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Navigating Technological Frontiers: The Significance of Mixed Reality in Pre-service Teacher Curriculum in Nigeria

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Abstract

This paper explores the significance of integrating Mixed Reality (MR) technologies into pre-service teacher education programs in Nigeria. MR, which blends virtual and augmented realities, offers unique opportunities for educators to develop essential skills and enhance their pedagogical approaches.This paper argues for including Mixed Reality (MR) in Nigerian teacher training. It uses TPACK theory to show how MR aligns with effective teaching and the SAMR model to assess how MR can be integrated for maximum impact.Document analysis and secondary data were used in the study. In other words, the authors analyze existing research on mixed reality (MR) and teacher education to argue for the importance of integrating MR into pre-service teacher education programs in Nigeria.Review revealed that MR allows pre-service teachers to virtually explore historical sites, manipulate 3D objects, and practice in simulated classrooms, fostering deeper understanding and engagement. Also, MR facilitates the application of theoretical concepts in simulated scenarios, preparing pre-service teachers for real-world classrooms. However, challenges exist such as , unequal access to reliable internet, power, and MR headsets impedes widespread implementation. The conclusion stresses the transformative potential of MR in preparing future educators for the evolving technological landscape. This review suggests that Mixed Reality has the potential to revolutionize pre-service teacher education in Nigeria by providing a more engaging, immersive, and effective learning experience. However, overcoming challenges related to access, training, and cultural context is crucial for successful implementation. The article affirms the potential of MR as a tool for improving teacher education in developing countries.

Keywords: *Education, Inequalities, Curriculum, Innovative Practices, Collaboration, Sustainable And Resilient Communities.*

Introduction

Rapid technological advancements in mixed reality (MR) have significantly transformed the immersive experience landscape across various domains. Researchers have devoted considerable academic interest to the development of MR, which includes virtual reality (VR) and augmented reality (AR) (Valente et al., 2021; Cheng et al., 2020; Dede, 2017). Multiple worldwide endeavors underscore the effective incorporation of MR within teacher education. The positive effects of MR on teacher preparation programs are illustrated through case studies conducted in several countries, including the United States, South Korea, and the United Kingdom (Merchant et al., 2014; Park et al., 2017; Mohammad et al., 2024a; Vogel et al., 2017). Nigeria is currently experiencing a paradigm shift in its educational environment, marked by a notable surge in the incorporation of technology into pedagogical and learning methodologies. Amid this ongoing development, mixed reality (MR) is a formidable catalyst for novelty, specifically in pre-service teacher education. The present condition of technology integration in Nigerian education encompasses both advancements and obstacles.

However, the emergence of mixed reality (MR) offers an intriguing opportunity for novel approaches to pre-service teacher education. By integrating the realms of physical and digital environments, MR presents distinctive opportunities to augment the education and readiness of prospective educators. By immersing pre-service instructors in replicated classrooms, historical events, or scientific phenomena, MR

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environments can cultivate a more profound comprehension and active involvement. Envision prospective educators immersed in various classroom situations or virtually traversing historical sites to augment their pedagogical methodologies (Akpan & Adeoye, 2023).

Using MR tools, pre-service teachers can test lesson plans, implement instructional strategies, and obtain immediate feedback in secure virtual environments. This process instills confidence and enhances teaching abilities before entering actual classrooms (Onuorah, 2022). MR technologies can tailor learning experiences according to the requirements and learning styles of the individual. Such an approach has the potential to accommodate varied student populations and promote classroom inclusivity (Federal Republic of Nigeria, 2012). Thus, this paper explores the importance of MR in pre-service teacher education in Nigeria.

Literature Review

The Concept of Mixed Reality

Mixed Reality (MR) intersects the real and virtual worlds, defying a singular, universally accepted definition. Achi and Taniyama (2016) define MR as "the seamless augmentation of a user's real-world sensory perception with virtual or computer-generated content" (p. 12). According to Kipper and Rampal (2018), MR is "a class of computing applications that place virtual objects in the real world in real time" (p. 8). Schmalstieg and Hollerer (2016) emphasise the ability to interact with both real and virtual elements in MR: "a human-computer interface paradigm that seamlessly merges real and virtual worlds into a new mixed environment" (p. 1). Added to this, Carruth and Hall (2014) describe MR as "the ability to physically interact with both real and virtual objects in the same space" (p. 8).

Akizono and Yano (2016) broaden the scope by including auditory and haptic feedback, defining hybrid reality as "a fusion of physical and computer-generated information through various sensory modalities, composed of real and virtual worlds" (p. 3). Laaninen et al. (2015) emphasise the role of sensorimotor coupling in creating a unified experience: "the seamless integration of virtual and real worlds across sensory, motor, and cognitive levels" (p. 5). More precisely, Kipper and Rampal (2018) highlight the potential for embodiment beyond visual augmentation: "the ability to seamlessly blend virtual objects and sensations with the real world, creating novel embodied experiences" (p. 8). The emergent technology known as mixed reality (MR) combines aspects of virtual and augmented realities to produce experiences where the physical and digital realms seamlessly coexist. However, it refers explicitly to settings where digital and corporeal entities seamlessly interact, although it is often used interchangeably with similar concepts like virtual reality (VR) and augmented reality (AR).

Theoretical Underpinning

This paper employed two theories, namely, Technological Pedagogical Content Knowledge (TPACK) and the SAMR model, to discuss the significance of MR in pre-service teachers' curricula in Nigeria.

Technological Pedagogical Content Knowledge (TPACK): Mishra and Koehler (2006) developed the TPACK framework to emphasize the essential integration of technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK) for effective teaching**.** An understanding of how technology can be utilized to augment pedagogical approaches for particular subject areas is reflected in TPACK, the overlapping space of these three knowledge domains. Koehler and Mishra (2008) expanded upon the TPACK framework by emphasizing the interdependence and dynamic characteristics of the knowledge domains. Individuals with a high TPACK score can discern and incorporate suitable technologies to further their pedagogical objectives (Mohammad et al., 2024b; Koehler & Mishra, 2008).

The incorporation of MR is consistent with TPACK principles, given that educators must have proficient technological knowledge, pedagogical expertise, and content expertise. MR facilitates the development of immersive learning experiences that establish connections between abstract principles and practical implementations (Mohammad et al., 2024c; Chen et al., 2017). Implementing TPACK and MR in teacher professional development necessitates providing specialised training for educators (Archambault & Barnett,

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2010). Teachers also require assistance and instruction to seamlessly incorporate MR tools into their pedagogical approaches (Ke, 2016). By addressing TPACK and MR, professional development programs can enable educators to create effective and novel learning environments.

*Substitution, Augmentation, Modification, and Redefinition (SAMR) Model***:** Four levels of technology integration in education are delineated by Puente Dura's (2006) SAMR model: redefinition, augmentation, substitution, and modification. From fundamental replacement to a radical reevaluation of educational objectives, these phases symbolize an evolution of technology utilization (Puentedura, 2006; Mohammad et al., 2023a; Mohammad et al., 2023b). The SAMR model offers a methodical framework for assessing technology integration within educational environments. Educators strive beyond mere substitution and augmentation to foster transformative learning experiences and higher-order thinking (Puentedura, 2006: Al-Fakeh et al., 2023; Hii, 2023).

By amalgamating features of virtual and augmented realities, mixed reality presents distinctive prospects for interactive and immersive learning experiences (Dunleavy et al., 2009). MR can captivate students unprecedentedly, promoting enhanced comprehension and retention of knowledge. As instructors investigate the incorporation of MR into pedagogical approaches, the SAMR model presents a valuable conceptual structure for evaluating the effects on student learning. MR may be utilized in augmentation as an alternative to traditional resources, which entails incorporating MR capabilities into existing operations. Redesigning tasks with MR may constitute modification, whereas redefinition may entail the creation of wholly new learning experiences enabled by MR technologies (Alkhawaldeh et al., 2023; Hai-Jew, 2019).

Research has demonstrated that MR has the potential to revolutionise educational experiences through the facilitation of collaborative problem-solving, simulation-driven learning, and spatial comprehension (Al-Husban et al., 2023;Akcayır & Akcayır, 2017). In addition, the SAMR paradigm guides educators on effectively utilizing MR in a transformative manner. Integrating MR into education effectively requires overcoming obstacles despite the methodical framework provided by the SAMR model. Successful implementation necessitates the resolution of challenges, including but not limited to access to MR technologies, teacher training, and the requirement for curricular alignment (Alshura et al., 2023; Aldaihani et al., 2023; Kearney et al., 2012). In conclusion, the incorporation of MR into the SAMR framework offers instructors a methodical strategy for optimizing the complete capabilities of MR technologies. Teachers can utilize MR to redefine and transform learning experiences, establishing dynamic and engaging educational environments by surpassing substitution and augmentation.

Components and Capabilities of MR in Education

MR offers diverse components, including augmented reality (AR) and virtual reality (VR), providing teachers and students with interactive, three-dimensional learning environments (Akçayır & Akçayır, 2017; Al-Adamat et al., 2023).

Virtual Reality (VR): According to Cruz et al. (2017), virtual reality (VR) is a digitally immersive setting where users actively participate in computer-generated simulations. This viewpoint emphasises the capacity of virtual reality to transport users into synthetic domains through its experiential nature. Also, Lackey defines virtual reality as an interactive, computer-generated experience that immerses users in a simulated environment, often through headsets and other sensory input devices. Rizzo and Shilling (2017) argue that virtual reality puts users in diverse situations and provides them with new viewpoints, earning it the title of an empathy machine.

The definitions above underscore VR's multifaceted character, which incorporates simulation, technology, perception, and interaction elements. The potential of virtual reality (VR) to strengthen student engagement in educational settings has been the subject of extensive research. Smith and Wang (2017) and Johnson et al. (2016) found that students exposed to virtual reality (VR) courses exhibited more significant levels of engagement compared to those exposed to conventional methods. The immersive qualities of virtual reality foster a sense of presence and connection, engrossing students in the educational material (Dalgarno & Lee, 2016).

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According to a study by Akcayr and Akcayr (2017), students exposed to virtual reality (VR) experiences retained more information than those in traditional classrooms. A study by Akcayr and Akcayr (2017) found that students exposed to virtual reality (VR) experiences retained more information than those in traditional classrooms. Virtual reality (VR) enhances the learning experience by offering spatial and sensory signals, which in turn assist in retaining knowledge over an extended period (Chittaro & Ranon, 2017). Virtual reality (VR) offers students several benefits and equips educators with resources to develop dynamic and interactive instructional modules. According to a study by Wu et al. (2019), instructors who utilized VR platforms reported greater ease and satisfaction in communicating complex ideas. Educators can accommodate various learning styles and personalize material for personalized instruction by utilizing the capability to generate virtual scenarios (Freina & Ott, 2015).

Augmented Reality (AR): Fuchs and Livingston (2018) put forth a definition of augmented reality that is centered on the human being, emphasizing the technology's capacity to augment human cognition, perception, and interaction with the environment through the superimposition of pertinent digital information. According to Schmalstieg and Hollerer (2016) and (Gee et al., 2021), AR is a subset of mixed reality in which digital content is seamlessly incorporated into the user's perception of the world to enable dynamic and interactive experiences.

The use of augmented reality has the potential to revolutionize the way students learn in conventional classrooms. Two studies, one by Dunleavy et al. (2010) and the other by Akçayır and Akçayır (2017), have shown that augmented reality applications make learning more engaging for students by creating immersive and interactive experiences. Study results from Johnson et al. (2016) and König et al. (2018) raised attention to using augmented reality in programs that prepare teachers. These studies highlight how augmented reality (AR) may improve teachers' professional development by providing new resources and approaches, leading to more engaging and successful classroom practices. Personalized learning experiences are made possible by the versatility of AR. Personalized instructional material that improves comprehension and retention may be provided to students using augmented reality apps, as discussed by Butler et al. (2017) and Chang et al. (2019).

Researchers Dede et al. (2014) and Wu et al. (2020) found that AR applications make it easier for students to work together to study. These results demonstrate the promise of augmented reality in creating an engaging and collaborative learning environment by improving students' communication and cooperation abilities. Scholars have investigated the use of augmented reality in specialized fields, including Li et al. (2018) and Billinghurst et al. (2015). These studies demonstrate the potential of augmented reality (AR) across various academic disciplines, from history to science, by allowing educators to develop curricularly relevant interactive material.

Navigating Technological Frontiers: The Significance of Mixed Reality in Pre-service Teacher Curriculum in Nigeria

Mixed reality technologies should be integrated into pre-service teacher curricula in Nigeria to enhance conventional teaching approaches (Olabode, 2020; Salami, 2020; Aina & Adediwura, 2019; Yusof et al., 2019; Cawley & Lynch, 2018; Falloon & Reeves, 2015). By integrating the digital and physical realms, MR generates interactive settings that elicit inquiry, active participation, and enhanced comprehension (Onuora & Achor, 2021; Akcapınar et al., 2020; Dunleavy et al., 2017). In a secure and interactive environment, pre-service educators can virtually explore historical sites, analyze virtual models, and engage in conceptual experimentation (Choi & Rausch, 2019; Ke et al., 2019).

MR promotes the development of critical thinking, problem-solving, collaboration, and digital literacy abilities, which are exceedingly valuable in the current era (Baş et al., 2019). By designing and implementing MR-based lessons, pre-service teachers can develop their technological proficiency and pedagogical innovation (Obodera & Ajiboye, 2022; Ertmer & Bell, 2014). In order to accommodate a wide range of learning styles, MR incorporates kinesthetic, auditory, and visual learning experiences (Bacca et al., 2014; O'Hearn & Jones, 2019). By implementing this individualized strategy, more inclusive education can benefit students with varying learning capacities (Chen & Lin, 2018).

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Incorporating MR into pre-service teacher education furnishes them with the essential competencies and understanding to employ this technology with assurance in their forthcoming classrooms (Czerkawski & Brown, 2015; Li et al., 2019). Such a solution may serve as a link between conventional teacher training and the changing requirements of modern learners (Adigwe, 2017). Conceptual comprehension can be enhanced by animating 3D models, simulations, and interactive overlays to materialise abstract ideas. For example, prospective science educators may delve into the intricacies of human anatomy, whereas individuals preparing to teach social studies or history may examine environments from the past. (Smets et al., 2021; Akçayır & Bozkurt, 2019; Bacca et al., 2014). Encouraging active participation in virtual subjects allows pre-service instructors to conduct experiments, test hypotheses, and establish practical connections in real time. This immersive learning can augment their confidence and pedagogical knowledge. (Akcayr & Bozkurt, 2019; Kloppfer & Miller, 2016).

Incorporating gamified learning experiences, interactive narratives, and collaborative problem-solving tasks will enable instructors to pique students' interest and improve their ability to retain information. (Wu et al., 2013; Sung & Hwang, 2012). MR platforms can provide customized learning experiences adapted to pupils' unique requirements and learning styles. This individualized methodology fosters inclusiveness and accommodates a wide range of learners. (Cheng et al., 2020; Graf & Holohan, 2019; Mishra & Kozma, 2019; Kiili et al., 2018). Individuals can refine their critical thinking and problem-solving abilities by engaging in immersive challenges and navigating complex virtual environments (Greenfield & DeWane, 2020; Czerkawski & Mast, 2014). According to Akcayr and Bozkurt (2019) and Kiili et al. (2018), engaging in collaborative efforts to accomplish objectives and exchange findings within MR environments cultivates proficient communication and teamwork capabilities. By honing their skills in devising and utilising MR experiences, pre-service educators equip themselves to proficiently incorporate this technology into their forthcoming classrooms. (Sung & Hwang, 2012; Kloppfer & Miller, 2016). Mishra and Kozma (2013) state that MR can facilitate learning for students with disabilities by developing immersive experiences that accommodate various learning styles and providing alternative information representations.

MR headsets like Microsoft's HoloLens and Magic Leap One are becoming increasingly affordable and accessible, paving the way for broader adoption in educational settings. Advancements in spatial mapping and hand tracking are making interactions with virtual objects more intuitive and realistic, further enhancing the immersive learning experience (Akçayır & Yalçın, 2020). Additionally, the development of cloud-based platforms like Spatial.io and Microsoft Mesh allows for collaborative learning in virtual environments, regardless of physical location (Wang et al., 2021).

MR enriches pre-service and in-service training by leveraging various aspects of teacher education. Virtual simulations can provide safe and controlled environments for practising diverse teaching strategies, facilitating the development of essential skills like classroom management and differentiation (Akinye, 2022). Immersive historical tours and cultural experiences can deepen understanding of diverse perspectives and enhance global citizenship education (Onuoha & Onuoha, 2021). Mixed reality facilitates the integration of theoretical concepts with real-world implementation within the realm of teacher education. By applying educational theories in simulated scenarios, pre-service teachers can strengthen their comprehension of pedagogical concepts and equip themselves to confront the intricacies of authentic classroom environments (Akcayoglu & Keskin, 2019; Ozcevik & Yalcin, 2019; Dede & Keengwe, 2016; Billinghurst et al., 2015; Lee & Park, 2015). Integrating these elements facilitates the transition from the classroom to professional practice.

Furthermore, MR can revolutionize the science education curriculum by allowing students to dissect virtual frogs or explore planets in real-time, making abstract concepts more concrete and engaging (Batiyeh et al., 2021). MR applications have the potential to be customized in order to tackle particular educational obstacles and augment cultural sensitivity in pedagogical approaches, given the cultural milieu of Nigeria (Eko & Ifeanyi, 2020). The potential for mixed reality to revolutionize teacher education is indisputable evidence of its significance in pre-service teacher curricula. Mixed reality facilitates the development of pedagogical skills, increases student engagement, and bridges the divide between theory and practice by providing interactive and immersive experiences. Integrating mixed reality into teacher education programs

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is becoming a more crucial component in equipping educators to address the changing demands of learners in the twenty-first century as technology progresses.

Challenges of the Inclusion of Mixed Reality in Pre-Service Teachers' Curricula in Nigeria

The integration of the physical and digital realms in mixed reality (MR) can revolutionize education significantly (Akcayir & Yalcin, 2019; Açık & Akçayır, 2018). Nevertheless, incorporating MR into pre-service teacher education (PSTE) programs encounters distinct obstacles, especially in developing nations like Nigeria. Restricted technological access continues to be a significant obstacle in Nigeria (Adeyinka & Ajayi, 2012). The exorbitant expenses associated with the necessary infrastructure, such as dependable internet connectivity, may impede the widespread implementation of MR headgear in PSTE institutions (Akcayir & Yalcin, 2019). In addition, the unreliable provision of power in numerous areas presents logistical obstacles to the continued implementation of MR (Osuji, 2012).

In order to successfully incorporate MR into the PSTE curriculum, it is imperative to develop pedagogically sound learning experiences that take advantage of its distinct functionalities (Vong, 2018). In light of this, transitioning from conventional methods of content delivery to those that prioritise student engagement and inquiry, leveraging the interactive and immersive attributes of MR, is imperative (Akcayir & Yalcin, 2019). PSTE teachers may need to understand the teaching possibilities of MR fully, and there are not many easy-to-find MR-based teaching materials, which could make it harder to integrate MR into the curriculum effectively (Ebenezer & Ogundele, 2018).

The effectiveness of MR adoption is contingent upon the presence of adequately trained and self-assured faculty members (Vong, 2018). On the contrary, a prevalent issue in Nigeria is the need for more digital literacy and familiarity of pre-service teachers with emerging technologies such as MR (Adeyinka & Ajayi, 2012). Therefore, comprehensive training programmes are required to furnish PSTE faculty with the essential competencies and understanding required to develop, execute, and assess MR-based learning initiatives (Akcayir & Yalcin, 2019).

Governmental policies and funding support significantly influence the promotion and implementation of technology in education (Ebenezer & Ogundele, 2018). Adequate policy guidance and limited funding present substantial obstacles to incorporating technology in PSTE programmes within the Nigerian context (Adeyinka & Ajayi, 2012). Clear national policies endorsing the implementation of MR in education and dedicated funding mechanisms are imperative for advancing its adoption (World Bank, 2018; UNESCO, 2016).

Adopting and utilizing technology in education may also be impacted by the sociocultural milieu (Akpan, 2019; Onasoga & Salami, 2017; Osunde, 2015). Due to a lack of awareness regarding MR's educational benefits and concerns regarding technology's potential adverse effects on students' well-being and learning, Nigerian institutions must consider these issues cautiously (Ebenezer & Ogundele, 2018). By actively involving stakeholders such as parents, educators, and community leaders in discussions regarding the potential of MR, it is possible to effectively tackle these concerns and cultivate a broader understanding and acceptance.

Future Trends and Implications

Potential advancements in MR for teacher education encompass enhanced hardware, broader content libraries, and heightened opportunities for collaboration (Yang & Lee, 2017). These developments may profoundly affect teacher preparation programs worldwide. Anticipating forthcoming developments, these trends underscore the progression of MR technology towards headgear that is more portable, cost-effective, and compatible with mobile devices; this will facilitate its broader implementation in developing nations such as Nigeria (Salinas & De-Pablos, 2023). Moreover, by circumventing geographical constraints, collaborative learning platforms within MR environments provide pre-service teachers with a thrilling opportunity to practice and receive remote feedback from mentors and peers (Vong et al., 2021).

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Given the country's multifaceted cultural and educational milieu, the utilization of MR in pre-service teacher training in Nigeria necessitates a context-specific approach. A potentially fruitful application is the simulation of difficult classroom situations, including managing diverse learning styles and controlling disruptive behavior (Akın & Erdem, 2016; Akinyemi, 2014; Salisu, 2014; Yusuf, 2014). Pre-service teachers can cultivate efficacious strategies and hone their critical decision-making abilities within a secure and regulated setting by virtually experiencing these scenarios (Akcayir & Akcayir, 2020). MR can also be utilised to highlight Nigeria's rich cultural heritage and linguistic diversity. By engaging in immersive virtual excursions of historical sites or simulating traditional customs, pre-service teachers can acquire a tangible comprehension and admiration for their own culture. They can subsequently incorporate this knowledge and appreciation into their instructional methodologies.

Conclusion

In conclusion, incorporating mixed reality (MR) into the pre-service teacher curriculum in Nigeria offers revolutionary potential that can enable aspiring educators to navigate the continuously evolving technological environment effectively. Through replicated classrooms, three-dimensional exploration of historical events, and virtual object manipulation, pre-service teachers can develop critical twenty-first-century competencies, enhance their comprehension of intricate principles, and nurture an ardour for inventive pedagogical approaches. The importance of MR transcends mere technical expertise. This opportunity empowers aspiring educators to develop cultural awareness and empathy by assuming the perspective of their heterogeneous students. It fosters critical thinking and creativity by motivating students to develop interactive educational experiences within digital environments. It facilitates the integration of practical application and theoretical understanding by establishing a secure environment where instructors can test and refine various teaching methodologies while receiving prompt feedback. Government agencies, universities, technology companies, and educators must work in concert to resolve these obstacles and guarantee equal access to this revolutionary technology. Hence, in light of Nigeria's advancements in education technology, integrating MR into pre-service teacher education is not a discretionary choice but an imperative. By providing forthcoming educators with the necessary resources and competencies to effectively utilise MR, we can establish a future where each classroom serves as an entrance to boundless opportunities, motivating an entire generation of young individuals to achieve their utmost capabilities.

Recommendations

The recommendations address pivotal strategies for integrating mixed reality technologies into Nigeria's educational framework, focusing on teacher training and professional development. Firstly, the National Commission for Colleges of Education (NCCE) and the National Universities Commission (NUC) must prioritize the inclusion of mixed reality courses in pre-service teacher curricula. This initiative aims to acquaint prospective teachers with emerging technologies, enriching the educational landscape. Secondly, fostering partnerships between educational institutions and technology firms is critical. Such collaborations would facilitate access to advanced mixed reality tools and resources, offering pre-service teachers hands-on experience with the latest technologies.

Moreover, artificial intelligence developers for mixed reality applications are encouraged to consider cultural, linguistic, and socio-economic factors. Tailoring AI to reflect Nigeria's diverse educational needs and goals will enhance its relevance and effectiveness. In addition, there is a pressing need for government and non-governmental organizations to support ongoing professional development for in-service teachers. Providing workshops, webinars, and platforms for collaborative learning can foster an exchange of innovative teaching methods and best practices related to mixed reality.

Finally, research organizations play a crucial role in assessing the impact of mixed reality in teacher education. Implementing a framework to evaluate outcomes such as student progress, instructor performance, and the overall enhancement of the learning experience is vital. Through systematic data collection and analysis, educators and policymakers can make informed decisions about the continued adoption of mixed reality technologies in Nigeria's teacher training programs. These recommendations

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collectively aim to modernize the educational sector, aligning it with global technological advancements while addressing local needs and challenges.

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Conflict of Interest

The writers have disclosed no conflict of interest. Nobody has anything to hide when it comes to their financial interests; all of the co-authors have read and approved the final manuscript. This work is not currently being considered for publication elsewhere, and the authors hereby attest that it is entirely original. Disclosure of all funding sources for the project is required.

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