International Journal of Engineering, Management and Humanities (IJEMH)
Volume 6, Issue 6, Nov.-Dec., 2025 pp: 98-108 ISSN: 2584-2145 www.ijemh.com

Reinterpreting Teacher Digital Competence in Popular Music Education: A Qualitative Synthesis of Skills as The Central Driver of Technology Integration

AUTHOR

Date of Submission: 14-11-2025 Date of Acceptance: 28-11-2025

Abstract

This qualitative synthesis examines how teacher digital competence is understood within popular music education, with a focus on how skills development facilitates effective technology use. The results suggest that, while technical expertise is only one aspect, digital competence can aid technology integration. Samples, loops, and drum machines, and samples are essential digital skills within popular music's informal learning paradigms. Online communication systems, multimedia, and design tools are also utilized for word processing, web browsing, and data retrieval. Skills used to develop a beneficial pedagogy serve as a mediating factor to ensure technical skills are put to work in classroom practice. Meaningful reinterpretations of the DigCompEdu and TPACK models are required for music education. The recommendations are targeted at professional development, collaborative learning communities, curriculum integration, and institutional infrastructure investment. This research deepens knowledge of how contextualised, skills-based approaches enable transformative technology integration, culminating in enhanced student engagement, creativity, and authentic music-making experiences in popular music learning environments.

Keywords: *Teacher digital competence, Technology integration, Popular music education, Pedagogical skill development, Digital musicianship*

I. Introduction

The teaching practices of today have become more digital in nature. The evolving frameworks like DigCompEdu and TPACK allow a deeper understanding of teacher technology integration (Vanegas et al., 2025). Nevertheless, conventional judgements of competence have previously focused almost entirely on technical skills and generic pedagogical applications, ignoring specific educational teaching sectors. This reinterpretation becomes necessary in a specific context, namely, popular music education. Technologies integration and music teaching practices have changed a lot. After the pandemic remote teaching experiences, important opportunities, challenges, and potentials for digital music making appeared (Camlin & Lisboa, 2021). The informal learning values of popular music education, which are supposedly like how today's musicians master their craft through ear-training and sharing with peers, suggest that teachers need richer digital competencies than standard framework definitions envision.

Qualitative synthesis methods bring together diverse qualitative evidence and create new understandings and themes (Flemming et al., 2019). These understandings differ from findings that result from quantitative syntheses. This process offers rich explanations and insights into complex, situated phenomenology, especially useful for educational researchers. By reframing teacher digital competence specifically through popular music pedagogy, this study argues that effective technology integration is accomplished by developing pedagogically situated skills, such as sonic manipulation, real-time collaborative co-creation, informal learning facilitation rather than decontextualized technical skills (Loureiro et al., 2024). The modern music education is characterised by the new pedagogical paradigms that are characterised by incorporate informal learning habits in the formal curriculum and mainly popular music. Digital competence models, such as DigCompEdu and TPACK models, have developed the background insights about the implementation of technologies (López-Nuñez et al., 2024). These models usually focus on the generic technical skills as opposed to the domain-oriented applications. The methods of popular music education that are based on collaborative peer-balanced learning techniques and ear-training require digitally contextualised skills. This difference makes it necessary to reinterpret teacher digital competence with special attention paid to popular music education.

Even with the significant levels of investments in technology as an educational tool, there exist significant gaps between the technical expertise of teachers and their ability to make

significant use of digital technology by applying it to pedagogical experiences in meaningful ways. Popular music educators have to deal with various complex aspects of digital competence in effective methods of teaching (Cuervo et al., 2023). Although certain educators show a high degree of technical literacy, they are characterised by moderate levels of technology in lesson incorporation and a wide range of pedagogic implementation of digital resources. Competence frameworks that are currently in use, mostly DigCompEdu and TPACK models, offer generalist principles (Kotzebue et al., 2021). These are inadequately relevant to the specialised requirements of popular music pedagogy, which focuses on collaborative composition, informal learning practices, and live musical practices. Besides, the association of digital competence of teachers, development of pedagogical skills, and technology integration is a poorly theorised issue (Falloon, 2020). This theoretical gap serves as an obstructive part to a comprehensive picture of how the skills can be the key engines that make technology adoption successful in a popular music teaching setting. To solve this issue, it is necessary to synthesise empirical research systematically to redefine teacher digital competence in terms of the pedagogically contextualised and skills-based point of view.

There are strong epistemological merits of qualitative synthesis methodologies in aggregating disparate empirical data and coming up with a new theory (Maeda et al., 2022). Through the synthesis of qualitative research, this specifically focuses on technology integration in popular music education. The study may systematically derive thematic regularities, determine usual obstacles, and form contextually-based conceptions of skills-based competence formation. This move is supported by reported results described in the literature that approached by professional development programs. These focus on pedagogically-specific skill training, and they show better results than such focused training, which relies on generic technical training (Tuononen et al., 2023). The area of popular music education offers an especially promising research location since the informal learning behaviour inherent in the way contemporary musicians master their skills necessitates the teacher in enabling the self-directed, collaborative process of musical composition, a set of skills which are improperly covered in the traditional digital competence models. In addition, qualitative synthesis helps the researcher conserve the richness of context, the fine-grained insight into how teachers navigate opposing tensions of technical competency, pedagogical creativity, and disciplinary genuineness (Lim, 2024). This methodology is in direct correlation to the modern academic concern with the focus on skills as the primary mechanisms of effectiveness in the process of technology integration, which makes the qualitative synthesis one of the methodological options to apply to redefine teacher digital competence in the field of specialised music.

The study fulfils the vital gaps in the educational technology research by advancing a reformulated conceptualisation of teacher digital competence that is tailored uniquely to the context of popular music education (Cuervo et al., 2023). First, in theory, the synthesis of qualitative research will allow creating a unifying model in which the process of developing pedagogical skills can be referred to as the mediating factor between digital competence and technology integration outcomes, which will promote theoretical knowledge improvement relative to the current one-way competence frameworks. Second, empirically, this study offers evidence-based information on the way skills serve as key agents that support meaningful technology adoption. Third, in terms of methodology, the study will help grow the application of the qualitative synthesis to educational research, as this area still does not exploit such methodologies even though it has been proven to be an epistemologically valuable tool.

To educational practitioners, Lage-Gómez et al. (2023) shed light on specific approaches towards the creation of contextualised digital competencies congruous with the concept of popular music pedagogy. This may serve to increase teacher confidence and consistency in the integration of technologies. The study speaks directly to the variable nature in the operationalisation of the use of digital tools as documented by the music educators, offering a systematic review of effective practise and the obstacles to such practices. This study influences the design of professional development programmes by promoting competence models that allow individual development beyond generic technical training skills towards pedagogically-based competence development (Wang et al., 2025). This can aid in the evidence-based revision of the curriculum in music teacher education programmes by ensuring that the pre-service teachers are given contextualised technological preparation. Finally, this study has made a significant contribution to the theoretical conceptualisation of teacher digital competence as a pedagogically instantiated, skills-oriented phenomenon.

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 6, Issue 6, Nov.-Dec., 2025 pp: 98-108 ISSN: 2584-2145 ww.ijemh.com

Research objectives

- To examine how digital competence impacts technology integration in music education.
- To identify specific digital skills essential for effective popular music teaching.
- To explore the role of pedagogical skill development in music education
- To propose strategies to enhance teachers' skills for improved technology use.

II. Literature review

Teacher Digital Competence Frameworks and Models

Teacher digital competence frameworks and models have been the dominant factor in the alignment of educators in incorporating digital technologies in pedagogy. According to Antonietti et al. (2022), it can be distinguished as the DigCompEdu framework, the Technological Pedagogical Content Knowledge (TPACK) model, and the ICT Competency Framework used by Teachers, peculiar to UNESCO. DigCompEdu uses a modular method to cover all the competence areas. This includes digital resources, teaching and learning, and assessment. It is a systematic approach to professional growth, but has received criticism over the reason of it being generic-oriented. Therefore, this constraint is in the area of domain applicability in fields such as music education. However, Chansanam et al. (2025) revealed that TPACK explicitly combines technology, pedagogy, and content knowledge, as it participates in the interdependence of successful digital teaching. Though TPACK can be very useful in providing theoretical knowledge, its operationalisation is not very clear, especially on issue domain specifics. Global inclusiveness and fair access in the UNESCO framework represent diversity as the competence is also placed within wider socio-educational frameworks. Nonetheless, it lacks specificity, in one case at the expense of instructional plans, and particularly on specialised subjects. More importantly, these frameworks are generally oriented to digital skillsets and vary in terms of specificity and situational flexibility. Nevertheless, irrespective of their contribution, none of them fully addresses the unique requirements of popular music education, in which unstructured learning and group creativity necessitate a more sophisticated digital and pedagogical capability (Chiba & Hebert, 2024). In turn, reconceptualization of teacher digital competence is justified to adapt structures of the specific challenges and practices in the sphere of popular music pedagogy.

Technology Integration in Music Education: Practices and Challenges

Technology integration is relevant to music education, referring to the application of digital resources to increase its pedagogical efficiency and potential creativity. Shen (2025) disclosed that the technological implication, as utilised by the practitioners, goes as far as music production software or interactive media, where learners collaborate. Good integration practices focus on alignment of teaching with curricular objectives, teacher competence, and flexibility towards different styles of learning. However, Mlambo et al. (2025) stated that there are problems, such as a lack of resources, proper professional growth, and opposition due to technophobia or the tradition of pedagogy. Technology supports innovative modalities, such as real-time digital co-creation, production of genre-diverse music compared to traditional music instruction, and a broader range of educational options. However, Raave et al. (2024) shed light on the change that requires teachers to have not only technical skills but also pedagogical flexibility so as to integrate technology into creative expression and less formal education systems easily. Other teachers are more concerned with technology because it is new, and this may not be congruent with genuine musical education. This opposition reveals the role of technology in which the success of integration will depend on a combination of teacher competency, contextual relevance contextually and student-centred practices (Zou et al., 2025). Moreover, it is complicated by the special focus of the field on the art of hearing and demonstrated musicianship. This makes simple models of digital adoption very difficult to apply to the rest of the subject. The technology adoption of music education requires specific models, which are sensitive to the ratio between the digital affordance and the value of the ability to create art. This is a critical balance that is a developing scholarly issue that requires continued research.

Informal Learning Pedagogies in Popular Music Education

In popular music educational practices, informal learning pedagogies precede the experiential, self-guided, and socially embedded learning practices and differ greatly from formal instruction in music. These pedagogies are based on the efforts of Lucy Green, and they place more importance on learning through the ear, collaboration with peers, and real cultural experiences, putting more emphasis on the

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 6, Issue 6, Nov.-Dec., 2025 pp: 98-108 ISSN: 2584-2145 ww.ijemh.com

independence of students and their preferences in music (Mariguddi, 2022). In comparison to formal pedagogies, which are teacher-directed and notation-based, informal learning creates democratic and flexible environments in music that support creation and identity formation. Most importantly, though informal learning leads to increased student motivation and applicability to the real world, there is are chance that formal training in skills will be neglected (Gamage et al., 2021). In comparison, formal pedagogies emphasise systemic advancement and curriculum conformity, respectively, which are both repressive of learner agency, but guarantee an all-encompassing musicianship. According to McCann et al. (2020), this paradigm conflict makes context and spontaneity of the subsumption of the literal informal learning as individuals respond to various issues, adaptive to formal instructions. The adoption of digital technologies in popular music education only complicates this situation since technology both facilitates and intensifies informal practices by providing platforms that support collaboration at a distance and digital sound production (Cuervo et al., 2023). Nevertheless, the issues of fair access and even the readiness of the teachers to scaffold informal learning can be observed. Therefore, informal learning pedagogies are a radical but disputed practice that requires subtle execution to strike a balance between the freedom and the acquisition of intellectual foundations of music learning.

Skills Development and Pedagogical Application of Digital Tools

The digital tools in music education are critical in terms of their skills development and other dimensions that pedagogically apply to music education and perform the function of transforming the current teaching methods. According to Palioura & Dimoulas (2022), digital consulting aids experience, personalised and collaborative learning opportunities. This promotes the acquisition of technical skills and expression in creative outlets through digital tools like digital audio workstations, virtual instruments, and even interactive learning platforms. The development of skills should not focus on the mastery of technology, and the main objective of the skills should be incorporated under the pedagogical methodology to help students gain a better understanding and interaction with music. Although traditional methods of music education focus on the study of notation, instrumental skills, and theory, digital technologies provide the possibility to use new forms of music listening, writing, or designing sounds in real-time (Yang & Li, 2025). The application of these tools in pedagogy requires that these tools be used not only by pedagogically literate but also pedagogically agile educators in scaffolding student autonomy and creativity. Certain obstacles are still present, such as inequalities in technology access, a lack of training of teachers, and possible distractions or shallow use of digital resources, which can undermine the depth of learning. Paolo & Todino (2025) disclosed that music education, in comparison with other academic fields, is the only one that demands the strike of epitomised musicianship and digital mediation. Therefore, effective integration requires a cyclical professional growth, contextualised modes of pedagogy, and reflective practice on how to match digital skills to artistic and teaching goals.

Conceptual framework

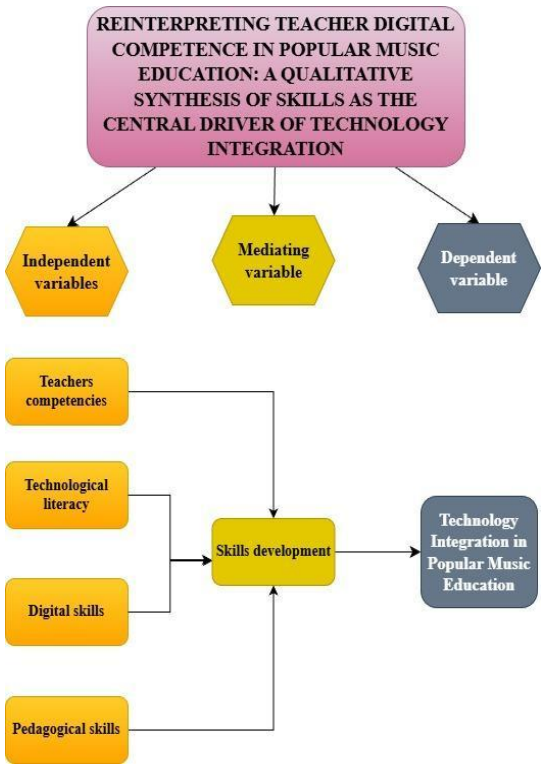

Figure 1: Conceptual framework

The conceptual framework demonstrates how teacher competencies, technological literacy, digital skills, and pedagogical skills contribute to skills development. This plays the role of a mediating variable contributing to the effective application of technology in popular music education as the dependent variable. It focuses on talents as keys to the success of integration.

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 6, Issue 6, Nov.-Dec., 2025 pp: 98-108 ISSN: 2584-2145 ww.ijemh.com

III. Methodology

This study applies a qualitative approach, which is the secondary one, to explore the reinterpretation of teacher digital competence in popular music education, with skills development being regarded as the driving force behind technology integration. The approach gives more importance to interpretative rigour and the depth of context (Lim, 2024). This is best suited to investigate the subtle contingencies of technology, pedagogy, and music-oriented teaching. Based on the traditional principles of conducting qualitative research at the secondary level, twelve peer-reviewed articles have been systematically gathered and included in the list; they were all published between 2021-2025 and found in the most renowned academic databases, which guarantees the timeliness and dependability of the basic of evidence base. Using peer-reviewed sources was necessary as an inclusion criterion to ensure the sources are directly related to teacher competence, digital skills, pedagogical models, or technology integration in music education to maximise the relevance and accuracy of the results of the analysis (Abusaada & Elshater, 2024). On the other hand, the exclusion criteria were strictly followed, which discounted non-peer-reviewed articles, opinion articles, articles that are beyond the target publication period, and articles dealing with popular music education. The random sampling was employed in order to increase objectivity and alleviate the selection bias factor (Berger, 2021). This provided an opportunity to represent a representative cross-section of the extant literature and further support the validity of the results. The cross-sectional nature of the time period of the study was yet another assurance that all data are based on the present condition of scholarship and practice (Capili, 2021). This is crucial to the dynamic and fast-changing environment of music education technology.

The qualitative evidence was systematically analysed and coded, and synthesised into patterns, concepts, and associations through the thematic analysis, which made it possible to identify recurring patterns, concepts, and relationships in the qualitative evidence (Ahmed et al., 2025). This method was specifically selected due to its ability to elicit subtle meanings, unmask thematic links, and create theoretically useful outputs that are applicable in policy, curriculum formulation, and practice. The thematic analysis also aids the critical reflection, as it maps both impediments and facilitators in the path of teachers to an effective incorporation of technologies, which is in line with the purpose and conceptual framework of the research (Kiger & Varpio, 2020). The methodological choices were justified based on being able to generate a rich synthesis, sensitive to context, relevant to scholarship and practice. These terms refer to a combination of second qualitative methods, thematic analysis, purposive inclusion/exclusion criteria, random sampling, cross-sectional design that ensures methodological transparency, reliability, and academic integrity. They provide an evidence-based examination that furthers the theory and practice of teacher digital competence and effective technology in popular music education.

IV. Results

Theme 1: Examination of digital competence impacts technology integration in music education

According to Demissie et al. (2022), digital competence has a significant effect on the quality and level of textbook incorporation in music education. A teacher who has high-order digital aptitudes will be more likely to include technology-enhanced experiences in their lessons, creating dynamic and approachable, and participatory learning experiences for students. The research by Joshi et al. (2025) indicates that student access and achievement increase significantly in case the teachers are competent enough to use digital audio workstations, music software, and web platforms. As an example, digital tools in teaching methods can be used with an individual approach to teaching, instant feedback, and adaptable environments. This can also prove particularly beneficial in popular music education, where flexibility and creativity are very important. There is also a greater accessibility and inclusivity as a result of technology implementation, with possible performance analytics and other assessment approaches as ways of polishing pedagogical practice (Feng et al., 2025). Digital competence should not simply be confined to the simple technical expertise, the pedagogical depth of comprehending the use of technology to facilitate compositional practice, improvisation, and experimentation with genres. In the COVID-19 pandemic, more digitally competent teachers were in a better position to adopt remote teaching to keep students engaged via novel digital pedagogies (West et al., 2023). Nevertheless, there are still certain problems in terms of infrastructure, uneven access to technologies, and the necessity of lifelong professional growth. Therefore, teacher preparation as well as institutional investment in technological infrastructure are paramount in maintaining and increasing the scale of technology integration.

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 6, Issue 6, Nov.-Dec., 2025 pp: 98-108 ISSN: 2584-2145 www.ijemh.com

Applying a critical analysis of the effect of digital competence on technology integration, it is clear that just accessibility to digital tools is not effective in terms of music education. The radical nature of technology can only be achieved when the teachers are competent enough to integrate digital technologies into their real pedagogical lives. The better the digital pedagogical competence of music teachers, the higher the student-based and inquiring learning experience, relative to the teachers who are solely guided by traditional instruction (Liu et al., 2022). Digital competence in popular music education promotes creative activities such as beat-making, production, and collaborative composition, matching teaching to the demands of the music industry and aligning it with the expectations of students in the present times. Moreover, the results of the analysis also prove the affirmative relation between the digital skills of a teacher and student motivation, engagement, and independent learning. The ability to select, adapt, and contextualise digital resources critically makes highly successful educators more identifiable, and technology is a high-quality stimulator of cognitive, creative, and social advancement in music-based classes. Conversely, digital competence gaps can be a barrier to innovation, decrease the quality of remote or hybrid learning processes, and reinforce disparities in the results of students (Zou et al., 2025). Thus, long-term investment into professional development based on competency is required to make sure that music teachers make the maximum use of their pedagogical and creative capabilities of digital technologies.

Theme 2: Identification of specific digital skills essential for effective popular music teaching

The modern educational environment that demands successful teaching of music to the masses necessitates the credentials of a unique combination of digital skillset specific to the dynamic and collaborative character of the genre. Individual skills are necessary skills like the ability to use digital audio workstations (DAWs) like Ableton Live, Logic Pro, and GarageBand to compose, record, mix, and produce music according to professional industry standards (Stickland et al., 2022). The skills in using online tools such as Soundtrap, BandLab, and cloud-based collaboration tools facilitate remote collaborative creativity and collaborative projects based on peer review, which reflects a modern practice in popular music production. Educators should also be familiar with music notation software (Sibelius, Finale), multimedia combination (audio, video, interactive apps), and virtual classes, which entail versatile and multimodal education (Tio et al., 2021). Additional important digital skills should be digital literacy that allows exploring resources, filtering the best elements on social media (TikTok, YouTube), and using technology-based assessment to receive instant feedback and create a portfolio. The synthesis of these tools into the process and methods of adaptive pedagogy is essential in capturing the attention of the students, supporting creativity, and instructing independent musicianship. The digital music notation and online collaboration skills are especially relevant in generational-specific teaching (Váradi et al., 2023). This includes beat-driven music, improvisation, and live-digital performances. Finally, these digital capabilities enable music teachers to design more inclusive, relevant, and innovative learning music education.

The critical examination of the mentioned digital skills indicates that they affect pedagogy and student learning outcomes in popular music education in a transformative way. The willing implementation of DAWs and collaborative platforms makes teachers bridge the gap between the industrial reality and the classroom by rendering classes more meaningful and motivating (Portuguez-Castro & Garduño, 2024). These competencies can facilitate project-based, learner-centred instruction reflecting informal and peer-based music learning beyond institutional constraints, which facilitates more intervention. Differentiation of instruction is enabled by notation and multimedia tools, to serve a wide range of abilities and styles of learning, which in heterogeneous classroom environments of popular music is very helpful. The ability to organise and evaluate technology-based tools of digital resources helps them sustain the feedback and reflective learning to ensure self-regulation and professional development in the students (Yaseen et al., 2025). Nevertheless, the consideration of the analysis reveals that even the lack of digital skills does not necessarily exclude effective teaching, and the context-sensitive and culturally-informed application of digital technology is needed. Instructors require the flexibility of instructional design and knowledge of the process of using technology in supporting creativity, collaboration, and exploring genres instead of simply duplicating the particular methods in the digital realm. Fragmented digital literacy and interactive barriers of low access to technologies are the indicators of the necessity of specific professional training and institutional assistance (Gkrimpizi et al., 2023). Overall, the digital skills vital in the peer-oriented popular music teaching are dynamic,

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 6, Issue 6, Nov.-Dec., 2025 pp: 98-108 ISSN: 2584-2145 www.ijemh.com

interdependent, and reliant on the skills of educators to adjust, be innovative, and implement technology in a purposeful way as a part of creative pedagogies.

Theme 3: Exploration of the role of pedagogical skill development in music education

The development of pedagogical skills is an essential factor that influences the results of music education in the popular music setting, in particular. The acquisition of engagement, motivation, and musical development of the students is more easily achieved with the help of teachers with high levels of pedagogical skills, like learner-centred exposition, adaptive classroom control, and differentiated assessment (Kiss et al., 2025). The incorporation of movement and collaborative tasks can not only improve musical understanding but also cognitive, emotional, and social development, and therefore, holistic musical pedagogy. Educators who possess good pedagogical proficiency use strategies, like performance-based projects, improvisation, and learning among students, which reflect the popular music activities in the real world, and develop student autonomy. Training systematic teacher practices in such practices builds up additional capability to provide inclusive music training supporting children, despite baseline capacity or prior musical training (Sim & Lee, 2024). The creative pedagogy, such as songwriting classes, computer composing, and ensemble creation, becomes the key to the classroom of popular music. Pedagogical skill development is one of the main mediators that can transform digital competency and content knowledge in teachers into effective technology integration and meaningful learning experiences. The studies have always stated the importance of continuous professional growth and reflective practice to remain agile in the area of pedagogy to make teachers responsive to the changes in musical trends and technologies.

The development of pedagogical skills is not just a by-product of any music teaching, but the main force of successful activity and innovation. Experienced educators look past a delivery in the key to embrace inquiry-based teaching and group learning, and establish the context where innovativeness, reasoning, and musical identity can thrive (Gholam, 2019). These methods enable students to be involved in genuine music-making, which results in resilience and adaptability in the case of success in popular music sectors. In comparison with the traditional, teacher-based approaches, the skill-grown pedagogues promote student-based exploration, independence, and cooperation through external forces, improving learning outcomes and musical artistry (Møller-Skau & Lindstøl, 2022). Nevertheless, it is analysed that there are issues, such as attempts to access professional development unequally, a lack of mentoring for new teachers, and, in some cases, the use of traditional practices. The distance between theory and classroom has traditionally been seen in the restrictive nature of initial teacher training and the institutional weakness of doing pedagogical experimentations. Music educators are better suited to exploit technology, cater to various learning needs, and help to transform educational experience (Holster, 2024). Pedagogical agility is the key to the process of bridging digital innovation with meaningful, inclusive music education in popular music education, which focuses on informal learning and creativity.

Theme 4: Strategies to enhance teachers' skills for improved technology use

The results obtained from the past research place the concept of targeted professional development as the most effective tool to help increase the skills of teachers in the use of technology in music education. The constant training, practical workshops, and mentorship programmes are generally suggested, as they provide teachers not merely with the understanding of technology, but with the pedagogical perception needed to make the creative integration (Amemasor et al., 2025). Learning communities based on collaboration among teachers can promote skill development through peer support and modelling of best practices through the sharing of digital resources, experiences, and lesson plans. The methods of curriculum integration, like incorporating technology courses in pre-service and in-service teacher education courses, with music technology being discussed as a stand-alone course and as modules as part of a larger, pedagogic package (Luo et al., 2025). The successful methods involve the use of music-specific software, the involvement in online professional groups, and living up to the current standards of education that lead to digital pedagogy. Technology-driven differentiated instruction through personalised learning applications and online composition tools improves the teacher self-efficacy and student engagement. Effective use of technology is also scaffolded by resources offered by professional organisations and institutions, such as guides and frequent updates, and pedagogic toolkits (Fernandes et al., 2020). The implementation of barriers to integration with a focus on accessible infrastructure, continual institutional support, and reflective

practice. This indicates the role of balancing digital innovation with the main principles of music learning in the long-term acquisition of skills and technology-enabled success.

The strategies are dependent on systematising the implementation process, their topicality to the classroom reality, and the continuous support. Practical use of software and digital pedagogy-based professional development is associated with quantifiable gains in educator confidence, flexibility, and creativity of the lesson being taught. Working communities enhance impact through changing reflective exchange, shared problem-solving, and unceasing learning that helps to view technology portions in a contextually sensitive manner (Tobin et al., 2024). The solution to integration into teacher training should be the integration of digital skills, not in isolation, but included as part of the real models of music teaching, that is, creating a linkage between theory and practice. In addition, the two-way nature of standalone and embedded technology training can provide customization in terms of skills development, and it accommodates various teachers and schools. Professional development programmes should be flexible to the fast change of the digital tools, so they have to be updated and changed on the appeared technologies appear. Organisational funding of infrastructure and support mechanisms, such as technical facilitation, software resource depositories, and time to train, is essential in lessening the chronic hurdles like resource disparity and change reluctance. More importantly, the improvement of technologies has to be in correlation with pedagogical purposes without neglecting the musical art and creativity inherent in popular music education (Jiang et al., 2025). General harmony between strategic skill development processes and transformative digital practices allows teachers to manoeuvre, adapt, and take the initiative of innovation in music classes in contemporary times.

V. Conclusion

The research shows that skills development is central to the teacher's digital competence, which is a critical factor in the successful use of technology in popular music education. Through the synthesis of recent studies, it is evident that digital pedagogies, contextualisation of skills, and continuous professional development are necessary to empower teachers and improve student engagement. Technological savvy is not enough, and it has to be integrated with pedagogical finesse, ingenuity, and reflective practice. Long-term institutional involvement, digital resources accessibility, and strong professional learning communities also make meaningful implementation and adjustment of technology in music classes possible. This eventually leads to improved learning outcomes and the creation of musicians who are future-ready. The study is consistent with its goals as it substantiates the influence of digital competence on the level of technology integration, the necessity of digital skills, the process of the development of teaching skills, and suggests specific strategies of teacher improvement. All the objectives are reflected in the synthesis and study of empirical research that is accumulated to show the interdependence between skills, pedagogy, and technology. The results confirm that the deliberately formed objectives have been met, and this gives practical implications to the curriculum developers, teachers, and policy makers, promoting popular music education amidst the digital era.

The use of secondary literature is also a limitation that might have missed classroom-specific realities and longitudinal effects. The institutional resources, teacher experience, and student demographics also vary and induce limitations on generalisability across varying educational environments. Further studies are required to use mixed-method and longitudinal studies that will determine the long-term potential of technology integration. Research on adaptive pedagogical models, student achievement, and equity in the distribution of digital resources will be beneficial and contribute to the best practices in popular music education. It is also suggested that institutions should introduce routine professional development that is practice-oriented with technological and pedagogical competencies. Regulatory networks to peer learn and exchange of best practices should be created so as to develop skills in totality. The curriculum revision also requires the incorporation of modern music technologies, which should focus on creativity, diversity of genres, and student-focused pedagogy. It is essential to have institutional investment in infrastructure and the availability of digital tools. Mentoring and reflective training based on suits will fill the gaps between theory and practice, which will make teachers constantly change in response to the changes in digital trends and other pedagogical innovations. These guidelines create sustainable implementation of technology in various music education processes.

References

[1]. Abusaada, H., &Elshater, A. (2024). Beyond Keywords: Effective Strategies for Building Consistent Reference Lists in Scientific

Research. *Publications*, *12*(3), 25–25. https://doi.org/10.3390/publications12030025

[2]. Ahmed, S. K., Mohammed, R. A., Nashwan, A. J., Ibrahim, R. H., Abdalla, A. Q., Ameen, B. M. M., &Khidhir, R. M. (2025). Using Thematic Analysis in Qualitative Research. *Journal of Medicine, Surgery, and Public Health*, *6*(6), 100198. ScienceDirect. https://doi.org/10.1016/j.glmedi.2025.100198

[3]. Amemasor, S. K., Oppong, S. O., Ghansah, B., Benuwa, B.-B., & Essel, D. D. (2025). A systematic review on the impact of teacher professional development on digital instructional integration and teaching practices. *Frontiers in Education*, *10*. https://doi.org/10.3389/feduc.2025.1541031

[4]. Antonietti, C., Cattaneo, A., &Amenduni, F. (2022). Can teachers' digital competence influence technology acceptance in vocational education? *Computers in Human Behavior*, *132*, 107266. https://doi.org/10.1016/j.chb.2022.107266

[5]. Berger, V. W. (2021). A roadmap to using randomization in clinical trials. *BMC Medical Research Methodology*, *21*(1). https://doi.org/10.1186/s12874-021-01303-z

[6]. Camlin, D. A., & Lisboa, T. (2021). The digital "turn" in music education (editorial). *Music Education Research*, *23*(2), 1–10. https://doi.org/10.1080/14613808.2021.1908792

[7]. Capili, B. (2021). Cross-Sectional Studies. *AJN, American Journal of Nursing*, *121*(10), 59–62. https://doi.org/10.1097/01.naj.0000794280.73744.fe

[8]. Chansanam, W., Kwangmuang, P., Detthamrong, U., & Li, C. (2025). Transforming Teacher Education with TPACK: Insights from a Multi-Dimensional Analytical Approach. *Educational Process International Journal*, *17*(1). https://doi.org/10.22521/edupij.2025.17.381

[9]. Chiba, M., & Hebert, D. G. (2024). Understandings of inclusivity in music education: a comparative policy study of Luxembourg and Japan. *Music Education Research*, 1–17. https://doi.org/10.1080/14613808.2024.2434839

[10]. Cuervo, L., Bonastre, C., Camilli, C., Arroyo, D., & García, D. (2023). Digital Competences in Teacher Training and Music Education via Service Learning: A Mixed-Method Research Project. *Education Sciences*, *13*(5), 459. https://doi.org/10.3390/educsci13050459

[11]. Demissie, E. B., Labiso, T. O., & Thuo, M. W. (2022). Teachers' digital competencies and technology integration in education: Insights from secondary schools in Wolaita Zone, Ethiopia. *Social Sciences & Humanities Open*, *6*(1), 100355. https://doi.org/10.1016/j.ssaho.2022.100355

[12]. Falloon, G. (2020). From digital literacy to digital competence: The teacher digital competency (TDC) framework. *Educational Technology Research and Development*, *68*(5), 2449–2472. https://doi.org/10.1007/s11423-020-09767-4

[13]. Feng, J., Yu, B., Tan, W. H., Dai, Z., & Li, Z. (2025). Key factors influencing educational technology adoption in higher education: A systematic review. *PLOS Digital Health*, *4*(4), e0000764. https://doi.org/10.1371/journal.pdig.0000764

[14]. Fernandes, G. W. R., Rodrigues, A. M., & Ferreira, C. A. (2020). Professional Development and Use of Digital Technologies by Science Teachers: A Review of Theoretical Frameworks. *Research in Science Education*, *50*(2), 673–708. https://doi.org/10.1007/s11165-018-9707-x

[15]. Flemming, K., Booth, A., Garside, R., Tunçalp, Ö., & Noyes, J. (2019). Qualitative evidence synthesis for complex interventions and guideline development: clarification of the purpose, designs and relevant methods. *BMJ Global Health*, *4*(Suppl 1), e000882. https://doi.org/10.1136/bmjgh-2018-000882

[16]. Gamage, K. A. A., Dehideniya, D. M. S. C. P. K., & Ekanayake, S. Y. (2021). The role of personal values in learning approaches and student achievements. *Behavioral Sciences*, *11*(7), 1–23. https://doi.org/10.3390/bs11070102

[17]. Gholam, A. (2019). Inquiry-Based Learning: Student Teachers' Challenges and Perceptions. *Journal of Inquiry & Action in Education*, *10*(2), 112–133. https://files.eric.ed.gov/fulltext/EJ1241559.pdf

[18]. Gkrimpizi, T., Peristeras, V., &Magnisalis, I. (2023). Classification of Barriers to Digital Transformation in Higher Education Institutions: Systematic Literature Review. *Education Sciences*, *13*(7), 746. mdpi. https://doi.org/10.3390/educsci13070746

[19]. Holster, J. (2024). Augmenting Music Education through AI: Practical Applications

of ChatGPT. *Music Educators Journal*, *110*(4), 36–42. https://doi.org/10.1177/00274321241255938

[20]. Jiang, W., Han, B., & Cui, Y. (2025). Influence of music educators on students' involvement in learning the theory of musical art. *Acta Psychologica*, *253*, 104722. https://doi.org/10.1016/j.actpsy.2025.104722

[21]. Joshi, D. R., Khanal, J., Prasad, K., & Adhikari, K. P. (2025). The impact of digital resource utilization on student learning outcomes and self-efficacy across different economic contexts: A comparative analysis of PISA, 2022. *International Journal of Educational Research Open*, *8*, 100443–100443. https://doi.org/10.1016/j.ijedro.2025.100443

[22]. Kiger, M. E., &Varpio, L. (2020). Thematic Analysis of Qualitative data: AMEE Guide no. 131. *Medical Teacher*, *42*(8), 846–854. NCBI. https://doi.org/10.1080/0142159X.2020.1755030

[23]. Kiss, B., Oo, T. Z., Biró, F., & Józsa, K. (2025). Students' Motivation for Classroom Music: A Systematic Literature Review. *Education Sciences*, *15*(7), 862. https://doi.org/10.3390/educsci15070862

[24]. Kotzebue, L. von, Meier, M., Finger, A., Kremser, E., Huwer, J., Thoms, L.-J., Becker, S., Bruckermann, T., & Thyssen, C. (2021). The Framework DiKoLAN(Digital Competencies for Teaching in Science Education) as Basis for the Self-Assessment Tool DiKoLAN-Grid. *Education Sciences*, *11*(12), 775. https://doi.org/10.3390/educsci11120775

[25]. Lage-Gómez, C., Chatelain, S., & Cremades-Andreu, R. (2023). Toward conceptualizations of musical creativities in secondary education: An integrative literature review between 1990 and 2020. *Research Studies in Music Education*, *46*(1), 164–183. https://doi.org/10.1177/1321103x231181559

[26]. Lim, W. M. (2024). What Is Qualitative research? an Overview and Guidelines. *Australasian Marketing Journal (AMJ)*, *33*(2), 199–229. Sage Journals. https://doi.org/10.1177/14413582241264619

[27]. Liu, Y., Zhao, L., & Su, Y.-S. (2022). The Impact of Teacher Competence in Online Teaching on Perceived Online Learning Outcomes during the COVID-19 Outbreak: A Moderated-Mediation Model of Teacher Resilience and Age. *International Journal of Environmental Research and Public Health*, *19*(10), 6282. https://doi.org/10.3390/ijerph19106282

[28]. López-Nuñez, J.-A., Alonso-García, S., Berral-Ortiz, B., & Victoria-Maldonado, J.-J. (2024). A Systematic Review of Digital Competence Evaluation in Higher Education. *Education Sciences*, *14*(11), 1181. https://doi.org/10.3390/educsci14111181

[29]. Loureiro, A. C., Santos, A. I., &Meirinhos, M. (2024). Digital Competence for Pedagogical Integration: A Study with Elementary School Teachers in the Azores. *Education Sciences*, *14*(12), 1293. https://doi.org/10.3390/educsci14121293

[30]. Luo, Y., Liu, Y., Siripala, W., Namtubtim, N., & Shen, Y. (2025). Incorporating multimedia learning into music teacher training program in rural Fujian. *Frontiers in Education*, *10*. https://doi.org/10.3389/feduc.2025.1531359

[31]. Maeda, Y., Caskurlu, S., Kenney, R. H., Kozan, K., & Richardson, J. C. (2022). Moving qualitative synthesis research forward in education: A methodological systematic review. *Educational Research Review*, *35*, 100424. https://doi.org/10.1016/j.edurev.2021.100424

[32]. Mariguddi, A. (2022). Tensions, issues and strengths of Professor Lucy Green's model of informal learning. *Music Education Research*, *24*(4), 1–13. https://doi.org/10.1080/14613808.2022.2074383

[33]. McCann, L., Granter, E., Hyde, P., &Aroles, J. (2020). "Upon the gears and upon the wheels": Terror convergence and total administration in the neoliberal university. *Management Learning*, *51*(4), 431–451. https://doi.org/10.1177/1350507620924162

[34]. Mlambo, P. B., Mthethwa, S. E., &Faloye, S. T. (2025). Examining factors contributing to technophobia: a case of secondary school teachers in KwaZulu-Natal province. *Discover Education*, *4*(1). https://doi.org/10.1007/s44217-025-00864-1

[35]. Møller-Skau, M., &Lindstøl, F. (2022). Arts-based teaching and learning in teacher education: "Crystallising" student teachers' learning outcomes through a systematic literature review. *Teaching and Teacher Education*, *109*, 103545. https://doi.org/10.1016/j.tate.2021.103545

[36]. Palioura, M., &Dimoulas, C. (2022). Digital Storytelling in Education: A Transmedia

Integration Approach for the Non-Developers. *Education Sciences*, *12*(8), 559. https://doi.org/10.3390/educsci12080559

[37]. Paolo, A. D., & Todino, M. D. (2025). Inclusive Music Education in the Digital Age: The Role of Technology and Edugames in Supporting Students with Special Educational Needs. *Encyclopedia*, *5*(3), 102–102. https://doi.org/10.3390/encyclopedia5030102

[38]. Portuguez-Castro, M., & Garduño, H. S. (2024). Beyond Traditional Classrooms: Comparing Virtual Reality Applications and Their Influence on Students' Motivation. *Education Sciences*, *14*(9), 963–963. https://doi.org/10.3390/educsci14090963

[39]. Raave, D. K., Saks, K., Margus Pedaste, &Roa, E. R. (2024). How and Why Teachers Use Technology: Distinct Integration Practices in K-12 Education. *Education Sciences*, *14*(12), 1301–1301. https://doi.org/10.3390/educsci14121301

[40]. Shen, D. (2025). Integrating multimedia technology into folk music education: impacts on student engagement and learning. *International Journal of Inclusive Education*, 1–25. https://doi.org/10.1080/13603116.2025.2567422

[41]. Sim, T., & Lee, J. A. C. (2024). Music-based language programme teacher training on preschool teachers' music teaching self-efficacy and delivery performance: A case study. *Southeast Asia Early Childhood Journal*, *13*(1), 133–151. https://doi.org/10.37134/saecj.vol13.1.9.2024

[42]. Stickland, S., Athauda, R., & Scott, N. (2022). *Professional Views of Digital Audio Workstations and Collaborative Audio Mixing*. *38*(1), 1–18. https://doi.org/10.5281/zenodo.6854136

[43]. Tio, O., Machfazia, A. N., Tyasrinestu, F., Djohan, &Sittiprapaporn, P. (2021). Sibelius as a Tool to Improve Student's Ability of Making Counterpoint Melody. *Journal of Web Engineering*. https://doi.org/10.13052/jwe1540-9589.2087

[44]. Tobin, B., Farren, M., & Crotty, Y. (2024). Impacting teaching and learning through collaborative reflective practice. *Educational Action Research*, 1–21. https://doi.org/10.1080/09650792.2024.2394933

[45]. Tuononen, T., Hyytinen, H., Kleemola, K., Hailikari, T., & Toom, A. (2023). Generic skills in higher education – teachers' conceptions, pedagogical practices and pedagogical training. *Teaching in Higher Education*, 1–18. https://doi.org/10.1080/13562517.2023.2248003

[46]. Vanegas, H. D. O., Cifuentes, Y. de M. S., &Morrás, A. S. (2025). Educational Technology in Teacher Training: A Systematic Review of Competencies, Skills, Models, and Methods. *Education Sciences*, *15*(8), 1036. https://doi.org/10.3390/educsci15081036

[47]. Váradi, J., Józsa, G., Fodor, A. Sz., Molnár-Tamus, V., & Szűcs, T. (2023). *Investigating music teachers' ICT skills and technical possibilities in the field of online music education during the COVID-19 pandemic*. *9*(6), e16463–e16463. https://doi.org/10.1016/j.heliyon.2023.e16463

[48]. Wang, X., Niu, J., Fang, B., Han, G., & He, J. (2025). Empowering teachers' professional development with LLMs: An empirical study of developing teachers' competency for instructional design in blended learning. *Teaching and Teacher Education*, *165*, 105091–105091. https://doi.org/10.1016/j.tate.2025.105091

[49]. West, H., Hill, J., Abzhaparova, A., Cox, W., & Alexander, A. (2023). Pandemic pedagogies: reflecting on online learning using the community of inquiry framework. *Journal of Geography in Higher Education*, *48*(2), 1–20. https://doi.org/10.1080/03098265.2023.2190962

[50]. Yang, X., & Li, Y. (2025). Long-term intervention through online courses in music education: Impact on assessment, performance, creativity, and musical culture. *Acta Psychologica*, *259*, 105363–105363. https://doi.org/10.1016/j.actpsy.2025.105363

[51]. Yaseen, H., Mohammad, A. S., Ashal, N., Abusaimeh, H., Ali, A., &Sharabati, A.-A. A. (2025). The Impact of Adaptive Learning Technologies, Personalized Feedback, and Interactive AI Tools on Student Engagement: The Moderating Role of Digital Literacy. *Sustainability*, *17*(3), 1133–1133. https://doi.org/10.3390/su17031133

[52]. Zou, Y., Kuek, F., Feng, W., & Cheng, X. (2025). Digital learning in the 21st century: Trends, challenges, and innovations in technology integration. *Frontiers in Education*, *10*(10). https://doi.org/10.3389/feduc.2025.1562391