



Enhancing Pre-service Teacher Training Through Virtual Reality: Addressing Inclusivity and Classroom Challenges

Pacifique Nkundabanzi
University of Kigali, Rwanda
Email: pacifnk1@gmail.com

Abstract: *Preservice teacher training in Rwanda faces persistent challenges in adequately preparing teachers to manage inclusive classrooms characterized by diverse learner needs, including students with disabilities and behavioral difficulties. This study examines the potential of Virtual Reality (VR) as an innovative tool to enhance preservice teacher preparedness for inclusive education. Adopting a mixed-methods research design, the study was conducted in Musanze District and involved 200 preservice teachers through structured questionnaires and 50 participants through semi-structured interviews. Quantitative data were analyzed using descriptive and inferential statistics, including t-tests, chi-square, and regression analysis, while qualitative data were analyzed thematically. The findings reveal that preservice teachers demonstrate moderate theoretical understanding of inclusive education but exhibit significantly low practical readiness ($M = 2.86, p < .001$). Key challenges identified include classroom behavior management (78%) and addressing diverse learning needs (72%). The introduction of VR-based simulations resulted in a statistically significant improvement in teacher preparedness ($M = 4.40, p < .001$). Regression analysis further identified VR exposure as the strongest predictor of teacher readiness ($\beta = 0.52, p < .001$), explaining 61% of the variance. The study concludes that VR provides immersive, safe, and repeatable learning environments that effectively bridge the gap between theory and practice in teacher education. It recommends the integration of VR into teacher training curricula, investment in digital infrastructure, and capacity building for educators. This research contributes empirical evidence from a developing country context, highlighting the transformative potential of VR in advancing inclusive and equitable education.*

Keywords: *Virtual Reality, Preservice Teacher Training, Inclusive Education, Classroom Management, Challenges*

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1. Introduction

Education systems globally are increasingly required to deliver inclusive, equitable, and high-quality learning experiences that respond to diverse learner needs, including students with disabilities, behavioral challenges, and varying learning abilities. This imperative is strongly emphasized by the UNESCO Sustainable Development Goal 4 (SDG 4), which advocates for inclusive and

equitable quality education for all (UNESCO, 2020). Achieving this goal depends largely on the preparedness of teachers to implement inclusive pedagogies and effectively manage diverse classrooms.

In Rwanda, considerable progress has been made in expanding access to education and strengthening teacher education systems through national reforms such as the Education Sector Strategic Plan (ESSP) and Vision 2050.

Despite these efforts, challenges persist in preparing preservice teachers to effectively address inclusive education demands and classroom complexities (MINEDUC, 2022). Traditional teacher training models primarily emphasize theoretical instruction, supplemented by short-term teaching practice placements, which may not sufficiently expose trainees to the full spectrum of real classroom challenges, particularly those involving learners with special educational needs and behavioral difficulties (Ndayambaje & Orodho, 2021).

Preservice teacher education is expected to equip future educators with both pedagogical knowledge and practical competencies through experiential learning. However, evidence suggests that many preservice teachers enter the profession with limited confidence and preparedness to manage inclusive classrooms (Darling-Hammond et al., 2020). Internship experiences, while valuable, are often constrained by time, context variability, and limited opportunities to encounter diverse or complex classroom situations. This creates a gap between theoretical knowledge and real-world application, particularly in inclusive education contexts.

Emerging technologies, such as Virtual Reality (VR), offer promising opportunities to address these limitations. VR enables the creation of immersive, interactive, and controlled learning environments where preservice teachers can practice teaching skills and classroom management strategies without the risks associated with real classrooms (Radianti et al., 2020). Through simulated scenarios, trainees can engage with diverse learner profiles, including students with special needs, and develop adaptive teaching strategies. Studies indicate that VR-based training enhances teacher confidence, reflective practice, and preparedness for classroom challenges (Makransky & Petersen, 2021; Lindner et al., 2022). However, the application of VR in teacher education remains limited in developing contexts, including Rwanda, where empirical evidence on its effectiveness is still scarce.

Despite Rwanda's strong commitment to inclusive education and teacher professional development, preservice teacher training programs remain insufficiently equipped to prepare teachers for the realities of inclusive classrooms. Existing training approaches rely heavily on theoretical instruction and limited teaching practice, which do not adequately expose preservice teachers to diverse learner needs, including students with disabilities, learning difficulties, and behavioral challenges. As a result, many newly trained teachers enter the profession lacking the confidence, practical skills, and adaptive strategies required to effectively manage inclusive classroom environments.

Furthermore, while global evidence highlights the potential of innovative technologies such as Virtual Reality to enhance experiential learning in teacher education, there is limited integration and empirical validation of such technologies within the Rwandan context. The absence of immersive, practice-based training tools creates a critical gap in teacher preparation, particularly in bridging the divide between theory and practice in inclusive education.

This gap raises a fundamental question: How can preservice teacher training in Rwanda be enhanced to better prepare teachers for inclusive and complex classroom environments? Addressing this challenge is essential for improving teaching effectiveness, learner outcomes, and the overall quality of education.

In response to this problem, this study investigates the integration of Virtual Reality (VR) into preservice teacher training programs, with a focus on enhancing inclusivity and classroom management competencies. By examining the experiences of preservice teachers in Musanze District and evaluating the potential of VR-based simulations, the study aims to provide evidence-based recommendations for strengthening teacher education in Rwanda. Ultimately, the research contributes to advancing technology-enhanced, inclusive, and future-ready education systems.

2. Literature Review

2.1 Concept of Inclusive Education in Teacher Training

Inclusive education refers to the process of ensuring that all learners, regardless of their abilities, disabilities, or socio-economic backgrounds, have access to equitable and quality education within mainstream classrooms. Globally, inclusive education has gained prominence as a fundamental human right and a cornerstone of education systems, particularly under frameworks promoted by UNESCO (UNESCO, 2020).

Teacher preparedness is a critical determinant of successful inclusive education implementation. Studies indicate that teachers often lack adequate skills, confidence, and pedagogical strategies to address diverse learner needs, particularly in developing countries (Ndayambaje & Orodho, 2021). Effective inclusive teaching requires competencies such as differentiated instruction, adaptive assessment, classroom management, and socio-emotional support.

However, traditional teacher training programs tend to emphasize theoretical knowledge with limited exposure to real inclusive classroom scenarios. As a result, preservice teachers frequently report feeling underprepared to manage

classrooms with diverse learning needs. This challenge underscores the need for innovative training approaches that simulate inclusive teaching environments and foster practical skills development.

2.2 Preservice Teacher Training and Experiential Learning

Preservice teacher education aims to equip future educators with both theoretical knowledge and practical teaching competencies. Experiential learning, which emphasizes learning through experience and reflection, is widely recognized as essential in teacher preparation (Darling-Hammond et al., 2020).

Teaching practice and internships are key components of experiential learning. However, research shows that these experiences are often limited in scope and inconsistent in quality, particularly in exposing trainees to diverse and complex classroom situations. For example, preservice teachers may not encounter learners with disabilities or behavioral challenges during their placements, leading to gaps in preparedness.

Moreover, variability in school environments, mentorship quality, and duration of internships can further limit the effectiveness of traditional training models. These constraints highlight the need for supplementary training methods that can provide standardized, repeatable, and diverse teaching experiences.

Emerging pedagogical approaches emphasize the integration of technology to enhance experiential learning. Simulation-based training, in particular, has been identified as a powerful tool for bridging the gap between theory and practice in teacher education.

2.3 Virtual Reality in Education

Virtual Reality (VR) is an advanced digital technology that creates immersive, interactive, and computer-generated environments, allowing users to experience simulated real-world scenarios. In education, VR is increasingly recognized as a transformative tool that enhances engagement, understanding, and skill acquisition.

Recent studies show that VR enables learners to interact with complex environments in ways that traditional teaching methods cannot replicate. For example, immersive VR environments allow users to visualize abstract concepts, engage in experiential learning, and practice real-life tasks in a controlled setting (Radianti et al., 2020).

In teacher education, VR is particularly valuable because it allows preservice teachers to experience realistic

classroom situations without the risks associated with actual teaching environments. According to recent research, immersive VR enables student teachers to confront authentic classroom challenges and practice teaching strategies in simulated settings.

Furthermore, VR supports active learning by engaging in multiple senses and promoting deeper cognitive processing. This aligns with constructivist learning theories, which emphasize learner engagement, interaction, and contextualized knowledge construction.

2.4 Virtual Reality in Teacher Training

The integration of VR into teacher education has gained increasing attention as a means of enhancing professional competencies. VR-based simulations provide preservice teachers with opportunities to practice classroom management, instructional strategies, and decision-making in realistic scenarios.

Studies indicate that VR enhances teacher confidence, reflective practice, and preparedness. For instance, immersive simulations allow preservice teachers to repeatedly practice handling challenging classroom situations, such as disruptive behavior or diverse learner needs, which may not be consistently available during traditional internships.

Recent evidence highlights that VR can complement teaching practice by offering exposure to a wide range of classroom contexts. For example, shared VR environments enable preservice teachers to observe and analyze teaching practices collaboratively, improving their ability to recognize effective instructional strategies and inclusive practices.

Additionally, VR supports safe failure and iterative learning, allowing trainees to make mistakes, receive feedback, and improve their performance without negative consequences. This iterative learning process is critical for developing teaching competence and confidence.

2.5 Virtual Reality for Inclusive Education

Virtual Reality has significant potential to enhance inclusive education by providing personalized and adaptive learning experiences. VR environments can simulate diverse classroom scenarios, including interactions with students with disabilities, learning difficulties, and behavioral challenges.

Research indicates that VR can support inclusive education by enabling teachers to develop empathy, understanding, and practical skills for addressing diverse learner needs.

For example, VR simulations can expose teachers to scenarios involving students with autism, hearing impairments, or behavioral disorders, helping them practice appropriate teaching strategies.

Moreover, VR supports “inclusivity by design”, where learning environments are tailored to accommodate different learner needs through features such as multimodal content, adjustable interfaces, and accessibility tools. These features ensure that VR-based training aligns with the principles of inclusive education.

Studies also show that VR enhances learner engagement, motivation, and participation, particularly for students with special needs. It provides a safe and controlled environment where learners can interact without fear of failure or stigma. Furthermore, VR facilitates personalized learning by allowing users to progress at their own pace and receive immediate feedback.

Despite these benefits, challenges remain in implementing VR for inclusive education. These include high costs, limited infrastructure, insufficient teacher training, and technical constraints, particularly in resource-limited contexts. Addressing these challenges is essential for the successful integration of VR in teacher training programs.

2.6 Challenges and Opportunities of VR Integration in Developing Contexts

The adoption of VR in education, particularly in developing countries such as Rwanda, presents both opportunities and challenges. On one hand, VR offers the potential to transform teacher training by providing scalable, standardized, and immersive learning experiences.

On the other hand, several barriers hinder its widespread implementation. Key challenges include:

- Limited access to VR equipment and infrastructure
- High costs of hardware and software
- Lack of technical expertise among educators
- Inadequate policy frameworks and institutional support

Studies conducted in resource-limited contexts reveal that while preservice teachers perceive VR as an engaging and effective learning tool, concerns about accessibility, cost, and sustainability remain significant barriers to adoption (Nyaaba et al., 2024).

However, ongoing advancements in technology, including affordable VR devices and mobile-based VR solutions, are gradually reducing these barriers. Additionally, national

digital transformation initiatives, such as those implemented by the Rwanda Basic Education Board, create a favorable environment for integrating innovative technologies into education systems.

2.7 Research Gap

Although existing literature highlights the potential of VR in enhancing teacher education and inclusive practices, several gaps remain. First, most studies have been conducted in developed countries, with limited empirical research in African contexts, including Rwanda. Second, there is insufficient evidence on how VR can be effectively integrated into preservice teacher training programs to address specific challenges of inclusive education.

Furthermore, while previous research has explored the general benefits of VR, there is a lack of context-specific studies examining its impact on teacher preparedness, classroom management, and inclusivity within Rwandan education systems. This study seeks to address these gaps by providing empirical evidence on the role of VR in enhancing preservice teacher training in Musanze District.

3. Methodology

3.1 Research Design

This study adopted a mixed-methods research design, combining both quantitative and qualitative approaches to provide a comprehensive understanding of how Virtual Reality (VR) can enhance preservice teacher training for inclusive education. The mixed-methods approach was selected to enable triangulation of findings, ensuring both breadth (through surveys) and depth (through interviews) in examining preservice teachers’ experiences and perceptions (Creswell & Plano Clark, 2018).

3.2 Study Area and Population

The study was conducted in Musanze District, Rwanda, selected due to its active teacher training institutions and diverse school environments. The target population included preservice teachers, teacher trainers, and education administrators involved in teacher education programs.

The study focused primarily on preservice teachers at different stages of training, including those currently undergoing training and those who had recently completed their teaching internships.

3.3 Sampling Techniques and Sample Size

A combination of purposive and stratified random sampling techniques was used. Purposive sampling was applied to select key informants (teacher trainers and administrators), while stratified random sampling ensured representation of preservice teachers across different training levels.

The sample comprised:

- 200 preservice teachers (quantitative survey)
- 50 preservice teachers who had completed internships (qualitative interviews)

This sample size was considered adequate to generate statistically meaningful results while allowing in-depth qualitative insights.

3.4 Data Collection Methods

Data were collected using two main instruments:

Structured Questionnaires

Administered to 200 preservice teachers, the questionnaire captured quantitative data on:

- Preparedness for inclusive teaching
- Classroom management challenges
- Perceptions of VR-based training

Semi-Structured Interviews

Conducted with 50 preservice teachers, interviews explored:

- Experiences during teaching practice
- Challenges faced in inclusive classrooms
- Perceived usefulness of VR simulations

The combination of these tools enabled a comprehensive assessment of both experiences and measurable outcomes.

3.5 Data Analysis

Quantitative data were analyzed using descriptive and inferential statistics, including frequencies, percentages, and mean scores, to identify trends in teacher preparedness and perceptions of VR.

Qualitative data from interviews were analyzed using thematic analysis, where responses were coded and categorized into key themes such as inclusivity challenges, classroom management, and perceived benefits of VR. This approach facilitated the identification of recurring patterns and deeper insights into participants' experiences (Braun & Clarke, 2021).

3.6 Validity and Reliability

To ensure validity, the research instruments were reviewed by experts in education and educational technology. A pilot study was conducted to refine the questionnaire and interview guide.

Reliability of quantitative data was ensured using internal consistency measures, while qualitative credibility was enhanced through triangulation of data sources and member checking.

3.7 Ethical Considerations

Ethical approval was obtained from relevant authorities. Participants were informed about the purpose of the study and provided informed consent prior to participation. Confidentiality and anonymity were strictly maintained, and participants were assured that their responses would be used solely for academic purposes.

4. Results and Discussion

4.1 Introduction

This section presents both descriptive and inferential findings on preservice teachers' readiness, classroom challenges, and the effectiveness of Virtual Reality (VR) in enhancing inclusive teaching competencies. Quantitative results are complemented by qualitative insights, and statistical tests are used to establish the significance of relationships among variables.

4.2 Preservice Teachers' Readiness for Inclusive Education

Table 1: Descriptive Statistics of Preservice Teachers' Readiness (n=200)

Indicator	Mean	Std. Dev.
Understanding of inclusive education principles	3.4	0.8
Ability to adapt teaching strategies	2.9	0.9
Confidence in managing diverse classrooms	2.7	1.0
Skills in supporting learners with disabilities	2.5	0.9
Behavior management skills	2.8	0.8
Overall Mean Score	2.86	—

A one-sample t-test comparing the overall readiness mean (2.86) to a benchmark of 3.5 (expected competency level) showed a statistically significant difference:

- $t(199) = -9.42, p < .001$

The results confirm that preservice teachers' readiness is significantly below the expected competency level,

indicating insufficient preparation for inclusive teaching. While theoretical understanding is moderate, practical competencies remain weak.

4.3 Classroom Challenges During Teaching Practice

Table 2: Classroom Challenges Experienced (n=200)

Challenge Category	Frequency	Percentage (%)
Behavioral management issues	156	78%
Diverse learning needs	144	72%
Lack of inclusive resources	130	65%
Large class sizes	120	60%
Limited mentorship	108	54%

A Chi-square test of independence was conducted to examine the relationship between training level (early vs advanced stage) and experience of classroom challenges:

- $\chi^2(4, N = 200) = 18.67, p = .001$

The significant chi-square result indicates that experience of classroom challenges varies by training level, with less

experienced preservice teachers reporting higher difficulty levels. This suggests that exposure alone is insufficient without structured and guided experiential learning.

4.4 Effectiveness of Virtual Reality in Teacher Training

Table 3: VR Training Outcomes (n=200)

VR Training Outcome	Mean	Std. Dev.
Improved classroom management skills	4.3	0.7
Enhanced inclusive teaching understanding	4.4	0.6
Increased teaching confidence	4.5	0.6
Ability to handle diverse learners	4.2	0.7
Engagement and motivation	4.6	0.5
Overall Mean Score	4.40	—

A paired-sample t-test comparing pre-training (Mean = 2.86) and post-VR training scores (Mean = 4.40) revealed:

- $t(199) = 21.35, p < .001$

The results indicate a statistically significant improvement in teacher preparedness following VR exposure. The large

t-value suggests a strong effect size, confirming that VR substantially enhances both confidence and practical competencies.

4.5 Regression Analysis: Predictors of Teacher Preparedness

Table 4: Multiple Regression Analysis Predicting Teacher Preparedness

Predictor Variable	Beta (β)	Std. Error	p-value
VR Exposure Level	0.52	0.06	< .001
Internship Experience Quality	0.28	0.07	.002
Access to Teaching Resources	0.19	0.05	.010
Training Duration	0.11	0.06	.082

- $R^2 = 0.61, F(4,195) = 76.45, p < .001$

The regression model explains 61% of the variance in teacher preparedness, indicating strong explanatory power. VR exposure emerges as the most significant predictor ($\beta = 0.52, p < .001$), suggesting that immersive training plays a critical role in enhancing teacher competencies.

Internship quality also significantly contributes, while training duration is not statistically significant, reinforcing the idea that quality of experience matters more than duration.

4.6 Comparative Analysis: Traditional vs VR Training

Table 5: Independent Samples t-test Comparison

Training Method	Mean Preparedness Score	Std. Dev.
Traditional Training	2.86	0.85
VR-Based Training	4.40	0.62

- $t(198) = 17.82, p < .001$

The significant difference confirms that VR-based training is substantially more effective than traditional approaches. The large mean difference highlights VR's role in bridging the theory-practice gap in teacher education.

4.7 Discussion of Findings

The findings provide strong empirical evidence that preservice teacher training in Rwanda is currently insufficient in preparing teachers for inclusive classrooms, particularly in practical competencies such as behavior management and supporting diverse learners. This aligns with previous research indicating gaps between theoretical training and classroom realities (Darling-Hammond et al., 2020).

The significant relationship between training level and classroom challenges suggests that experience alone does not guarantee preparedness, emphasizing the need for

structured and guided learning environments. This supports the argument that traditional internships are limited in scope and consistency.

The most important contribution of this study lies in demonstrating the statistically significant impact of Virtual Reality on teacher preparedness. The paired t-test and regression analysis confirm that VR is not only effective but also a primary predictor of improved teaching competencies. These findings are consistent with studies showing that immersive technologies enhance experiential learning, confidence, and skill acquisition (Makransky & Petersen, 2021; Radianti et al., 2020).

Furthermore, the regression results highlight that VR exposure has a stronger impact than traditional factors such as training duration, suggesting a paradigm shift in teacher education from time-based training to experience-based, technology-enhanced learning. From a policy perspective,

these findings support the integration of VR into teacher training curricula in Rwanda. However, successful implementation will require addressing infrastructural and capacity challenges, including access to VR equipment and training for educators.

This study contributes to the literature by providing robust statistical evidence from a developing country context, demonstrating that VR can play a transformative role in enhancing inclusive education.

5. Conclusion and Recommendations

5.1 Conclusion

This study examined the potential of Virtual Reality (VR) to enhance preservice teacher training in Rwanda, with a focus on improving inclusivity and classroom management competencies. The findings reveal that while preservice teachers demonstrate a moderate understanding of inclusive education principles, their practical readiness remains significantly below expected competency levels, particularly in adapting teaching strategies, managing diverse classrooms, and supporting learners with special needs. This gap highlights a critical limitation in traditional teacher training approaches, which rely heavily on theoretical instruction and limited teaching practice.

The study further established that preservice teachers face substantial challenges during internships, especially in managing student behavior and addressing diverse learning needs. These challenges are compounded by systemic constraints such as limited resources, large class sizes, and insufficient mentorship. The significant chi-square results confirm that these challenges vary across training levels, indicating that experience alone is insufficient to ensure preparedness without structured and guided learning environments.

Most importantly, the study provides strong empirical evidence on the effectiveness of VR-based training. The statistically significant improvements observed in the paired t-test ($p < .001$) and the regression analysis ($R^2 = 0.61$) demonstrate that VR is a powerful predictor of teacher preparedness, surpassing traditional training variables such as duration of training. VR-based simulations significantly enhance teacher confidence, engagement, and ability to manage inclusive classrooms by providing immersive, repeatable, and risk-free learning environments.

The study concludes that integrating VR into preservice teacher training has the potential to transform teacher education in Rwanda, bridging the gap between theory and

practice and fostering inclusive, learner-centered teaching. This contribution is particularly important in advancing Rwanda's education transformation agenda and achieving inclusive education goals aligned with global frameworks such as those promoted by UNESCO.

5.2 Recommendations

1. The Ministry of Education should formally integrate VR-based simulation training into preservice teacher education programs to complement traditional teaching practice. This will ensure standardized exposure to diverse classroom scenarios.
2. There is a need for strategic investment in VR infrastructure, including affordable VR devices and simulation software, particularly in teacher training institutions. Partnerships with organizations such as the Rwanda Basic Education Board and development partners can support this initiative.
3. Policymakers should develop clear frameworks and guidelines for the adoption and implementation of immersive technologies in education to ensure quality, scalability, and sustainability.
4. Teacher training institutions should provide continuous professional development for tutors and lecturers to effectively integrate VR into teaching and learning processes.
5. Institutions should adopt a blended approach that combines traditional internships with VR simulations, ensuring that preservice teachers benefit from both real-world and simulated experiences.
6. Future research should examine the long-term impact of VR training on teacher performance and student learning outcomes.
7. Studies should explore the economic feasibility and scalability of VR in resource-constrained environments.
8. Further research should investigate the integration of VR with Artificial Intelligence and learning analytics to enhance personalized teacher training.

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