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# EVALUATION OF THE CHALLENGES OF THE ADOPTION OF VIRTUAL REALITY TECHNOLOGY IN RADIOGRAPHY TRAINING IN SOME SELECTED SCHOOLS IN THE SOUTHEAST, NIGERIA.

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## ABSTRACT

**Background:** Radiography, being inherently reliant on visual interpretation and precise procedural skills benefit significantly from the immersive and interactive capabilities of Virtual Reality (VR), as this technology provides a platform for an enhanced understanding of radiographic procedures and positioning, offering a realistic and risk-free environment for learning and practice.

**Objectives:** This study aimed to evaluate the challenges associated with implementing virtual reality technology in radiography training and education in selected schools in the southeast region.

**Materials and Methods:** A cross-sectional survey design was adopted which included 14 respondents involved in radiography training and education across four universities in the south-east, Nigeria. The instrument used for data collection in this study was a comprehensive online questionnaire. The questionnaire measured the demographic information of the respondents, level of adoption and implementation of VR in their institutions, challenges in VR adoption, strategies, and solutions to these challenges. These questions were tested for internal consistency using Cronbach's alpha reliability test and a coefficient value of 0.562 got.

**Results:** The results of this study showed that financial constraints (n=8, 57%) and lack of technical support or expertise (n=8, 57%) are major challenges in adopting VR technology in radiography education and training. Seven respondents (50%) agreed that technical difficulties are another major challenge in adopting VR technology in radiography education and training. Challenges of virtual reality technology were believed to have an overall negative impact on the adoption of virtual reality technology in radiography instruction and training (n=10, 71%). The study also indicated how these challenges affected the efficacy and standard of radiography education, with 10 respondents (71%) claiming these challenges to be detrimental.

**Conclusion:** The adoption of Virtual Reality (VR) technology in radiography training and education faces significant challenges in southeast, Nigeria.

**Keywords:** Virtual, Reality, Technology, Radiography, Training.

## Introduction

The advent of simulated reality technologies, notably Augmented Reality (AR) and Virtual Reality (VR), marks a significant milestone in the evolution of interactive digital environments. They have found use in entertainment, gaming[1], education[2], and sports[3] because they have not only improved user engagement but also transformed conventional approaches. The integration of VR technology into educational settings has attracted significant attention due to its ability to enhance learning experiences and outcomes. Recent studies highlight the transformative impact of VR on medical education, demonstrating its effectiveness in improving clinical skills and knowledge retention[4,5].

Radiography, being a field that relies on visual interpretation and precise techniques and positioning, benefits from the immersive and interactive functions of AR and VR[6]. They serve as a tool for better understanding of radiographic techniques and procedures thereby offering a safe and risk-free environment for learning and practice while also keeping the students more interested. With the realistic simulations of radiography procedures that virtual reality offers, teachers can improve their teaching experience without the hazards involved in direct patient engagement. According to a study, virtual reality (VR) can enhance learning outcomes by enabling students to practice skills frequently, which improves retention and skill development[7].

Radiography training is inherently hands-on, requiring students to develop precise technical skills and a deep understanding of anatomy, imaging techniques, and patient care. Traditional methods of training, which rely heavily on physical resources like cadavers, phantoms, and direct patient interactions, are increasingly complemented by technology-based solutions. VR provides a unique opportunity to create simulated environments where students can practice radiographic procedures in a risk-free setting, allowing for repeated exposure and mastery of skills. This can be particularly beneficial in radiography, where accuracy and safety are paramount[7]. As the healthcare industry rapidly evolves, there is a growing demand for radiographers who are not only proficient in traditional techniques but also adept at using advanced technology. VR has emerged as a powerful educational tool that can bridge the gap between theoretical knowledge and practical application. However, while these advancements are well-documented in various global contexts, there seems to be a notable absence of research addressing the specific challenges faced by institutions in the Southeast region of Nigeria.

Previous researches have explored the broader aspects of VR adoption in educational settings, emphasizing technological benefits and pedagogical improvements[8,9]. Additionally, studies have highlighted barriers to VR adoption, including financial constraints, technological infrastructure, and resistance to change[10, 11]. The integration of VR into educational programs, particularly in radiography, also presents a complex set of challenges that must be thoroughly examined to ensure successful implementation[6,12]. Unfortunately, there is a critical lack of localized studies examining the unique challenges faced by Nigerian educational institutions, particularly those in the Southeast region.

This study, therefore, aimed to bridge this gap by evaluating the exact challenges encountered by selected schools in the Southeast of Nigeria when adopting VR technology for radiography training. By conducting a detailed assessment of these challenges, this work sought to contribute valuable insights to the educational technology field. The findings may guide policymakers, educators, and technology developers about regional barriers and provide practical suggestions for enhancing the adoption and implementation of VR in radiography education. Addressing this research gap is essential for advancing technological integration in Nigerian educational institutions and ensuring that they be positioned to benefit from the innovative potential of VR.

## Methods:

A prospective, cross-sectional study was carried out at four select academic institutions in the South-East, of Nigeria, where there was ongoing consideration or partial implementation of Virtual Reality technology for radiography teaching. Purposive sampling

technique was used to select a specific group of participants who are directly involved with the implementation of VR technology in radiography education within the chosen institutions in the southeast. We had 7 participants from Nnamdi Azikiwe University, Anambra State; 4 Participants from Evangel University, Ebonyi State; 2 Participants from Gregory University, Uturu, Abia State and 7 Participants from the University of Nigeria, Enugu Campus, Enugu State. This population is comprised of heads of the radiography department and other staff members from each of the selected institutions. The inclusion criteria were individuals directly involved in radiography education and training (lecturers and administrators), those who consented to participate in the study, technological or laboratory assistants who help implement and maintain VR technology within the radiography department, and Heads of departments (HODs) involved in decision-making about integrating VR technology in education. Staff or students from other departments not related to radiography and other individuals in the radiography department who are not involved in VR-based radiography education or training were excluded from this study. Data was collected through a comprehensive questionnaire made up of three sections labeled A to C and twelve questions in total. Section A was for the demographic information of the participants, section B was on the challenges in adopting VR technology and the impact of these challenges and section C was on the strategies and solutions to these challenges. These questions were tested for internal consistency using Cronbach's alpha reliability test and a coefficient value of 0.562 was obtained. The data was analyzed with version 25.0 of the Statistical Package for Social Sciences (SPSS), with a 0.05 significant level of error (α-level). The results were presented using descriptive statistics like mean, standard deviation, frequency distribution, and percentage. Satisfaction levels were displayed using bar charts with 'agree' and 'strongly agree' lumped together as positive responses while 'neutral', 'disagree', and 'strongly disagree' were lumped together as negative responses.

**Results:**

A total of 20 questionnaires were distributed, and responses were received from 14 participants, representing a response rate of 70%. Most respondents (86%) were lecturers (n=12), with 36% having 6-10 years of experience in radiography education (n=5) at the time of this study.

The findings revealed as shown in Table 1, that financial constraints and the lack of technical support or expertise were highlighted by 57% of respondents (n=8) as major challenges to the adoption of VR technology in radiography education. Additionally, technical difficulties were seen as a critical issue impeding VR integration, with 50% of respondents (n=7) identifying it as a major challenge. Interestingly, resistance to change among staff or students was not seen as a major challenge, with 71% (n=10) disagreeing with this notion. Similarly, 79% of respondents (n=11) did not consider the integration of VR into the existing curriculum a key challenge. Our results further showed that 79% of respondents (n=11) agreed that these challenges have significantly delayed the VR implementation process. More than half (57%, n=8) indicated that these challenges have led to downsizing the initial VR implementation plans. Additionally, 50% (n=7) agreed that the challenges necessitated additional staff training, and 79% (n=11) noted that external technical support or partnerships had to be sought to address these issues. Moreover, 71% (n=10) agreed that these challenges have diminished the effectiveness of VR technology in enhancing learning outcomes, and 86% (n=12) believed that these issues have limited the accessibility of VR technology for all students. Despite these challenges, only 29% (n=4) of respondents felt that they affected the motivation of staff to integrate VR into their teaching, and the same proportion noted that these challenges led to modifications in evaluation and assessment methods (Fig. I). Overall, 71% (n=10) of respondents believed that the challenges had a negative impact on the adoption of VR technology in radiography education and training, while 28% (n=4) felt the challenges had no significant impact. Notably, no respondents believed that these challenges had a

positive impact on the effectiveness and quality of radiography training (Fig. II). The respondents proposed several solutions to overcome these challenges, including increased financial support for purchasing VR equipment and software (n=13), investment in technical training for both staff and students (n=10), and technical support for maintaining and troubleshooting VR equipment (n=10). Additional suggestions included administrative and leadership support for VR initiatives, training programs for educators on using VR in teaching and securing additional funding or resources for VR technology (Table 2)

Table 1: Key challenges in adopting VR technology in radiography training and education (n = 14)

| Variable | Strongly agree (%) | Agree (%) | Neutral (%) | Disagree (%) | Strongly disagree (%) | Mean±SD |
|---|---|---|---|---|---|---|
| Technical difficulties | 0 (0.0) | 7 (50.0) | 1 (7.1) | 4 (28.6) | 2 (14.3) | 2.93±1.21 |
| Financial constraints | 4 (28.6) | 4 (28.6) | 4 (28.6) | 1 (7.1) | 1 (7.1) | 3.64±1.22 |
| Lack of technical support or expertise | 3 (21.4) | 5 (35.7) | 2 (14.3) | 4 (28.6) | 0 (0.0) | 3.50±1.16 |
| Resistance to change among staff or students | 2 (14.3) | 2 (14.3) | 1 (7.1) | 2 (14.3) | 7 (50.0) | 2.29±1.59 |
| Integration into existing curriculum | 1 (7.1) | 2 (14.3) | 3 (21.4) | 2 (14.3) | 6 (42.9) | 2.29±1.34 |

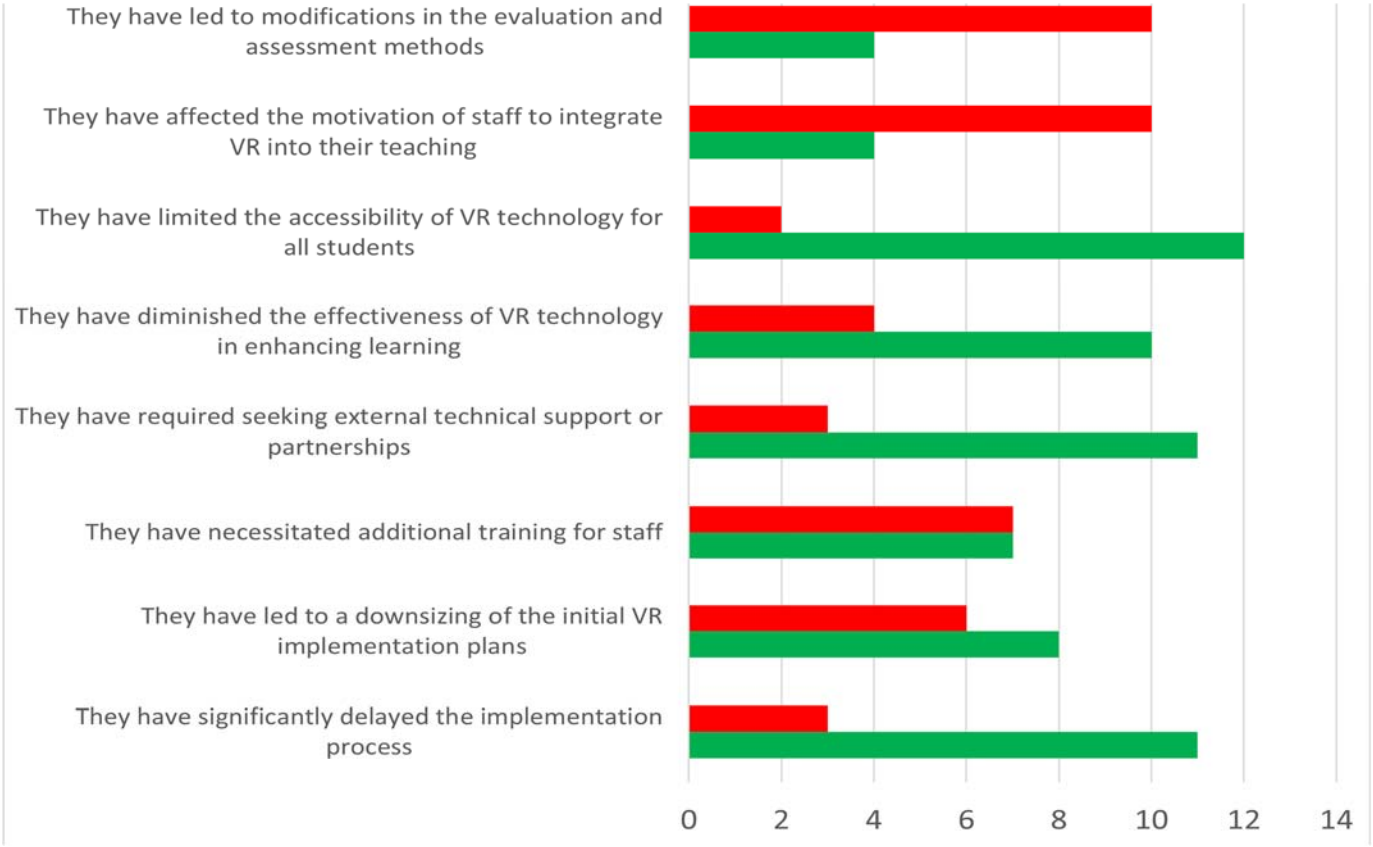


Figure 1: Impact of the challenges on the effectiveness and quality of radiography training (n = 14)

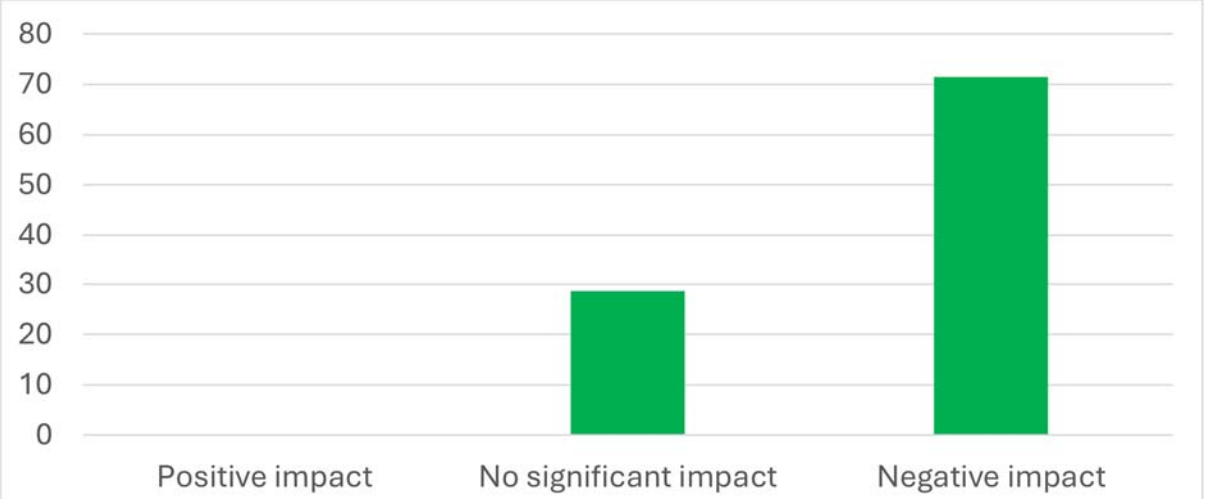


Figure 2: Evaluation of the impact of the challenges on the effectiveness and quality of radiography training (n = 14)

Table 2: Potential strategies to overcome the challenges (n = 14)

| Variable | Freq.(n) | Percentage |
|---|---|---|
| Investment in technical training for staff and students | 10 | 71.4 |
| Securing additional funding or resources for VR technology | 9 | 64.3 |
| Developing partnerships with VR technology providers | 3 | 21.4 |
| Integrating VR technology into the curriculum in phased stages | 1 | 7.1 |
| Conducting workshops to demonstrate the value and use of VR in education | 2 | 14.3 |
| Seeking feedback from staff and students to guide implementation | 2 | 14.3 |
| Financial support for purchasing VR equipment and software | 13 | 92.9 |
| Training programs for educators on using VR in teaching | 9 | 64.3 |
| Technical support for maintaining and troubleshooting VR equipment | 10 | 71.4 |
| Guidance on integrating VR technology into existing curricula | 2 | 14.3 |
| Research and evidence on the effectiveness of VR in radiography education | 2 | 14.3 |
| Support from administration and leadership for VR initiatives | 9 | 64.3 |

**Discussion:**

The findings of this study draw attention to several critical challenges in the adoption of Virtual Reality (VR) technology in radiography training within selected schools in Southeast Nigeria. The prominent issues identified, such as financial constraints, lack of technical support or expertise, and technical difficulties, all align with challenges described in related studies conducted in other contexts.

Financial limitations emerged as a major barrier to VR adoption, with 57% of respondents identifying it as a key impediment. This finding resonates with the work of Schuster et al.11, who argued that the high cost of VR equipment and the ongoing expenses related to software updates and maintenance often deter institutions from adopting this technology. The financial burden is particularly pronounced in developing regions, where educational budgets are typically constrained. Chen et al.[5] also emphasized that without adequate funding, even the most innovative technologies cannot be sustainably integrated into educational frameworks. However, in contrast, some studies have suggested that initial financial outlays can be offset by long-term educational benefits and cost savings from reduced need for physical training materials[4].

The lack of technical support or expertise, as identified by 57% of the respondents, underscores the need for

specialized training and ongoing support to effectively implement VR technology. This finding is consistent with the conclusions drawn by Harris et al.[10], who reported that educators struggle to utilize VR tools to their full potential, when there is no proper training and that in turn could diminish the effectiveness of these technologies. The importance of continuous professional development in the use of emerging technologies was also highlighted by Rizzo and Koenig[13], who argued that investment in training is as crucial as investment in technology itself.

Half of the respondents (50%) in this study cited technical difficulties as another major barrier to VR adoption. This is consistent with findings from Harris et al.[10], who identified technical complexities, such as hardware and software compatibility issues, as significant obstacles in implementing VR technology in educational institutions. Similarly, Anderson and Bower[8] noted that the steep learning curve associated with VR technology often hampers its integration into academic curricula. However, contrary to these findings, Rizzo and Koenig[13] reported that in well-resourced institutions, technical challenges were less of an issue due to robust IT support and infrastructure, suggesting that the degree of technical difficulties may be dependent on institutional resources and expertise.

Interestingly, the study found that a majority of respondents (71%) did not perceive resistance to change among staff or students as a major challenge. This contrasts with findings from Anderson and Bower 8, who noted that resistance to new technologies is usually a major barrier in educational settings. However, it is possible that in the context of this study, there is already an existing positive disposition towards technological innovations among the departments and students, which may have mitigated the usual resistance observed in other studies. Alternatively, this could reflect a recognition of the potential benefits of VR, which may outweigh the discomfort associated with adopting new methods.

Another notable finding is that 79% of respondents did not view the integration of VR into the existing curriculum as a key challenge. This is surprising, given that many studies, such as Schuster et al.[11], have highlighted curriculum integration as a significant hurdle. It is possible that the schools in this study have more flexible curricula, allowing for easier incorporation of new technologies, or that there is a strong institutional commitment to adopting innovative teaching methods, which facilitate smoother integration. With the recent the move by the National Universities Commission (NUC), to implement the Core Curriculum Minimum Academic Standards (CCMAS) in the Nigerian university system, different departments may have made room for incorporation of VR in their curricula.

The study found that the identified challenges have significantly delayed the VR implementation process and diminished its effectiveness in enhancing learning, as agreed upon by 71% of the respondents. This finding is in line with Hollins et al.[4], who noted that when significant barriers are not addressed early in the adoption process, it will most definitely result in delays in implementation and diminished effectiveness. Moreover, 86% of respondents agreed that these challenges limited the accessibility of VR for all students, which further underscores the need for comprehensive strategies to address these barriers to ensure unbiased access to educational technology.

The respondents proposed several solutions to overcome these challenges, including financial support, investment in technical training, and securing external technical partnerships. These recommendations are consistent with the strategies suggested by Harris et al.[10] and Chen et al.[5], who emphasized the importance of financial investment and continuous professional development in the successful adoption of VR technology in educational settings.

Most respondents (71%) believed that the challenges associated with VR adoption had an overall negative impact on its implementation in radiography training. This is in line with previous studies that have documented the prolonged effects of unresolved challenges on the successful integration of educational technologies[11]. The absence of any respondents who thought these difficulties had a positive effect pinpoints the urgent need for focused actions to address the obstacles preventing VR adoption.

The study encountered some limitations that could have influenced the findings. One of the primary challenges was the small sample size. This was largely because only a few Nigerian universities are yet exploring the adoption of VR technology in radiography education at the time of the study. As a result, the scope of data collected was limited, which may impact on the generalizability of the study's conclusions to a broader context. Additionally, the study encountered issues with participant engagement. Many of the potential respondents were reluctant to complete the questionnaire, primarily due to their demanding work schedules during the study period. Those who participated may not fully represent the wider population of radiography educators.

**Conclusion**: The results of this study highlight the various obstacles that Southeast Nigerian radiography schools encounter while implementing virtual reality technology. Although these problems are not exclusive to the area, local elements such as lack of funding and technical expertise make them worse. To fully realize VR technology's promise in improving radiography education, it is imperative to address these barriers through strategic partnership creation, training investment, and targeted financial support. To evaluate the long-term effects of these treatments on VR uptake and educational results, future research should concentrate on longitudinal studies.

**Declaration of conflict of interest**

None.

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