

# Reshaping vocational education: the profound impact and practice of virtual reality and augmented reality on skills training

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## Abstract

**In the vast field of vocational skills training, VR (virtual reality) and AR (augmented reality) technologies have great potential. Through immersive and interactive innovative teaching methods, they transform traditional lectures into a more realistic and operational learning experience, significantly improving the training effect, accelerating the speed of skill acquisition, and better meeting actual work needs. With the in-depth application of VR and AR in vocational education, integrating cross-domain skills and global collaboration has gradually become possible, opening up new opportunities for students' career development. However, technology maturity and equipment costs are still a major challenge, and these obstacles need to be overcome through technological innovation, policy support, and multi-industry collaboration, to more widely promote and deepen the application of VR and AR in vocational skills training.**

## Keywords

**VR technology; AR technology; vocational skills training; teaching model reform; improvement in training outcomes.**

## 1. Introduction

These In the era of rapid technological advancement, industries around the world are increasingly requiring skilled professionals who can adapt to evolving work environments (Susskind, R., & Susskind, D. 2022). At the forefront of these changes are Virtual Reality (VR) and Augmented Reality (AR) technologies, which have garnered widespread attention for their capacity to revolutionize various sectors—from entertainment and healthcare to manufacturing and education. Unlike traditional training methods that often rely on lectures, demonstrations, and static media, VR and AR enable learners to interact with simulated or enhanced real-world scenarios, thereby deepening engagement and boosting practical competence (AlGerafi, M. A., Zhou, Y., Oubibi, M., & Wijaya, T. T. 2023).

Vocational education, which emphasizes hands-on skills crucial for diverse professional domains, stands to reap substantial benefits from VR and AR integration. These technologies allow trainees to engage in safe, realistic, and cost-effective simulations, effectively bridging the gap between theoretical knowledge and workplace application. Furthermore, the immersive experiences foster accelerated learning, increased motivation, and improved retention of complex concepts. Despite these advantages, the widespread adoption of VR and AR in vocational education still faces significant hurdles—such as high implementation costs, technological limitations, and the need for supportive policies (Akçayır, M., & Akçayır, G.2017). This paper thus delves into how VR and AR are reshaping vocational skills training by examining their core features, real-world applications, major benefits, and persistent challenges, concluding with suggestions for broader, more effective deployment in the future.

## **2. Application of Virtual Reality (VR) Technology in Vocational Skills Training**

### **2.1. Overview of VR Technology**

Virtual reality (VR) technology is a cutting-edge digital interactive platform that builds a highly simulated three-dimensional environment for users through the integration of multiple fields such as computer graphics, sensors, and artificial intelligence. Learners can "immerse" themselves in the virtual world and interact naturally with the environment using head-mounted displays, motion capture, tactile feedback, and other systems (Shin, D. H. 2017). High-fidelity visual, auditory, and tactile simulations give VR the potential to replace or even surpass traditional practical operations in vocational skills training.

### **2.2. Specific applications of VR in vocational skills training and its far-reaching advantages**

In the medical field, VR is gradually reshaping surgical training. For example, by wearing a VR headset, zero-risk surgical simulation can be achieved. With the help of a highly simulated virtual operating room, trainees can perform sutures, bypasses, and other operations in a zero-risk environment, avoiding the use of animals or real patient resources, and providing a safer and more flexible training method for medical teaching. In addition, timely operational feedback can be obtained. Combined with sensing and motion capture technology, the system can record the surgical process in real time and give error correction prompts, allowing trainees to practice repeatedly in a short period, greatly improving the efficiency of skill acquisition.

The manufacturing industry also benefits from VR. Using virtual factories and dangerous environment simulations, workers can transfer complex production lines or dangerous operation scenes to VR platforms, which can reduce safety risks and reduce dependence on physical equipment, allowing trainees to become familiar with precision equipment operation and maintenance processes in virtual factories. Taking automobile manufacturing as an example, VR can simulate the entire assembly process including engine installation and body welding, allowing trainees to practice in the virtual space, and detect and solve problems promptly. By reducing safety risks and lowering training costs, VR creates more flexible teaching strategies for institutions, allowing them to complete multiple rounds of practical exercises without having to shut down production or make large-scale renovations to training venues. Timely feedback and data analysis can also help training institutions optimize course design and improve overall training effectiveness.

## **3. Application of Augmented Reality (AR) Technology in Vocational Skills Training**

### **3.1. Overview of AR Technology**

The key to AR technology lies in its powerful real-time interactive capabilities and unique augmented reality features (Craig, A. B. 2013). To analyze this key technology, factors such as high-precision sensors, cutting-edge computer vision algorithms, and innovative display technologies are required. Sensors are needed to capture three-dimensional data from the real world, and these data are processed by computer vision algorithms to achieve the purpose of identifying and tracking target objects and to ensure that virtual information can be accurately presented in the correct position. Sorting also requires the use of innovative display devices such as AR glasses or smartphone screens as a connection tool between virtual information and the real world, showing users a seamless and integrated augmented reality picture.

### **3.2. Specific applications of AR in vocational skills training and its far-reaching advantages**

The traditional training process requires technicians to rely on drawings and video materials, which makes it difficult to understand the internal structure and working principle of complex equipment. However, the existing augmented reality (AR) technology has changed this situation. It can display the internal structure, operating data, and troubleshooting steps of the equipment on the screen. After wearing AR glasses, you can observe the above information while viewing the appearance. When maintaining a piece of complex mechanical equipment, AR technology provides technicians with guidance on how to disassemble the equipment step by step, displaying key components and maintenance points to ensure correct operation. This "what you see is what you learn" training method has improved the actual operation ability of technicians, greatly shortened troubleshooting time, and improved production efficiency. In the medical field of anatomy teaching, the unique advantages of AR technology are highlighted. Traditional anatomy teaching relies too much on physical specimens and two-dimensional images, and cannot fully display the complexity and dynamics of human structure. However, AR technology can embed three-dimensional human models into real space (Geng, J. 2013). By scanning a handheld device with a book or model, you can see highly realistic three-dimensional anatomical images in front of you. In order to have a deeper understanding of the human structure and its function, you can also freely rotate and scale the model, and even perform virtual surgical operations.

The application of AR technology in vocational skills training has far-reaching advantages that are not only reflected in specific cases but also have a broader impact on the entire training system (Rampolla, J., & Kipper, G. 2012). It provides learners with practical operation experience in a nearly real working environment and enhances the pertinence and effectiveness of training content. The instant feedback mechanism brought by the implementation of AR technology supports learners in correcting mistakes on time, enhancing their understanding of knowledge points, and shaping their memory.

## **4. Potential impact of VR and AR technologies on vocational skills training**

### **4.1. Innovation of teaching mode: from traditional lectures to immersive and interactive**

learning the profound impact of change is shaking the teaching mode in the field of vocational skills training that integrates VR (virtual reality) and AR (augmented reality) technologies. In traditional teaching methods, most of the time is spent on explaining theoretical knowledge, which is intuitive and in-depth. Today, a new round of immersive exploration journey is opened by the introduction of VR and AR technologies. Trainees who "experience" the work scene are enjoying the pleasure of real-time communication with virtual objects. Drawings or videos may be the only means for traditional mechanical manufacturing skills training to depict the mechanical structure and principle operation mode. The challenge of strong spatial senses is considered difficult, but at this moment, VR technology guides them to step into the virtual factory workshop and perform tasks such as precise disassembly and assembly of mechanical equipment and observe each internal drive and data flow.

### **4.2. Significant improvement in training effectiveness, faster skill acquisition, and simultaneous enhancement of proficiency and practical ability**

The effect of vocational skills training has been greatly improved by the application of VR (virtual reality) and AR (augmented reality) technologies. This experience reflects the overall growth of nurses' mastering speed, proficiency, and practical ability. Take medical nursing training as an example: to acquire precise operating skills such as venous puncture, it takes a

lot of time to go back and forth in practice. With the intervention of VR technology, the situation has changed. The simulation environment allows nurses to practice repeatedly, benefit a lot in adjusting the techniques, and quickly achieve success rate, technique knowledge, and confidence. Compared with the traditional learning method, which is both inefficient and panicky, this method can avoid unnecessary troubles. The introduction of AR glasses to directly display the relationship between circuit diagrams and equipment has an immediate help to vision, allowing the electrical class to have a comprehensive glimpse of the quick way to locate and solve problems in the process of reviewing the old and learning the new, and thereby build a more experiential and rich learning atmosphere.

#### **4.3. Broadening of career development paths, new opportunities for cross-domain skills learning and global collaboration**

The rapid development of VR (virtual reality) and AR (augmented reality) technologies has led to an unprecedented change in the field of vocational skills training, bringing about a significant expansion of students' career development paths. These new technologies that break the boundaries of traditional training have opened the door to cross-domain skill learning. For example, in the field of electronic engineering, students who have "traveled" through the past mechanical manufacturing majors, under the guidance of VR technology, can thoroughly understand and master new knowledge and skills such as circuit design and programming with their gestures, and use this to nourish their personal knowledge structure and skill system and forge future career transformation or promotion. Reshaping barrier-free and interactive space, all students inspired by VR and AR technology can generate spiritual sparks in the process of solving complex problems together and sharing experiences and knowledge.

#### **4.4. Challenges and Solutions**

In vocational skills training, VR and AR, which have great potential, are still plagued by the dual challenges of low technological maturity and high costs (Ausburn, L. J., & Ausburn, F. B. 2004). Among them, user experience and training effects may be reduced due to imperfect technology, and the high price of equipment may discourage many students and institutions. Prescribe a prescription for these difficulties: adopt diversified solutions and countermeasures. The first task is innovation-driven, optimizing algorithms and improving performance to lower the threshold for use and reduce costs. Making VR and AR more widely applicable is also within the plan.

The goal of low latency and high bandwidth in the network environment will be promoted when 5G is popularized (Pierucci, L. 2015). It is extremely beneficial to improve the user experience of VR and AR and expand its application scope in the field of vocational skills training. As for policy support, such as the introduction of relevant support policies such as tax incentives and financial subsidies, we cannot forget its role in encouraging and motivating enterprises and training institutions to introduce VR and AR technologies and improve the efficiency and quality of vocational skills training.

### **5. Conclusion**

Vocational skills training is experiencing a disruptive upgrade due to the addition of VR and AR technologies. The immersive and interactive learning model not only improves students' learning interest and operational proficiency but also takes cross-domain skills learning and global collaboration to a new level. Faced with realistic challenges such as technology maturity and cost, multiple parties need to work together to promote technological innovation, consolidate the industrial ecology, and promote the in-depth application of VR/AR in vocational skills training through policy support and teacher training. Only in this way can its potential be

fully unleashed, more high-quality professional talents can be exported to society, and innovation and sustainable development in all walks of life can be promoted.

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