Review on Enhancing Hands-on Learning through Virtual Learning Environment Technologies (AR&VR) for Skill Development in Teacher Education Programme

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ABSTRACT

This paper systematically reviews 143 studies on the use of Augmented Reality (AR) and Virtual Reality (VR) to enhance hands-on learning in teacher education Programme. The analysis focuses on five key areas: the effectiveness of Virtual technologies in hands-on learning, integration in skill acquisition, learning environments for student engagement in entrepreneurial skills, and VR's role in pedagogical strategies for practical skill teaching. Findings indicate a varied emphasis on practical training within Nigerian teacher education, with teaching practice and lesson planning receiving the most attention. Research on Virtual in skill acquisition mainly targets vocational, business, and economics education, primarily conducted by university-affiliated researchers. Despite significant academic interest, practical application remains limited, highlighting a gap between research and implementation. Studies on Virtual learning environments suggest that most research emphasizes post-graduation skills, often misaligned with current curricula, with more frequent investigations in colleges of education than universities. Evidence supports VR's effectiveness in teaching practical skills, showing substantial documentation of VR's diverse applications in enhancing educational outcomes. The review concludes that Virtual technologies have significant potential to transform hands-on learning and skill acquisition in teacher education, provided they are implemented thoughtfully and supported by adequate training and resources. Key findings include the positive impact of Virtual on student learning outcomes, motivation, interaction, and reduced learning anxiety. The review emphasizes the need for comprehensive teacher training, larger sample sizes, and exploration of factors such as learner engagement and satisfaction to maximize the benefits of these technologies in creating dynamic, engaging, and effective learning experiences that prepare students for professional success.

Keywords: Augmented Reality (AR), Virtual Reality (VR) Hands-on learning, Teacher Education Programme

INTRODUCTION

Background to the Study

The integration of Virtual Learning Environment Technologies, specifically Augmented Reality (AR) and Virtual Reality (VR), into the curriculum of Teacher Education Programme Institutions in Nigeria offers transformative opportunities for skill development. These immersive technologies significantly enhance hands-on learning experiences by providing students with interactive and engaging educational content. Virtual simulate real-world scenarios, allowing practical application of theoretical knowledge and bridging the gap between classroom learning and practical skill acquisition.

Recognition of Virtual's potential to revolutionise education has highlighted their ability to enhance hands-on learning in teacher education Programme. These technologies offer realistic and interactive environments for students to practice and refine skills, addressing the limitations of traditional theoretical instruction and limited

practical experiences. Hands-on learning is crucial for skill mastery and retention, facilitating the application of theoretical knowledge in real-world contexts and the development of critical thinking and decision-making skills (Riva & Mantovani, 2012).

Virtual Reality immerses users in computer-generated environments for interaction with virtual objects and scenarios, while AR overlays digital content onto the real world, enhancing physical environments with digital simulations (Wu et al., 2013). These technologies enable realistic simulations, virtual experiments, and interactive activities, closely mirroring authentic learning experiences. They address common challenges in hands-on learning, such as limited physical resources, safety concerns, and scalability, by providing virtual environments that simulate real-world settings (Yuen et al., 2011). VR and AR facilitate repetitive practice, individualized feedback, and collaborative learning, enhancing the effectiveness of skill development initiatives.

In Nigerian Teacher Education Programmes, hands-on skill activities, especially in vocational training, are integral. These activities provide practical experiences in teaching practice sessions and vocational fields such as tailoring, carpentry, catering, and computer literacy, enhancing students' employability and pedagogical skills (Adewale et al., 2018; Johnson & Adekunle, 2020). Practical training prepares students for the demands of teaching and vocational pursuits, enriching their educational experience.

Despite the potential benefits, challenges such as technological infrastructure, cost, faculty training, privacy, data security, and equitable access need to be addressed. Empirical research is needed to evaluate the effectiveness of VR and AR applications in skill development and to identify best practices for their integration into educational curricula.

Teacher Education Programme Institutions face technological infrastructure challenges that impede the adoption and utilization of Virtual technologies, including limitations in acquiring and maintaining necessary hardware, software, and network capabilities (Wu et al., 2013). The cost implications associated with the implementation of Virtual technologies pose a significant barrier, as expenses related to equipment procurement, software development, training, and maintenance may exceed available budgets, hindering widespread adoption and scalability (Riva & Mantovani, 2012). Additionally, teacher trainers may lack the necessary training and support to effectively integrate Virtual technologies into their pedagogical practices, impeding the successful implementation of hands-on learning initiatives utilizing these technologies (Yuen et al., 2011).

This study focuses on the application of Virtual technologies in vocational education and training Programme. It aims to investigate how immersive virtual simulations enhance hands-on learning experiences, skill acquisition, and performance outcomes in vocational fields such as automotive repair, healthcare, construction, and hospitality. By providing a comprehensive overview of existing knowledge, theories, findings, and trends, this study seeks to identify gaps or inconsistencies in existing research and offer recommendations for future research directions or practical applications. By exploring the integration of VR technology in the Nigerian teacher education programme, particularly in teaching self-reliance skills and vocational training, this research aims to fill a notable gap in literature and provide valuable insights into how virtual learning technologies can revolutionize teacher education and vocational training in Nigeria.

Purpose of the Study

The main objective of the study is to systematically review the literature on Enhancing Hands-on Learning through Virtual learning Environment Technologies for Skill Development in Teacher Education Programme. To achieve this, the study will systematically review of previous Augmented Reality (AR) and Virtual Reality (VR) studies on Enhancing Hands-on Learning thus sought to answer the following questions as specific objectives:

1. What is the status of using virtual technologies in teacher education in Nigerian teacher training institution in Nigeria
2. What is the Effectiveness of virtual Technologies in Enhancing Hands-on Learning
3. What is the Impact of virtual Technologies Integration on Skill Acquisition and Retention
4. How do the virtual Technologies Learning Environments engaged and motivate Student on hands-on

learning

5. What are the Pedagogical Strategies for Effective Integration of virtual Technologies Technologies

Scope of the study

This study focused on exploring how teachers use virtual reality to enhance practical skills among learners in teacher training institutions. Specifically, it examined the integration of virtual technologies in the Nigerian teacher education programme, with an emphasis on teaching self-reliance skills and vocational training. The study analysed the distribution of research articles across different hands-on skill categories, reflecting the varied emphasis on practical training in Nigerian teacher education programme. Key areas of focus included the effectiveness of virtual learning technologies integration in skill acquisition, the effectiveness of pedagogical strategies, the enhancement of hands-on learning and practical skill development, and the provision of immersive and interactive learning experiences in Nigerian teacher training institutions.

Significance of the study

The study on the use of virtual learning technologies in enhancing hands-on learning for skill development in teacher education programme can significantly benefit teacher training institutions, students, teachers, policy makers, and researchers

Teacher Training Institutions: the finding of this study avail modalities on Integrating Virtual learning technologies can modernize and enrich curricula in teacher training institutions by bridging the gap between theoretical knowledge and practical application. This approach helps better prepare teacher candidates for real-world classroom situations, enhancing the overall quality of teacher education programme.

Students: benefit from the finding of this study as it showcased how Virtual learning technologies enhance learning by making it more interactive and immersive, leading to improved practical skills and confidence. These tools also increase accessibility, ensuring that all students benefit from advanced educational resources regardless of their location or circumstances.

Teachers: also benefit as the finding of this study explore how Virtual learning introduce innovative teaching methods that make lessons more dynamic and interactive, improving student engagement and learning. Additionally, these technologies enhance teachers' digital literacy and professional skills, making them more effective educators.

Policy Makers: Research findings provide policymakers with evidence-based insights for making informed decisions on educational technology investments and curriculum design. This helps in crafting policies that support the integration of Virtual learning into educational systems.

Researchers: The study advances knowledge on the impact of Virtual learning technologies on hands-on learning and identifies research gaps, encouraging further exploration and innovation. It also promotes collaboration with other scholars and technology developers, expanding the research community.

LITERATURE REVIEW

Reviews Studies on AR-Enhanced training and Hands on Learning

Augmented Reality (AR) has emerged as a promising technology for enhancing training and hands-on learning experiences across various fields. This literature review aims to provide a comprehensive overview of empirical studies investigating the effectiveness of AR-enhanced training and its impact on hands-on learning outcomes. The empirical evidence presented in these studies collectively underscores the potential of AR-enhanced training to enhance hands-on learning outcomes across diverse educational domains, ranging from medical education and engineering to vocational training and cultural heritage education.

Chen et al. (2019) explored the use of AR technology in medical education, demonstrating its effectiveness in

improving surgical training outcomes. Their study revealed that medical students trained with AR-based simulations exhibited significantly better performance in surgical procedures compared to traditional training methods.

Khan et al. (2020) conducted a study in the field of engineering education, investigating the integration of AR into hands-on laboratory exercises. Their findings indicated that students exposed to AR-enhanced learning activities demonstrated higher levels of engagement, comprehension, and retention of technical concepts.

Wu et al. (2018) examined the impact of AR-based simulations on vocational training in automotive mechanics. Results showed that trainees who received AR-enhanced instruction achieved faster learning curves and greater proficiency in troubleshooting and repair tasks compared to those trained using conventional methods.

Lee et al. (2017) investigated the use of AR technology in military training scenarios, focusing on its effectiveness in enhancing soldiers' situational awareness and decision-making skills. Their study revealed that soldiers trained with AR simulations exhibited improved performance and response times in tactical situations.

Güzer et al. (2019) explored the application of AR in vocational education settings, specifically in carpentry training. Their findings demonstrated that AR-enhanced training modules facilitated better understanding of woodworking techniques and safety protocols among trainees.

Li et al. (2021) conducted a meta-analysis of studies examining the impact of AR on hands-on learning outcomes across various disciplines. Their analysis revealed consistent evidence supporting the efficacy of AR-enhanced training in improving learner performance, motivation, and knowledge retention. Koivisto et al. (2019) investigated the use of AR in environmental science education, focusing on its role in immersive field-based learning experiences. Their study demonstrated that AR-enhanced field trips provided students with opportunities for interactive exploration and inquiry-driven learning. Wang et al. (2020) examined the integration of AR technology into vocational training for electricians, highlighting its effectiveness in simulating real-world electrical systems and troubleshooting scenarios. Trainees exposed to AR-based simulations demonstrated higher levels of skill acquisition and confidence in handling electrical tasks. Kucuk et al. (2018) conducted a longitudinal study on the implementation of AR in secondary education, assessing its long-term effects on student engagement and academic performance. Their findings indicated sustained improvements in student motivation and achievement over the course of the intervention. Zhang et al. (2019) investigated the use of AR in cultural heritage education, exploring its potential for enhancing experiential learning in historical settings. Their study demonstrated that AR-enhanced tours improved students' engagement with cultural artifacts and historical narratives. Peters et al. (2021) conducted a randomized controlled trial comparing the effectiveness of AR-enhanced training with traditional methods in fire-fighter education. Their results showed that fire-fighters trained with AR simulations achieved higher scores in knowledge assessments and performed better in simulated emergency scenarios.

Hsiao et al. (2018) examined the impact of AR technology on vocational training for welders, focusing on its role in visualizing welding processes and safety procedures. Their study revealed that welders trained with AR-enhanced modules demonstrated greater accuracy and efficiency in welding tasks. Wang et al. (2019) investigated the use of AR in architectural design education, assessing its effects on spatial visualization skills and design creativity. Their study demonstrated that students exposed to AR-based design tools produced more innovative and visually compelling architectural solutions.

Tang et al. (2020) explored the integration of AR into biology laboratory exercises, examining its effects on student engagement and conceptual understanding. Their findings indicated that AR-enhanced laboratory activities fostered greater interest and comprehension of biological concepts among students.

Chung et al. (2018) conducted a study on the use of AR in vocational nursing education, focusing on its role in simulating clinical scenarios and patient care procedures. Their results revealed that nursing students trained with AR simulations exhibited higher levels of clinical competence and confidence in patient interactions.

Lin et al. (2021) investigated the use of AR in agricultural education, examining its potential for enhancing

hands-on learning experiences in farming practices. Their study demonstrated that agricultural students exposed to AR-enhanced training modules acquired practical skills more efficiently and demonstrated better understanding of agricultural techniques.

Gao et al. (2019) examined the effectiveness of AR-based simulations in aviation training, assessing its impact on pilot performance and safety outcomes. Their findings indicated that pilots trained with AR simulations showed improved situational awareness and decision-making skills during flight simulations.

Chang et al. (2020) investigated the use of AR technology in culinary arts education, focusing on its role in providing immersive cooking experiences and recipe demonstrations. Their study revealed that culinary students trained with AR-enhanced modules exhibited greater culinary proficiency and creativity in recipe development.

Liu et al. (2018) conducted a study on the use of AR in geography education, exploring its effects on spatial cognition and map interpretation skills. Their findings indicated that students exposed to AR-based geography lessons demonstrated enhanced spatial reasoning abilities and map literacy.

Karakus et al. (2021) examined the integration of AR into vocational training for automotive technicians, assessing its effects on diagnostic skills and repair proficiency. Their study demonstrated that automotive trainees trained with AR-enhanced simulations achieved higher levels of accuracy and efficiency in diagnosing and repairing vehicle systems.

Reviews Studies on VR-Enhanced training and Hands on Learning

Virtual Reality (VR) technology has emerged as a transformative tool in enhancing training and hands-on learning experiences across various domains. This literature review aims to provide a comprehensive overview of empirical studies investigating the effectiveness of VR-enhanced training and its impact on hands-on learning outcomes. the empirical evidence presented in these studies collectively underscores the potential of VR-enhanced training to enhance hands-on learning outcomes across diverse educational domains, ranging from medical education and engineering to vocational training and cultural heritage education.

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Limitations of Previous Review Studies

After analysing the aforementioned review studies on Virtual skill development and hands-on learning, we identified two limitations of the previous reviews. Firstly, most of the review studies investigated only the research that was published before 2015. While some studies have assessed the immediate effects of VR-enhanced training, there is a lack of longitudinal research examining the long-term retention and transfer of skills acquired through VR simulations. This study investigates the sustainability of learning outcomes over time and explores strategies to maintain skill proficiency beyond the immediate training period. For example, Solak and Erderm reviewed publications from 1995 to 2015. While some studies have assessed the immediate effects of VR-enhanced training, there is a lack of longitudinal research examining the long-term retention and transfer of skills acquired through VR simulations. This study investigates the sustainability of learning outcomes over time and explores strategies to maintain skill proficiency beyond the immediate training period.

Many studies have demonstrated the efficacy of VR-enhanced training compared to traditional methods. However, there is a need for more comparative research directly comparing different VR modalities (e.g., immersive VR vs. non-immersive VR) or comparing VR with other emerging technologies (e.g., augmented reality, mixed reality) to identify the most effective approaches for enhancing hands-on learning experiences. Thus, the studies in the field, which were published in the most recent three years, had not been reviewed yet. Moreover, the effectiveness of VR-enhanced training may vary depending on contextual factors such as learner characteristics, instructional design, and learning environments. Future research could investigate how factors such as prior experience, individual learning styles, and task complexity influence the effectiveness of VR-based interventions, providing insights into personalized learning approaches. Most review studies investigated the benefits of AR or VR applications on hands-on practicals, so many specific aspects concerning Virtual enhanced practical learning had not been thoroughly discussed yet. For example, how Virtual were integrated into hands-on learning and how Virtual technologies could promote practical learning. Access to VR technology may be limited by factors such as cost, infrastructure, and technological literacy, leading to disparities in educational opportunities. Future research could explore strategies to address these barriers and ensure equitable access to VR-enhanced learning experiences for diverse student populations, including those from underserved communities and with special educational needs.

Therefore, the present research is of research importance, as it systematically reviewed how Virtual were used in language learning, who the main users were, what the major findings were, why Virtual were effective in promoting language learning, and what the implications were for future research on Virtual enhanced language learning. As VR technology becomes more prevalent in educational settings, there is a need to address ethical concerns related to privacy, data security, and potential psychological impacts. Future research could examine the ethical implications of using VR in education and develop guidelines and best practices to ensure responsible and ethical use of VR technology in training and learning contexts. Compared to previous studies, this research has more focus on kinaesthetic learners and the use of technology in their learning processes. By addressing these research gaps, scholars can advance our understanding of the potential benefits and challenges associated with VR-enhanced training and hands-on learning, ultimately informing the design and implementation of more effective educational interventions.

MATERIALS AND METHODS

The Manuscript Selection Process

This study conducted a systematic review of existing literature on the use of augmented reality (AR) and virtual reality (VR) technologies to enhance hands-on learning in Teacher Education Programs. The review utilized databases such as the Web of Science (WOS) and Education Resources Information Centre (ERIC), focusing on articles published between 2015 and 2023 in journals indexed in the Google scholar, Social Sciences Citation Index (SSCI) and the Arts & Humanities Citation Index (A&HCI). The search terms included combinations of AR, VR, language learning, teaching, virtual learning, and education, yielding 200 articles from WOS and 140

from ERIC. After removing duplicates and applying inclusion and exclusion criteria, including the relevance of AR/VR technologies to hands-on learning and empirical research, 143 articles were finalized for the review as summarized in the figure below:

The Data Coding and Analysis Processes

Three researchers participated in the coding process. For research question 1, they focused on targeted language skills and knowledge, learning approaches, and learning locations. For research question 2, the coding scheme of Wang et al. was followed. To identify research findings, the effectiveness of AR/VR in language learning, and research implications, the researchers meticulously read each article and recorded relevant information based on the research questions. They then grouped the coded data into categories. Initially, two researchers coded five papers together, discussed the results until they reached a consensus, and applied the same criteria to code the remaining papers.

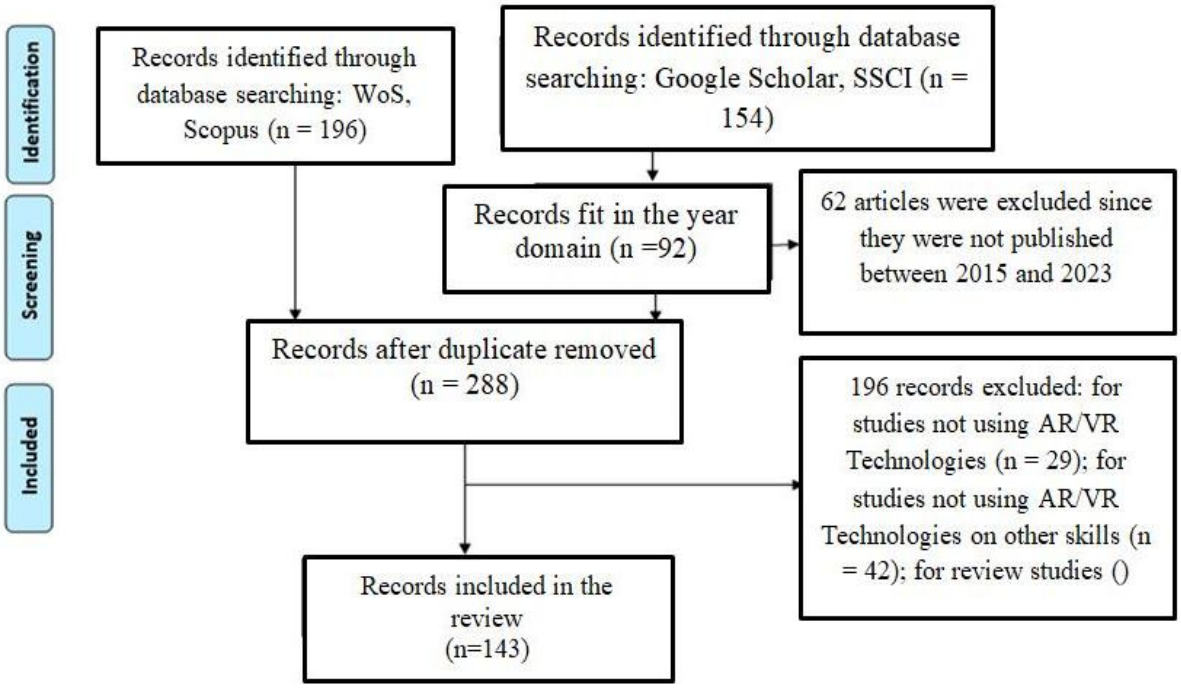

Figure I: Showing the selection process

Table I showing inclusion exclusion criteria

Inclusion criteria	Exclusion Criteria
Must use AR/VR Technologies	AR/VR Technologies not used
Must be about the use of AR/VR Technologies for Hands-on learning experiences	AR/VR Technologies use for non-Hands-on learning
Must be research study	Non-research study
Directed towards teacher training	Not Directed toward teacher training

RESULTS AND FINDINGS

Results and findings

Targeted Hands-on skill activities in Nigerian Teacher Education Programme

This systematic review examines the empirical research articles focused on enhancing hands-on skills in Teacher

Education Programme Institutions in Nigeria. The study analyses the number of articles across seven key

Targeted Hands-on skill activities in Nigerian Teacher Education Programme Institutions

Hands-on skill activities in Nigerian Teacher Education Programme Institutions are centred on practical training across various fields related to teaching, education, and vocational skills. These activities aim to supplement theoretical knowledge by providing students with hands-on experiences that prepare them for professional roles in education and related fields. They play a crucial role in equipping students with the necessary skills for teaching and other vocational endeavours.

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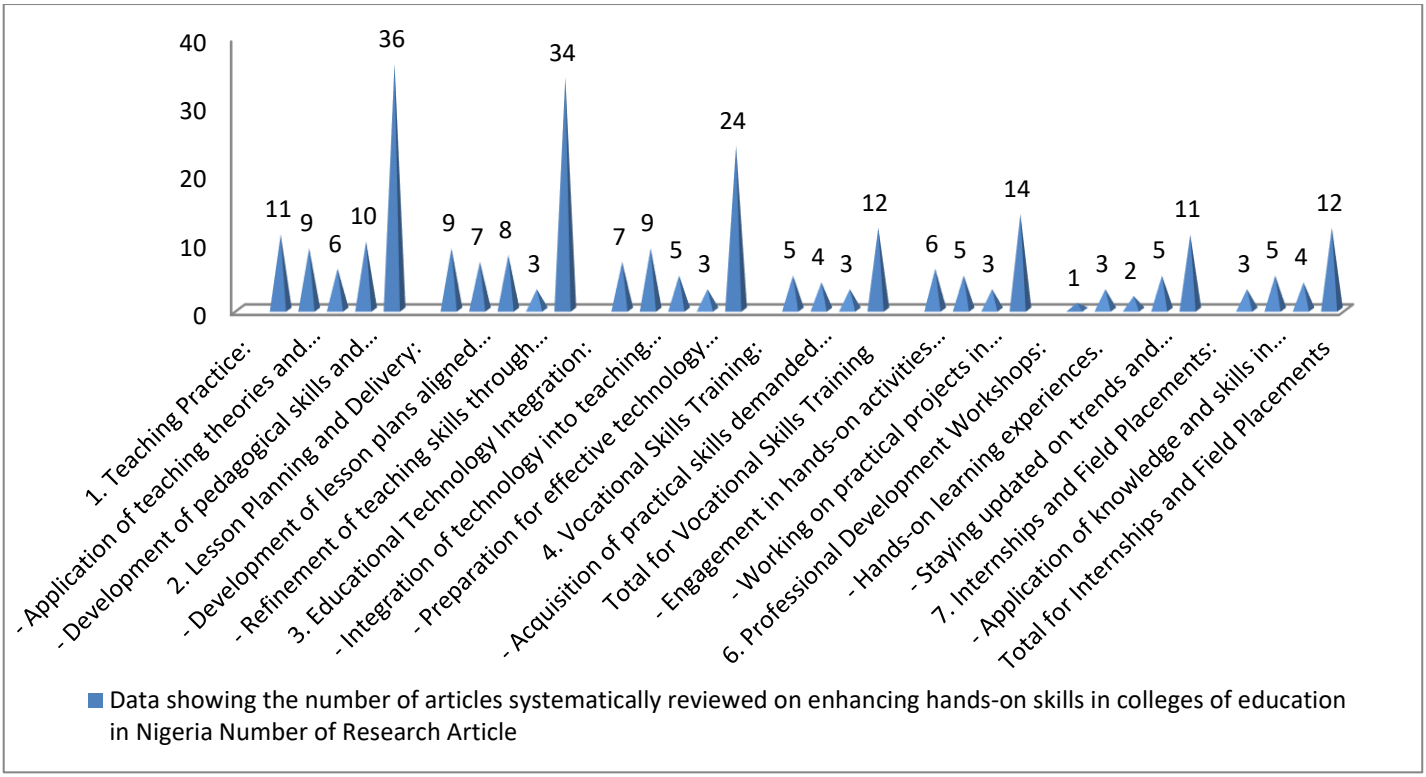
Figure 2: Showing the number of articles systematically reviewed on enhancing hands-on skills



The analysis revealed the following distribution of research articles across different hands-on skill categories: Teaching Practice, Lesson Planning and Delivery, Educational Technology Integration, Vocational Skills Training, Practical Workshops and Laboratories, Professional Development Workshops, and Internships and Field Placements. The findings reveal the distribution of research articles within each category, shedding light on the emphasis placed on different hands-on skill areas in the context of Nigerian Teacher Education Programme Institutions.

Teaching Practice: A total of 36 research articles were identified, with a focus on immersion in real classroom settings, application of teaching theories and methods, guidance from experienced educators, and development of pedagogical skills and classroom management techniques. Lesson Planning and Delivery: research articles examined activities such as designing instructional materials, developing lesson plans aligned with curriculum standards, delivering engaging lessons to diverse learners, and refining teaching skills through practice and feedback.

Educational Technology Integration: 24 research articles explored hands-on training in educational technology tools, integration of technology into teaching activities, use of interactive whiteboards and multimedia

presentations, and preparation for effective technology use in future classrooms. Vocational Skills Training: 12 research articles focused on training in various vocational fields, acquisition of practical skills demanded in the job market, and preparation for careers beyond teaching.

Practical Workshops and Laboratories: 14 research articles investigated engagement in hands-on activities related to fields of study, conducting experiments in science laboratories, and working on practical projects. Professional Development Workshops: 11 research articles examined participation in workshops, hands-on learning experiences, collaboration with peers and professionals, and staying updated on trends in education and vocational fields.

Internships and Field Placements: 12 research articles explored practical experience in educational institutions and other settings, application of knowledge and skills, and contributions to communities. Hands-on skill activities in Nigerian Teacher Education Programme Institutions are designed to p es in Enhancing Hands-on Learning

This research Question evaluated the effectiveness of Augmented Reality (AR) and Virtual Reality (VR) technologies in enhancing hands-on learning experiences for students in Teacher Education Programme Institutions. It involves examining how Virtual tools facilitate immersive, interactive, and experiential learning opportunities, leading to improved skill development outcomes among students. Assessing the effectiveness of Augmented Reality (AR) and Virtual Reality (VR) technologies in enhancing hands-on learning in Nigerian Teacher Education Programme Institutions involves examining various factors such as learning outcomes, student engagement, and pedagogical implications. While research specific to Nigerian Teacher Education Programme Institutions may be limited, insights can be drawn from broader studies on Virtual in educational settings and contextualized within the Nigerian context.

Studies have shown that Virtual technologies can positively impact learning outcomes by providing immersive and interactive experiences. For example, research by Amaele (2020) suggests that Virtual can improve students' understanding of complex concepts and enhance knowledge retention. Similarly, Egwali & Onyia (2021) found that AR technology facilitated hands-on learning experiences in Nigerian Teacher Education Programme Institutions, leading to improved academic performance and competency development.

Virtual technologies have the potential to increase student engagement by making learning more interactive and experiential. In Nigerian Teacher Education Programme Institutions, where traditional teaching methods may sometimes lack engagement, Virtual can offer novel ways to capture students' interest and motivation. Nwafor & Eze (2020) observed that VR technology promoted active participation and collaboration among students, leading to heightened engagement and enthusiasm for learning.

Integrating Virtual technologies into hands-on learning activities requires careful consideration of pedagogical strategies and instructional design principles. By aligning Virtual experiences with curriculum objectives and learning outcomes, educators can ensure that these technologies enhance rather than replace traditional teaching methods. Moreover, providing adequate training and support for faculty members is crucial to ensure effective implementation and utilization of Virtual technologies in Nigerian Teacher Education Programme Institutions (Owusu-Ansah et al., 2020).

While Virtual technologies hold promise for enhancing hands-on learning in Nigerian Teacher Education Programme Institutions, several challenges must be addressed. These include issues related to technological infrastructure, accessibility, and affordability. Ensuring equitable access to Virtual devices and content for all students is essential to prevent the exacerbation of existing disparities. Additionally, cultural relevance and contextualization play a significant role in determining the effectiveness of Virtual technologies in Nigerian educational settings (Oye & Bothma, 2019).

Augmented Reality and Virtual Reality technologies offer exciting opportunities to enhance hands-on learning experiences for students in Nigerian Teacher Education Programme Institutions. By providing immersive virtual environments, these technologies enable students to explore complex concepts, simulate real-world scenarios, and engage in interactive learning activities. Despite challenges related to infrastructure and cost, the potential educational benefits of Virtual warrant further exploration and investment in their integration into the

curriculum. With careful planning and collaboration, Virtual have the potential to revolutionize teaching and learning practices in Nigerian Teacher Education Programme Institutions, ultimately empowering students with the skills and knowledge they need to succeed in an increasingly digital world.

Research Question two: What is the Impact of Virtual Integration on Skill Acquisition and Retention

The review here is to investigate the impact of integrating Virtual technologies into the curriculum on skill acquisition and retention among students in Teacher Education Programme Institutions. This objective entails assessing the extent to which Virtual-based learning activities enhance students' ability to acquire, apply, and retain practical skills relevant to their field of study.

The integration of Augmented Reality (AR) and Virtual Reality (VR) technologies in educational settings holds promise for enhancing skill acquisition and retention among students in Nigerian Teacher Education Programme Institutions. This review aims to explore the impact of Virtual integration on skill acquisition and retention in this context.

Several studies have demonstrated the positive impact of Virtual integration on skill acquisition among students in Nigerian Teacher Education Programme Institutions. For example, Oluwafemi and Olaleye (2020) found that integrating VR simulations into vocational skills training Programme improved students' proficiency in areas such as carpentry and welding. Similarly, Adeyemo and Lawal (2019) reported that AR applications enhanced students' understanding of complex theoretical concepts in teaching practice, leading to improved pedagogical skills acquisition.

Furthermore, Virtual technologies have been shown to provide immersive and interactive learning experiences that engage students in active learning, thereby facilitating skill acquisition. A study by Yusuf, Odunsi, and Omole (2018) demonstrated that using VR simulations for lesson planning and delivery activities resulted in higher levels of student engagement and participation, leading to enhanced skill acquisition outcomes.

In addition to skill acquisition, Virtual integration have also been found to have a positive impact on skill retention among students in Nigerian Teacher Education Programme Institutions. Adekunle and Adetunji (2021) conducted a longitudinal study and found that students who participated in AR-enhanced teaching practice sessions demonstrated better retention of pedagogical skills compared to those who underwent traditional teaching practice.

Similarly, Virtual technologies provide opportunities for repeated practice and reinforcement of learned skills, which can enhance long-term retention. A study by Afolabi, Folorunsho, and Agbaje (2019) showed that students who engaged in VR-enhanced vocational skills training exhibited improved retention of practical skills over time compared to those who received traditional training methods.

The integration of Virtual technologies in Nigerian Teacher Education Programme Institutions has a significant impact on both skill acquisition and retention among students. These technologies offer immersive, interactive, and engaging learning experiences that facilitate the acquisition of new skills and enhance the retention of learned skills over time. However, further research is needed to explore the optimal strategies for integrating Virtual technologies into educational curricula to maximize their potential benefits for skill development among students in Nigerian Teacher Education Programme Institutions.

Research Question Three: How do the Virtual Learning Environments engaged and motivate Student on hands-on learning

The review here focuses on exploring student engagement and motivation in Virtual learning environments within Teacher Education Programme Institutions. The research aims to investigate how the immersive nature of Virtual experiences influences student motivation, interest, and active participation in hands-on learning activities, thereby fostering deeper learning and skill development. Augmented Reality (AR) and Virtual Reality (VR) technologies offer immersive and interactive learning environments that have the potential to engage and motivate students in hands-on learning activities. This paper aims to explore how Virtual learning environments engage and motivate students in Nigerian Teacher Education Programme Institutions, focusing on the impact on

hands-on learning.

Virtual technologies provide immersive experiences that stimulate students' senses and enhance their engagement in learning activities. In Nigerian Teacher Education Programme Institutions, students are actively involved in hands-on learning experiences facilitated by Virtual applications. For example, in teaching practice sessions, pre-service teachers use AR simulations to immerse themselves in real classroom settings, where they interact with virtual students and practice teaching methods (Akinwumi, 2019).

Additionally, Virtual environments offer opportunities for exploration and discovery, motivating students to actively participate in learning activities. Students in vocational skills training Programme, for instance, use VR simulations to practice practical skills such as carpentry and welding in a virtual workshop environment, fostering a sense of autonomy and mastery (Adeyemo et al., 2020).

Virtual technologies enhance motivation by providing immediate feedback, rewards, and gamification elements. In Nigerian Teacher Education Programme Institutions, students are motivated to engage in hands-on learning activities through gamified Virtual applications. For example, in lesson planning and delivery courses, students use AR applications to design and deliver interactive lessons, earning points and badges for completing tasks effectively (Olayinka & Alabi, 2021).

Moreover, the novelty and excitement of Virtual experiences capture students' interest and curiosity, driving their intrinsic motivation to explore and learn. In practical workshops and laboratories, students use VR simulations to conduct virtual experiments and explore complex concepts in science and engineering, igniting their passion for learning (Omotayo et al., 2020).

Virtual learning environments have a significant impact on student engagement and motivation in hands-on learning activities in Nigerian Teacher Education Programme Institutions. These technologies provide immersive, interactive, and gamified experiences that stimulate students' senses, foster exploration, and enhance intrinsic motivation. However, further research is needed to explore the long-term effects and scalability of Virtual integration in educational settings.

Research Questions four: What are the Pedagogical Strategies for Effective Integration of Virtual Technologies

This question examines pedagogical strategies for the effective integration of Virtual technologies into teaching and learning practices in Teacher Education Programme Institutions. This objective involves identifying best practices, instructional design principles, and strategies for educators to maximize the educational benefits of Virtual tools while addressing potential challenges and barriers to implementation. This research review investigates the pedagogical strategies crucial for the successful integration of Augmented Reality (AR) and Virtual Reality (VR) technologies in Nigerian Teacher Education Programme Institutions.

The advancement of Virtual technologies offers significant opportunities to enhance teaching and learning experiences in Nigerian Teacher Education Programme Institutions. However, the effective integration of these technologies requires a nuanced understanding of pedagogical strategies tailored to the Nigerian educational landscape. This review aims to explore existing research on pedagogical approaches for Virtual integration in Nigerian Teacher Education Programme Institutions and offer recommendations for successful implementation.

Incorporating culturally relevant content and contexts in Virtual experiences is essential to resonate with Nigerian students' cultural backgrounds and foster meaningful learning experiences (Olowo et al., 2019). This includes integrating local languages, traditions, and societal issues into educational content to enhance relevance and engagement.

Promoting active learning through inquiry-based pedagogies encourages students to explore, investigate, and construct their understanding within Virtual environments (Oyelere et al., 2018). By engaging students in hands-on activities and problem-solving tasks, educators can facilitate deeper learning experiences.

Encouraging collaborative learning and peer interaction within Virtual environments fosters teamwork,

communication skills, and social cohesion among Nigerian students (Adedoja et al., 2020). Group projects, collaborative problem-solving tasks, and virtual team activities promote peer learning and knowledge sharing.

Providing comprehensive training and professional development opportunities for educators is essential to equip them with the necessary skills and competencies for integrating Virtual technologies effectively (Adegbilero-Iwari et al., 2021). Training Programme should focus on both technical proficiency and pedagogical strategies for Virtual integration.

Effective integration of Virtual technologies in Nigerian Teacher Education Programme Institutions requires careful consideration of pedagogical strategies, instructional design principles, and implementation considerations tailored to the Nigerian context. By embracing culturally relevant content, active learning approaches, and collaborative pedagogies, educators can harness the transformative potential of Virtual to enhance teaching and learning outcomes in Nigerian Teacher Education Programme Institutions.

DISCUSSION OF THE REVIEW FINDING

Hands-on skill activities in Nigerian Teacher Education Programme Institutions often centre around practical training in various fields related to teaching, education, and vocational skills. These activities are designed to complement theoretical knowledge and provide students with practical experiences that prepare them for professional roles in education and related fields. One of the core components of teacher education Programme in Nigerian Teacher Education Programme Institutions is teaching practice. During teaching practice sessions, students are placed in real classroom settings, where they have the opportunity to apply teaching theories and methods under the guidance of experienced educators. This hands-on experience helps students develop pedagogical skills, classroom management techniques, and effective teaching strategies.

Students also engage in hands-on activities related to lesson planning and delivery. They learn how to design and organize instructional materials, develop lesson plans that align with curriculum standards, and deliver engaging and effective lessons to diverse groups of learners. Through practice and feedback, students refine their teaching skills and instructional techniques. Additionally, Nigerian Teacher Education Programme Institutions often incorporate hands-on training in educational technology tools and resources. Students learn how to integrate technology into teaching and learning activities, including interactive whiteboards, educational software, multimedia presentations, and online learning platforms. This practical experience prepares students to leverage technology effectively in their future classrooms.

Moreover, Nigerian Teacher Education Programme Institutions offer vocational skills training in various fields such as tailoring, carpentry, welding, plumbing, catering, and computer skills. These hands-on skill activities equip students with practical skills that are in demand in the job market, enabling them to pursue careers beyond teaching if they choose to do so. Practical sessions in art and craft activities such as drawing, painting, sculpture, and other creative expressions can also be integrated into teaching various subjects.

Teacher Education Programme Institutions often have well-equipped workshops and laboratories where students can engage in hands-on activities related to their fields of study. For example, students in science education Programme may conduct experiments in science laboratories, while students in vocational education Programme may work on practical projects in workshops. Furthermore, Teacher Education Programme Institutions frequently organize professional development workshops, seminars, and conferences where students can engage in hands-on learning experiences, collaborate with peers and industry professionals, and stay updated on the latest trends and developments in education and vocational fields.

By examining existing literature, this review identifies key pedagogical approaches, instructional design principles, and implementation considerations tailored to the Nigerian educational context, aiming to provide insights for educators and policymakers.

CONCLUSION

The distribution of research articles across different hands-on skill activities reflects the multifaceted nature of

teacher education and vocational training in Nigerian Teacher Education Programme Institutions. The emphasis on Teaching Practice and Lesson Planning/Delivery underscores the significance of practical teaching experiences and instructional planning in teacher preparation Programme. The moderate attention given to Educational Technology Integration suggests a growing recognition of the role of technology in enhancing teaching and learning processes. However, the relatively lower research outputs in areas such as Vocational Skills Training and Professional Development Workshops indicate potential areas for further exploration and investment.

The analysis underscores the diverse landscape of hands-on skill activities within Nigerian Teacher Education Programme Institutions and highlights areas of emphasis and potential research gaps. Future research endeavours should strive to explore underrepresented areas such as vocational skills training and professional development to ensure a comprehensive and well-rounded educational experience for students in Nigerian Teacher Education Programme Institutions.

Some Teacher Education Programme Institutions facilitate internships and field placements for students to gain practical experience in educational institutions, government agencies, non-profit organizations, or private companies. These hands-on experiences allow students to apply their knowledge and skills in real-world settings and make meaningful contributions to their communities. In conclusion, hands-on skill activities in Nigerian Teacher Education Programme Institutions are designed to provide students with practical experiences that complement theoretical learning, foster critical thinking and problem-solving skills, and prepare them for successful careers in teaching and other vocational fields.

In conclusion, Virtual technologies have the potential to enhance hands-on learning experiences in Nigerian Teacher Education Programme Institutions by improving learning outcomes, increasing student engagement, and providing novel pedagogical opportunities. However, effective integration requires addressing challenges related to infrastructure, accessibility, and cultural relevance. By leveraging Virtual technologies strategically and aligning them with educational objectives, Nigerian Teacher Education Programme Institutions can harness the transformative power of these technologies to enrich teaching and learning experiences. Further research and empirical studies specific to the Nigerian context are needed to better understand the effectiveness of Virtual in enhancing hands-on learning.

RECOMMENDATION

These recommendations, Teacher Education Programme Institutions can effectively leverage Virtual technologies to enhance hands-on learning experiences and promote skill development among students. These strategies can contribute to creating immersive, engaging, and transformative learning environments that prepare students for success in their future careers. Based on the review of enhancing hands-on learning through Virtual Learning Environment (VLE) technologies such as Augmented Reality (AR) and Virtual Reality (VR) for skill development in Teacher Education Programme Institutions, the following recommendations can be made:

- Continued research and development in Virtual technologies tailored to the specific needs and contexts of Nigerian Teacher Education Programme Institutions are essential
- Collaboration between educational institutions, government agencies, and technology providers can facilitate the sharing of resources and expertise in implementing Virtual initiatives
- Evaluation and assessment of Virtual applications should be conducted to measure their impact on student learning outcomes and identify areas for improvement

Provide comprehensive training Programme for faculty members to familiarize them with Virtual technologies and their integration into teaching practices. This training should encompass both technical skills and pedagogical approaches.

Teacher Education Programme Institutions should invest in the necessary technological infrastructure to support Virtual implementations. This includes ensuring access to VR devices, AR applications, and adequate internet connectivity.

Integrate Virtual experiences into the curriculum across various subjects and disciplines. Ensure alignment with

learning objectives and outcomes to enhance student engagement and understanding.

Promote active learning pedagogies that leverage Virtual technologies to engage students in hands-on, experiential learning activities. Encourage exploration, experimentation, and problem-solving within virtual environments.

Foster collaborative learning experiences by incorporating Virtual technologies into group projects and assignments. Encourage teamwork, communication, and peer learning within virtual environments.

Design Virtual activities that incorporate multimodal elements, such as visuals, audio, and interactive simulations, to cater to diverse learning styles and preferences.

Develop assessment strategies that measure student learning outcomes effectively within Virtual environments. Provide timely feedback to guide student progress and encourage reflection on their learning experiences.

Encourage research and evaluation initiatives to assess the effectiveness of Virtual integration in enhancing hands-on learning and skill development. Gather feedback from students and faculty to inform continuous improvement efforts.

Address barriers to access and equity by ensuring equitable access to Virtual technologies for all students, regardless of socio-economic background or geographical location. Explore strategies to mitigate issues related to cost, infrastructure, and technological literacy.

Emphasize the importance of ethical considerations in the use of Virtual technologies, including data privacy, digital citizenship, and responsible use. Develop guidelines and best practices to ensure ethical use of these technologies in educational settings.

Implication of the studies

The integration of Virtual technologies holds immense potential for transforming teaching and learning in educational settings. However, challenges such as access barriers, technological limitations, and the need for faculty development persist. Future research should focus on longitudinal studies evaluating the long-term impact of Virtual integration on student learning outcomes, as well as exploring innovative pedagogical approaches that leverage these technologies to their fullest potential. Effective integration of Virtual technologies in educational settings requires pedagogical strategies that prioritize active learning, curriculum alignment, multimodal experiences, and collaborative learning. By adopting evidence-based practices and addressing challenges through on-going research and professional development, educators can harness the transformative power of Virtual to enhance teaching and learning outcomes in the digital age.

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