

Review

Integration of Open Distance Electronic Learning Technologies in South African Music Education: A Thematic Literature Review Towards Advancing the Sustainable Development Goals

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Abstract

South African higher education institutions continue to face challenges in integrating Open Distance Electronic Learning (ODEL) technologies, particularly within historically marginalised universities. Music education is especially affected by infrastructural limitations and uneven digital literacy, constraining the pedagogical potential of digital tools. This article presents a thematic literature review that systematically maps, codes, and synthesises research on ODeL integration in South African music education. A total of 52 studies were included, comprising peer-reviewed journal articles, dissertations, conference papers, and institutional reports retrieved from ProQuest, EBSCOhost, JSTOR, ERIC, LearnTechLib, and Google Scholar. Studies were selected based on relevance to technology integration in music education and alignment with Sustainable Development Goals (SDGs) 4 and 10. The PRISMA framework guided the search, screening, inclusion, and exclusion processes, ensuring transparency and methodological rigour. Thematic analysis was conducted manually in five stages: data familiarisation, open coding, code refinement, theme development, and review. The Substitution, Augmentation, Modification, and Redefinition (SAMR) model (Substitution, Augmentation, Modification, Redefinition) was applied as a descriptive framework to classify technology use without evaluative judgment. Findings show ODeL technologies are most frequently implemented at Substitution and Augmentation, with fewer examples at Modification and Redefinition. Challenges include limited infrastructure, low digital literacy, and institutional resistance, while opportunities exist in professional development, infrastructure investment, and curriculum redesign. The review highlights trends, gaps, and potential directions for advancing ODeL in South African music education to support SDG 4 and SDG 10.

Keywords: digital literacy; music education; Open Distance Electronic Learning (ODEL); SAMR model; Sustainable Development Goals (SDGs); South Africa

Introduction

Perhaps, it is essential to foreground this article by providing a brief background about South Africa's higher education landscape, so that the Open Distance Electronic Learning (ODEL) technologies in music education programmes offered within the higher institution of learning could be contextualised. Teachers and students do not have to be present at the same time or location, according to [Queiros & de Villiers \(2016\)](#). The Open and Distance Learning (ODL) system is flexible in terms of the methods and timing of teaching and learning as well as the admission requirements without sacrificing essential quality considerations. [Marutha & Dube \(2023, p. 286\)](#) backed up this assessment by pointing out that “the university used what it called correspondence distance study in the early years, later it moved to ODL, and currently teaching and learning are rendered through ODeL.” Under apartheid, universities serving Black South Africans were underfunded and deprived of quality education infrastructure, including in the arts ([De Villiers, 2022](#); [Mugovhani, 2012](#); [Nompula, 2011](#); [Yende & Madolo, 2023](#)). A study by [Mugovhani \(2012\)](#) highlights that post-1994 efforts to redress inequalities have yielded some gains, but vast disparities persist. Music departments at marginalised institutions remain under-resourced, with outdated or non-existent facilities, limited curricula, and a lack of access to modern teaching tools. The COVID-19



pandemic has accelerated digital learning innovations, opening new possibilities for ODeL in higher education (Yende & Madolo, 2023). Institutions now have an opportunity to reimagine music education through technology, multimedia, and open-source platforms, which could help level the playing field across socio-economic divides (De Villiers, 2022; Yende & Madolo, 2023). This aligns with Principle 8 of Whole Schooling, which is the principle of Equitable Access, which explicitly foregrounds equitable access to education through the deliberate identification and removal of structural, institutional, and socio-economic barriers that limit learners' participation. The principle of Equitable Access is a cornerstone of Whole Schooling, focusing on creating inclusive learning environments that provide all students with fair opportunities to succeed regardless of their socio-economic, cultural, or geographic background. Principle 8 emphasises that educational systems must actively intervene to ensure that all learners have meaningful access to learning opportunities, resources, and institutional support (Peterson, 2025).

This principle advocates for inclusive learning environments, the fair distribution of resources, and the use of adaptable support systems to ensure that all students, regardless of background, are able to access, engage with, and benefit meaningfully from educational opportunities (Kenny et al., 2023; Peterson, 2025). The principle of Equitable Access, which centers equity as a fundamental educational objective, views access as an ethical and structural obligation of institutions, necessitating intentional policies, practices, and interventions that actively eliminate obstacles to participation, rather than as a passive condition. Open-source platforms are software systems whose source code is freely accessible, allowing users to use, modify, and share them without financial barriers. They promote collaboration, adaptability, and equitable access, enabling tools to be customised to meet specific needs. In music education, open-source platforms may include programs for music notation, audio editing, or interactive learning, providing students and educators with resources that are accessible regardless of socio-economic background (Yende, 2024). The use of open-source platforms directly reflects the principle of Equitable Access by providing low-cost, adaptable, and widely available educational tools, ensuring that students from under-resourced schools or communities can participate fully in music learning activities. In this way, the adoption of open-source technologies operationalises Principle 8 by translating equity commitments into practical pedagogical and technological interventions.

According to University of Johannesburg (2020), "ODeL is a different way of learning ... there is a physical distance between you and your university." This suggests that learning and teaching lessons are available online rather than requiring physical attendance, enabling flexible access for students, which aligns with the principle of Equitable Access of Whole Schooling by ensuring that students can participate in learning regardless of their physical location or personal circumstances. It gives students and professors the chance to access a variety of information to fulfil their demands for instruction and learning. Since there are no lectures given in class, ODeL demands students to be able to autonomously manage their time and create their own study schedule. To support this autonomy and facilitate equitable participation, the Dean of Students and Student Affairs offers a number of programmes that operationalise the principle of Equitable Access, including tutoring, library services and resources, the myUnisa portal, the myLife email account, social media platforms, University of South Africa (UNISA) radio, Digital Access Centres, counselling, and other targeted academic support initiatives (Marutha & Dube, 2023; Pitsoe & Baloyi, 2015).

It is also important to mention that globally, studies highlight the transformative potential of technology in music education, emphasising active engagement and self-directed learning (Bucura, 2020; Karkina & Mena, 2025; Ma & Wang, 2025; Zurita et al., 2014). According to Waddell & Williamon (2019), for example, music technology has advanced to the point that it has encouraged music to be shared more widely. Tools for music and education like Soundtrap and Google Classroom, as well as more general multimedia social media sites like YouTube, demonstrate this. Tools for music education that provide extra practice to enhance classroom instruction with certain abilities are now accessible. Teachers may now concentrate on other important abilities and greater self-paced learning has been made possible by these tools (Hockly, 2013; Waddell & Williamon, 2019). The integration of these technologies supports the principle of Equitable Access by enabling students to learn at their own pace, access high-quality resources without financial burden, and participate fully in music education regardless of prior opportunities or geographic limitations.

In Africa, research of scholars such as Adeyeye & Mason (2020), Mailula (2018), and Modeme (2022) indicates a growing interest in integrating technology to preserve indigenous music and expand educational reach. However, Modeme (2022, p. 125) mentions that, for instance:

Nigerian music education, for some time now, tends to move in circles rather than progress in a straight course. Some of the problems include high cost of internet connectivity, lack of updated materials, lack of research co-operation among sister institutions, inadequate research fund, lack of consolidation/execution of research findings among others.

Based on this statement, it is inevitable that music education in Africa faces recurring challenges that hinder progress as seen in Modeme' study. High internet costs limit access to digital resources, while outdated materials and a lack of research collaboration among institutions stifle innovation (Adeyeye & Mason, 2020; Modeme, 2022). Insufficient funding for research and the failure to implement findings further weaken development efforts. As a result, the sector often moves in circles rather than forward. Addressing these issues through ODeL technologies can promote equitable learning opportunities, directly linking to Principle 8 of Whole Schooling and the Sustainable Development Goal (SDG) 10.

According to Statistics South Africa (2023, p. 145), SDG 10 aims to reduce inequalities within and among countries by addressing disparities in income, social status, access to education, and opportunities for participation. It seeks to ensure that no individual is excluded from economic, social, or political life due to factors such as gender, race, ethnicity, disability, or economic background. By promoting inclusive policies and equitable access to resources, SDG 10 provides a global framework for reducing systemic inequalities and fostering social cohesion, which aligns closely with educational initiatives that aim to provide all learners with fair and meaningful opportunities.

In South Africa, initiatives like the integration of digital tools in music practice have shown promise (De Villiers, 2022; Yende & Madolo, 2023). For example, according to a study by Yende & Madolo (2023), one noteworthy development is the growth of virtual ensembles and group projects made possible by cutting-edge technology, which allows students to participate in group music-making activities even when they are geographically separated. Real-time insights and mentorship have been provided to students through interactive online masterclasses and seminars involving renowned artists and industry executives. The integration of digital tools in South African music education reflects a shift toward more accessible and collaborative learning. Through virtual ensembles and online group projects, students can engage in collective music-making despite physical distance. Interactive masterclasses and seminars led by renowned artists further enrich the learning experience by offering real-time feedback and industry exposure. These developments suggest that technology can bridge gaps in music education, fostering both practical skills and professional growth in increasingly flexible and innovative ways.

Despite individual studies on technology integration in music education, a comprehensive review examining the influence of Open Distance Electronic Learning (ODeL) technologies on the SDGs within South African higher education institutions remains lacking. Addressing this gap is essential for informing both policy and pedagogical practice. The adoption of ODeL technologies offers significant opportunities to overcome geographical and resource-based barriers, aligning with SDG 4 (Quality Education), which seeks to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (UNESCO, 2016). Furthermore, the integration of digital tools has the potential to enhance learning experiences, support diverse musical expressions, and bridge educational disparities, contributing to SDG 10 (Reduced Inequalities). By explicitly linking technology integration with Principle 8 of Whole Schooling, this review foregrounds the role of ODeL in facilitating inclusive and equitable music education (Unterhalter, 2019). However, the effectiveness of these technologies in advancing the SDGs within the specific context of South African music education remains underexplored.

This review aims to synthesise existing research on ODeL technologies' role in advancing SDGs through innovative music education in South Africa. Understanding this relationship is vital for policymakers, educators, and stakeholders to make informed decisions that promote sustainable and inclusive educational practices. The findings could guide curriculum development, resource allocation, and strategic planning to harness technology's potential in achieving SDGs. This study explicitly demonstrates the connection between SDG 10 and Whole Schooling Principle 8, showing how technology can reduce inequalities and enhance student learning in music education.

Research Questions

1. How are emerging ODeL technologies integrated into music education curricula in South African higher institutions?

2. In what ways do these technologies contribute to achieving SDG 4 (Quality Education) and SDG 10 (Reduced Inequalities)?
3. What challenges and opportunities exist in implementing ODeL technologies for music education in the context of SDGs?
4. How can the integration of ODeL technologies in music education be optimized to further SDG objectives?

Theoretical Framework

This article employs the Substitution, Augmentation, Modification, and Redefinition (SAMR) model as a theoretical framework to explore how emerging ODeL technologies can be integrated into music education to enhance access, quality, and inclusivity in South African higher education institutions. Scholars note that the SAMR model was developed by Dr. Ruben Puentedura in 2006 (Puentedura, 2006; Romrell et al., 2014). According to Castro (2018), the SAMR model is divided into four stages: Substitution, Augmentation, Modification, and Redefinition. While modification and redefinition are seen as “transformation” processes, substitution and augmentation are regarded as “enhancement” steps. Consider how adding seasoning to an old family recipe (Enhancement) differs from making a completely new, unique meal (Transformation). According to Puentedura (2013), learning can be transformed by engaging in activities that fall under the SAMR framework’s modification and redefinition levels. The entire potential of mobile device learning is realised at these upper levels of the SAMR framework (Setiyawati & Efendi, 2023).

The researcher chose to use SAMR Model to provide a lens to evaluate the impact of technology integration in education. It categorises technology use along a continuum from enhancement to transformation:

1. Substitution: Technology acts as a direct substitute for traditional methods, with no functional change.
2. Augmentation: Technology replaces traditional methods with functional improvements.
3. Modification: Technology allows for significant redesign of tasks, fostering deeper learning experiences.
4. Redefinition: Technology enables the creation of new tasks previously inconceivable, transforming learning.

The researcher believes that applying the SAMR Model helps assess how ODeL technologies are utilised in music education, from basic substitution to transformative practices that align with SDG objectives. This framework aids in identifying the depth of technology integration and its potential impact on educational outcomes.

Methodology

Study Design

This study employed a thematic literature review methodology to systematically collate, code, and synthesise existing research on the integration of ODeL technologies in South African higher education music programs. Unlike purely descriptive reviews, a thematic literature review allows for the identification of recurring patterns, categories, and overarching themes across studies, while still maintaining transparency and methodological rigour (Braun & Clarke, 2006; Capilla Garrido et al., 2021; Hartling et al., 2012).

A total of 52 studies were included, comprising peer-reviewed journal articles, dissertations, conference papers, and institutional reports. Sources were retrieved via ProQuest, EBSCOhost, LearnTechLib, JSTOR, ERIC, and Google Scholar through the University library portal. Selection criteria focused on studies that examined the integration of ODeL technologies within South African higher education music programs and their relevance to global development priorities. Specifically, the studies were evaluated for their alignment with the SDGs. SDG 4, Quality Education, aims to ensure inclusive and equitable education and to promote lifelong learning opportunities for all learners, across all levels from early childhood to higher education (Kim et al., 2017). SDG 10, Reduced Inequalities, seeks to address disparities in income, social status, and access to opportunities both within and among countries, fostering social and economic inclusion for all individuals. Non-academic sources and studies outside Africa were excluded. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework was applied to transparently document the search, screening, inclusion, and exclusion process (Rethlefsen & Page, 2022; Figure 1).

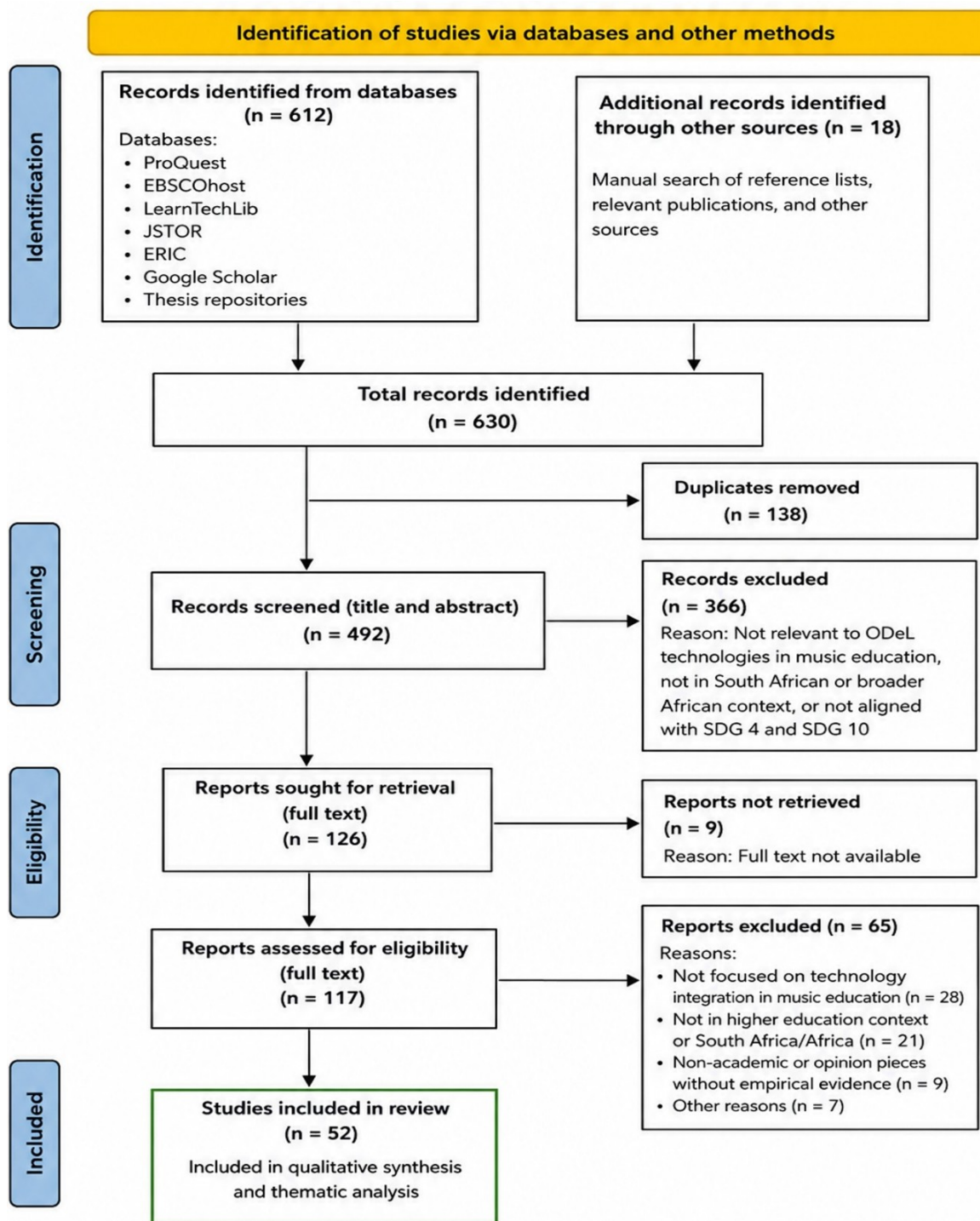


Figure 1. PRISMA 2020 flow diagram of literature search and study selection. Note: Records identified from databases (n = 612), including ProQuest, EBSCOhost, LearnTechLib, JSTOR, ERIC, and Google Scholar, and additional records identified through manual searching (n = 18). After duplicate removal and screening, full-text articles were assessed for eligibility based on relevance to ODeL integration in music education and alignment with SDG 4 and SDG 10. A total of 52 studies were included in the final qualitative synthesis. The diagram illustrates the sequential stages of identification, screening, eligibility, and inclusion. ODeL, Open Distance Electronic Learning; SDG, Sustainable Development Goal.

To conduct the thematic analysis, the following procedures were implemented:

1. Data familiarisation: All included studies were reviewed in detail to identify relevant textual content on ODeL integration.
2. Second, open coding was undertaken, where key concepts and findings were systematically identified and assigned descriptive codes using NVivo 14 (Lumivero, Denver, CO, USA).
3. Code refinement: Codes were iteratively reviewed, merged, or split to enhance clarity and reduce redundancy.
4. Theme development: Related codes were grouped into higher-order categories, from which overarching themes were identified, defined, and named to reflect patterns in technology use, challenges, and opportunities.
5. Review and finalisation: Themes were cross-checked against the original studies to ensure accuracy and representativeness of the data.

This approach ensured that the review was systematic, transparent, and reproducible, providing a rigorous overview of the literature while highlighting trends, gaps, and key insights into ODeL integration in South African music education.

Search Strategy

Comprehensive searches were conducted across academic databases, as described in the previous section, to identify peer-reviewed journal articles, conference papers, and relevant reports published between 2010 and 2025. The search used keywords and phrases such as “ODeL technologies,” “music education” “SDG 4” “SDG 10” and “South Africa,” applied individually and in combination, with Boolean operators (AND, OR) to refine results and ensure broader coverage (Alharbi & Stevenson, 2020). Table 1 presents the inclusion and exclusion criteria applied in this review. Inclusion criteria focused on studies examining the integration of technology in music education within South African higher education institutions, emphasizing contributions toward achieving SDGs, particularly SDG 4 and SDG 10. Studies from other African countries were selectively included for comparative insights. Exclusion criteria encompassed non-academic sources, opinion pieces without empirical evidence, and articles unrelated to the South African or broader African context. Additionally, manual searches of reference lists of key articles were conducted to identify further relevant sources (Aromataris & Riitano, 2014).

Table 1. Inclusion and exclusion criteria for literature review.

Criteria	Inclusion	Exclusion
Population/Context	Music education programs in South African higher education institutions; selected African countries for comparative insights	Studies unrelated to South African or African music education context
Intervention/Focus	Integration of Open Distance Electronic Learning (ODeL) technologies; use of digital tools in music education	Non-technology-focused studies; opinion pieces without empirical evidence
Outcomes	Contributions toward Sustainable Development Goals (SDG 4: Quality Education; SDG 10: Reduced Inequalities); effectiveness, challenges, and opportunities of ODeL	Studies not addressing SDG outcomes or education quality
Study type	Peer-reviewed journal articles, dissertations, conference papers, government or institutional reports	Non-academic sources, magazines, blogs, or non-peer-reviewed opinion pieces
Publication date	Published between 2010 and 2025	Studies published before 2010
Language	English	Non-English publications (without translation)
Access	Available via databases: Thesis Repository, Proquest, EBSCOhost, LearnTechLib, JSTOR, ERIC, Google Scholar	Unavailable full text or inaccessible articles

Thematic Analysis

The identified studies were systematically analysed to extract key themes related to the levels of technology integration, guided by the SAMR Model (Substitution, Augmentation, Modification, Redefinition). Particular attention was given to how these integrations contribute to achieving SDGs, especially SDG 4 and SDG 10. Challenges encountered in implementing ODeL technologies, as well as opportunities for improvement and innovation, were also examined. This thematic analysis provided a comprehensive overview of the current landscape of music education through ODeL in South Africa, offering valuable insights to inform future policies, curriculum design, and strategic development in the sector.

Thematic Analysis of the Literature

Theme 1: Integration Levels of ODeL Technologies

The analysis revealed that most studies demonstrate the use of ODeL technologies predominantly at the Substitution and Augmentation stages of the SAMR Model (Ghavifekr & Rosdy, 2015; Wahyuni et al., 2020; Wijaya et al., 2021). Wahyuni et al. (2020) report that both teachers and students have incorporated a range of technologies into instructional activities, with integration primarily occurring within the Enhancement levels (Substitution and Augmentation) and some progression towards the Transformation stages (Modification and Redefinition). At the Enhancement levels, technology tends to replace traditional teaching methods without fundamentally altering the learning experience. Ghavifekr & Rosdy (2015) further support this perspective, highlighting that Information and Communication Technology (ICT) integration helps educators move beyond conventional pedagogies and adopt technology-based teaching tools and facilities.

However, there remains limited evidence of technology being applied at the Modification and Redefinition stages, where it has the potential to significantly redesign tasks or create entirely new educational practices (Costley, 2014; Gilakjani, 2017; Raave et al., 2024). This gap underscores the need for a more innovative and transformative approach, particularly within music education. Higher levels of integration could facilitate meaningful learning experiences, enabling students to engage in creative, collaborative, and critical tasks previously inconceivable without technological support (Godsk & Møller, 2025; Yende, 2025). Addressing this gap requires deliberate strategies for enhancing digital pedagogical skills among educators, redesigning curricula to leverage technology's transformative potential, and fostering a culture of innovation within ODeL environments.

Theme 2: Contributions to SDGs Through SAMR

The integration of technology within ODeL environments demonstrates measurable progress towards SDG 4 (Quality Education) and SDG 10 (Reduced Inequalities), with the level of SAMR implementation influencing the scope and depth of impact. At the Substitution level, digital tools replicate traditional learning resources, enabling students who are geographically isolated or economically disadvantaged to access content remotely, thereby directly contributing to SDG 4. At the Augmentation level, technology enhances pedagogical effectiveness, for example, through interactive modules, immediate feedback, and enriched digital resources, promoting more equitable learning opportunities and supporting SDG 10.

Hariyani et al. (2025, p. 1) emphasise that digital technologies play a pivotal role in advancing SDGs by offering innovative solutions to challenges such as poverty alleviation, equitable healthcare, climate action, and responsible consumption. In South Africa, Statistics South Africa (2023, p. 5) highlights that SDGs are embedded in national, provincial, and local government policies, formalised through the National Development Plan (NDP), which sets targets for 2030 to enhance the quality of education and reduce socio-economic disparities.

Technology applied at the Modification level allows educators to redesign tasks, integrating collaborative, inquiry-based, or project-oriented activities that transform traditional practices. At the Redefinition level, technology enables entirely new learning experiences, such as virtual ensembles, interactive simulations, and student-driven digital content creation, which not only broaden access but actively reduce inequalities and foster inclusive, transformative education.

Despite these opportunities, the impact of technology integration remains uneven. To maximise SAMR-driven interventions, strategic investment in infrastructure, comprehensive digital literacy training for educators and students, and policies promoting equitable access are essential. When applied thoughtfully across all SAMR levels, digital technologies can serve as catalysts for achieving SDG 4 and SDG 10, ensuring education is inclusive, equitable, and capable of transforming learning experiences in South African music education.

Theme 3: Challenges in Integrating ODeL Technologies Through the SAMR Lens

Several persistent challenges continue to hinder the effective integration of ODeL technologies in marginalised South African universities (Chomunorwa & Mugobo, 2023; Xuan & Fitri bin Mohamad Haris, 2025; Yende & Madolo, 2023). Key barriers affecting music education include inadequate infrastructure, such as unreliable internet connectivity and limited access to digital devices. At the Substitution level of the SAMR model, these deficits prevent basic replacement of traditional teaching resources with digital equivalents, restricting students' ability to access learning materials online. Similarly, at the Augmentation level, the lack of infrastructure and support constrains educators from enhancing pedagogical practices using technology, limiting opportunities for interactive or enriched learning experiences.

Limited digital literacy among educators further restricts effective use of technology. Ndibalema (2025, p. 10) observes:

Limited digital skills among instructors and students are also influenced by little management support and lack of adequate technological equipment that could support the development of more technological solutions. This is often the case because there has been less emphasis put on digital integration into curriculum and culture even before the outbreak of COVID-19 pandemic. Although some universities in sub-Saharan countries noted the growth of digitalisation for online learning solutions during COVID-19, teaching has returned to normal face-to-face lectures which appear to have limited avenues for students to develop digital literacy skills.

This challenge particularly limits progress at the Modification and Redefinition levels, where technology could otherwise enable transformation of learning tasks or creation of new, innovative pedagogical experiences. Without sufficient digital competence and institutional support, educators cannot redesign curricula, facilitate collaborative online projects, or implement student-driven, technology-enhanced learning activities.

Institutional resistance to change further impedes technology adoption, reinforcing traditional face-to-face teaching even after the COVID-19 shift to online learning. Consequently, the potential of ODeL to move beyond Substitution and Augmentation is unrealised, leaving transformative possibilities largely untapped. Strategic interventions investing in infrastructure, providing professional development, and cultivating an institutional culture that values digital transformation are therefore essential. These measures would enable progression across all SAMR levels, ensuring that ODeL integration supports meaningful, innovative, and inclusive learning experiences in South African music education.

Theme 4: Opportunities for Optimisation and Advancement Through SAMR

Despite persistent challenges, scholars such as Muyambi & Ramorola (2025) and Nyathi & Joseph (2024) highlight significant opportunities for advancing ODeL integration. Nyathi & Joseph (2024, p. 2) note, "Digital learning can improve accessibility, engagement, personalisation and collaboration. Educators thus have the opportunity to create dynamic and inclusive learning environments that meet the diverse needs of students." From a SAMR perspective, these opportunities illustrate potential progression from Substitution and Augmentation toward Modification and Redefinition, where digital tools enable transformative pedagogical practices rather than merely replacing traditional methods.

Targeted professional development programmes, as noted by Derder et al. (2023), can enhance educators' digital competencies, supporting the use of technology to redesign learning tasks and foster collaborative, interactive, and personalised learning experiences. Such interventions facilitate Modification-level practices by allowing educators to restructure assignments, integrate multimedia, and design tasks that encourage higher-order thinking.

Investing in infrastructure addresses access and connectivity issues, enabling broader participation in online learning and supporting Redefinition-level practices, where learners can engage in entirely new, technology-enabled learning experiences. Thoughtful curriculum redesign, as Yende & Madolo (2023) emphasise, can move beyond simple substitution, empowering students to collaborate, personalise, and co-create knowledge in ways impossible in traditional settings. Therefore, by leveraging these opportunities, institutions can advance ODeL integration across all SAMR levels, aligning with SDG 4 (Quality Education) and SDG 10 (Reduced Inequalities). This approach ensures education is not only accessible but also transformative, inclusive, and equitable, maximising the pedagogical potential of digital technologies in South African music education.

Discussion

The current study sought to explore the integration of emerging ODeL technologies into music education, aiming to enhance access, quality, and inclusivity in South African higher education institutions. This article argues that, while significant progress has been made in adopting digital tools, substantial challenges persist, particularly in marginalised universities, which hinders the full realisation of ODeL's potential. Additionally, the study highlights significant opportunities for growth and optimisation in how ODeL technologies can be leveraged to improve music education. These opportunities align with broader educational goals of inclusivity and equity, which resonate with several Whole Schooling principles, including Equity, Access, and Community Engagement.

One of the key themes that emerge from this study is the varying levels of ODeL technology integration in music education, especially in South African universities. Consistent with previous research (Maboe, 2019; Marutha & Dube, 2023; Queiros & de Villiers, 2016), the findings reveal that, although ODeL technologies are being adopted, their integration largely remains at the Substitution and Augmentation stages of the SAMR Model (Puentedura, 2013). This model, divided into four stages: substitution, augmentation, modification, and redefinition, guides educators in moving beyond mere replacement of traditional methods toward more transformative practices (Puentedura, 2013; Romrell et al., 2014). In the current study, ODeL technologies were primarily used to substitute traditional teaching methods, with limited examples of transformation that could significantly redefine the educational experience. These findings indicate that much work remains to be done to progress to the Modification and Redefinition stages, where digital tools can genuinely enhance music education in innovative and student-centred ways. This observation directly supports the Whole Schooling principle of Teaching and Learning Innovation, emphasising the need for curricula that foster creativity, collaboration, and critical thinking.

Another central finding from this study is the significant challenges hindering effective integration of ODeL technologies in marginalised South African universities. In line with earlier research by Yende & Madolo (2023), this study identifies inadequate infrastructure, such as unreliable internet connectivity and lack of access to essential devices, as major barriers. These challenges are compounded by limited digital literacy among educators, which restricts their ability to use technology effectively. This finding corroborates previous research by Yende & Madolo (2023), who found that the lack of appropriate technological infrastructure in South African universities limits the integration of ODeL technologies in music education. Inadequate training and professional development for educators further exacerbate these challenges, leaving many educators ill-equipped to incorporate digital tools into their teaching practices. As a result, students, particularly those from disadvantaged backgrounds, are denied the opportunity to benefit fully from ODeL's potential to enhance learning experiences, highlighting a gap in Whole Schooling principles of equity and access.

The study also underscores the need for universities to invest in both infrastructure and professional development to ensure successful integration of ODeL technologies. This finding aligns with the recommendations of De Villiers (2022) and Mugovhani (2012), who emphasised that institutions should prioritise building a solid technological foundation to support digital learning. Similarly, the current study supports the idea that universities should focus on targeted professional development programmes for educators to enhance their digital competencies (Mugovhani, 2012; Yende & Madolo, 2023). It is clear from the findings that without adequate support, educators will continue to struggle with effectively integrating ODeL technologies, which undermines the overall quality and impact of digital education. These findings reflect the Whole Schooling principles of Professional Learning Communities and Leadership Support, demonstrating that institutional commitment is critical for meaningful technology integration.

Furthermore, the findings indicate that curriculum redesign is essential for maximising the potential of ODeL technologies. The integration of digital tools should not merely substitute traditional methods but should lead to transformative practices that enhance teaching and learning. This observation resonates with Yende & Madolo (2023), who advocate for a shift in music education curricula, arguing that digital tools should be incorporated to promote creativity, collaboration, and personalised learning experiences. Such redesign would involve moving beyond passive consumption of information toward active, student-centred learning, where students can meaningfully engage with content, collaborate with peers, and create new forms of musical expression using digital technologies. These outcomes are consistent with Whole Schooling principles of Active Learning, Collaboration, and Student-Centred Education.

Another significant contribution of this study is its alignment with the United Nations' SDGs, particularly SDG 4

(Quality Education) and SDG 10 (Reduced Inequalities). The integration of ODeL technologies in music education can help address disparities in access to quality education by providing remote learning opportunities, especially for students in rural or underserved areas. These findings support [Hariyani et al. \(2025\)](#), who note that digital technologies play a critical role in addressing global challenges such as poverty alleviation and equitable access to education. In South Africa, where significant inequalities persist in educational access, the strategic use of ODeL technologies can bridge the gap and ensure that all students have equal opportunities to succeed, directly supporting Whole Schooling principles of equity, inclusion, and access.

However, despite these opportunities, the impact of ODeL technologies remains uneven, with many challenges persisting. The current study suggests that, while ODeL technologies can enhance access to education, their effectiveness is limited by inadequate infrastructure, resistance to change, and insufficient digital literacy. This highlights the need for strategic and coordinated interventions to address these barriers and ensure ODeL technologies are used effectively to promote inclusive, equitable, and high-quality education. The results indicate that a multi-faceted approach is necessary, involving infrastructural investment, targeted professional development, and a culture of innovation to fully leverage ODeL's potential within higher education.

The study highlights the critical role of marginalised universities in prioritising ODeL technology integration into their music education curricula. By doing so, they can enhance access, improve quality, and contribute to SDG attainment, particularly SDG 4 and SDG 10. However, for these benefits to be realised, universities must invest in infrastructure and educator professional development, redesign curricula to meaningfully integrate digital tools, and address structural barriers that limit access to technology. Only through these comprehensive efforts can the full potential of ODeL technologies be realised, transforming the educational experience for students across South Africa's higher education system, in alignment with the principles of Whole Schooling.

Recommendations

Based on these findings and reflecting on the study, the following recommendations are made:

(a) Invest in Infrastructure and Technological Access: Prioritise investments in reliable internet, digital devices, and technological infrastructure for effective ODeL integration.

(b) Implement Targeted Professional Development for Educators: Enhance educators' digital literacy and pedagogical skills to improve ODeL technology use and teaching practices.

(c) Redesign Curricula to Integrate Digital Tools Meaningfully: Rework curricula to incorporate digital tools, fostering active, collaborative, and innovative student learning experiences.

Conclusions

This article has explored the integration of ODeL technologies in music education within South African higher education institutions, highlighting both the opportunities and challenges associated with their adoption. The findings reveal that while ODeL technologies have the potential to enhance access to education, especially for students in geographically isolated or economically disadvantaged areas, their integration remains limited, primarily confined to the Substitution and Augmentation stages of the SAMR Model. This finding underscores the need for more transformative uses of technology in music education, moving beyond basic substitution to redefined and innovative teaching practices. Moreover, the study identifies significant barriers, such as inadequate infrastructure, limited digital literacy among educators, and resistance to change, which hinder the effective integration of ODeL technologies. However, the article also highlights that there are considerable opportunities for growth, including targeted professional development programmes for educators, investments in digital infrastructure, and the redesign of curricula to more effectively integrate digital tools. These efforts are crucial in ensuring that ODeL technologies can be fully leveraged to promote inclusive, equitable, and quality education, in alignment with the United Nations' SDGs, particularly SDG 4 and SDG 10. In conclusion, this article exemplifies the principle of Equitable Access, demonstrating how ODeL technologies can reduce structural and socio-economic barriers, enhancing inclusive participation and equitable opportunities for all students in music education.

Author Contributions

Conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing original draft preparation, writing review and editing, visualization, supervision, project administration, and funding acquisition were carried out by SJY. The author has read and agreed to the published version of the manuscript.

Ethics Approval and Consent to Participate

Not applicable.

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Availability of Data and Materials

The data supporting the findings of this study are available within the article. No additional datasets were generated or analysed during the current study. Where applicable, sources used in this study are publicly available in academic databases and open-access repositories as cited in the reference list. If further clarification or access is required, requests may be directed to the corresponding author.

Conflict of Interest

The author declares no conflict of interest.

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