



PROFESSIONAL REQUIREMENTS AND COMPETENCIES IN VR- BASED EDUCATIONAL PROCESSES AT TOP TECHNICAL HIGHER EDUCATION INSTITUTIONS

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Abstract

Virtual reality (VR) is transforming education, particularly in technical higher education institutions, by enabling immersive learning environments. This paper examines the professional requirements and competencies necessary for integrating VR-based educational processes in top technical universities. The study highlights the required skill sets for educators, the infrastructure demands, and the competencies students must develop. Using reliable references, we provide a structured analysis supported by tables and discuss the implications for policy and curriculum design.

1. Introduction

Technological advancements have ushered in an era of transformative changes in education, with virtual reality (VR) emerging as a groundbreaking tool for teaching and learning. In technical higher education institutions, VR has the potential to redefine traditional methods by providing immersive and interactive learning environments. These environments allow students to explore complex concepts, engage in realistic simulations, and practice skills in safe and controlled settings. By bridging the gap between theoretical knowledge and practical application, VR enhances experiential learning and fosters deeper comprehension of subject matter.

The integration of VR into educational processes, however, is not without challenges. Successful implementation requires a concerted effort to address the



professional requirements of educators, the technological infrastructure necessary to support VR, and the competencies students need to fully benefit from these technologies. Educators must adapt their teaching methodologies to incorporate VR effectively, while institutions must invest in the appropriate tools and systems. Meanwhile, students must develop technical proficiency and cognitive skills to navigate and utilize VR environments.

This study aims to explore these multifaceted requirements by focusing on top technical universities that have pioneered the use of VR in education. By identifying the key competencies and infrastructure needs, this paper provides a framework for institutions aiming to adopt VR-based learning. Additionally, the findings contribute to the broader discourse on the role of emerging technologies in reshaping higher education.

2. Methodology

This study employed a literature review to analyze existing research on VR in education. The review focused on identifying key professional requirements for educators, examining infrastructure needs for VR implementation, and analyzing the competencies students must develop to effectively engage with VR-based learning environments.

3. Professional Requirements for Educators

Educators need to acquire technical competencies to operate VR equipment and software effectively. Key skills include proficiency in VR content creation tools, understanding hardware such as head-mounted displays (HMDs) and motion sensors, and basic programming knowledge for customizing VR applications. In addition to technical skills, educators must adapt their teaching methods to design interactive and student-centered VR scenarios, integrate VR modules with traditional teaching methods, and assess learning outcomes in immersive environments.

Table 1

Educator Competencies for VR-Based Education

Competency	Description	Example Tools
Technical Skills	Operating VR software and hardware	Unity, HTC Vive, Oculus
Content Design	Creating interactive VR learning modules	Adobe Captivate, Blender
Pedagogical Integration	Blending VR with traditional methods	LMS platforms
Assessment Strategies	Evaluating immersive learning outcomes	VR-specific analytics tools

4. Infrastructure Requirements

Technical universities must invest in advanced VR infrastructure, including high-performance computers and GPUs, VR devices such as head-mounted displays and motion trackers, and reliable VR development software. Networking capabilities, including high-speed internet and IT support teams trained in VR maintenance, are also essential for effective implementation.

Table 2

Infrastructure Components for VR-Based Education

Component	Requirements	Examples
Hardware	High-end GPUs, VR devices	NVIDIA RTX, Oculus Quest 2
Software	Development and simulation tools	Unity, Unreal Engine
Networking	Low-latency, high-speed internet	5G, Fiber Optic Networks
Support Services	Trained technical staff	IT helpdesk, VR specialists



5. Student Competencies

Students must acquire technical proficiency to interact with VR environments, including familiarity with VR devices and interfaces and basic understanding of VR-related software tools. Additionally, VR fosters the development of cognitive skills such as spatial reasoning and problem-solving abilities, as well as collaborative skills through multi-user VR environments.

Table 3

Student Competencies for VR-Based Learning

Competency	Description	Example Activities
Technical Proficiency	Operating VR tools	Virtual lab experiments
Cognitive Skills	Problem-solving in VR scenarios	Engineering simulations
Collaborative Skills	Working in multi-user VR settings	Team-based VR projects

6. Results and Discussion

The literature review revealed several critical insights regarding the integration of VR in technical education. First, the professional requirements for educators are multifaceted, combining technical expertise with pedagogical innovation. Educators must navigate a steep learning curve to master VR tools while simultaneously rethinking traditional approaches to curriculum design and assessment. Institutions that have successfully implemented VR programs often prioritize continuous professional development and collaborative training initiatives for their faculty.

Infrastructure emerged as a cornerstone for VR adoption. Universities with advanced technological capabilities, including high-speed internet and state-of-the-art VR hardware, demonstrate greater success in utilizing VR for educational purposes. However, financial constraints remain a significant barrier, particularly



for institutions in developing regions. The findings underscore the need for strategic investments and partnerships to make VR more accessible and sustainable.

For students, VR offers unparalleled opportunities to develop technical, cognitive, and collaborative skills. The immersive nature of VR enhances engagement and retention, making it particularly effective for complex subjects such as engineering and architecture. However, the effectiveness of VR-based learning depends on the quality of the content and the extent to which it aligns with educational objectives. Institutions must, therefore, prioritize the development of high-quality VR modules that cater to diverse learning needs.

The discussion also highlights several challenges, including the high initial costs of infrastructure development, the lack of training programs for educators, and limited access to VR tools for students in low-income regions. Addressing these challenges requires a collaborative approach involving policymakers, educators, and technology providers. Subsidies, open-source tools, and scalable training programs are potential solutions to these issues.

7. Conclusion

VR-based education holds immense potential for technical universities by enhancing experiential learning. However, successful implementation requires addressing the professional requirements of educators, infrastructure needs, and the competencies students must develop. Collaboration between policymakers, educators, and technologists is vital to harness the full potential of VR in education.

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