# Application of Virtual and Augmented Reality to the Field of Adult Education

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**Abstract:** This research reviews the extant literature and resources of VR and AR to provide new insights and future direction for adult learning and the field of adult education.

**Keywords:** virtual reality, augmented reality

## Purpose of This Research

Technology has long been considered as helpful and supportive in making learning engaging and flexible. It has also changed the modalities of learning and teaching in various ways (McKnight, O'Malley, Ruzic, Horsley, Franey, & Bassett, 2016). The advancement of technology enables people to learn anything, anytime, and anywhere they want, making mobile and ubiquitous learning possible (Hwang, Chin-Chung, & Yang, 2008; Sakamura & Koshizuka, 2005). Virtual Reality (VR) and Augmented Reality (AR), already established technologies but receiving new attention, are being regarded as potential for surprisingly changing the way we learn and teach.

To date, VR and AR have been widely used in a variety of fields, including military, industrial, navigation, and medical applications to provide a vivid and immersive experience. For example, the VR and AR technologies have been used for military navigation, to help create lifelike battlefields, and to also diagnose health issues with less use of surgical interventions. However, the use of VR and AR is now gaining attention towards applications in the field of

training and/or education. In the fields of medicine and military, VR and AR are used to effectively train and educate soldiers and hospital employees in a risk-free environment. As shown in these examples, VR and AR are considered potential learning tools to facilitate effective learning in various adult education fields.

Despite the recognized significance of using VR and AR, there has been no conceptual or empirical studies examining the implication and influence of VR and AR in the field of adult education. Only limited studies have investigated the effects of VR and AR on training or acquiring knowledge and skills in the field of psychology (Formosa, Morrison, Hill, & Stone, 2017). We expect that these technologies will provide adult learners with great access to learning resources, enhanced motivation for learning through lifelike experiences, and help reduce overall costs and time for learning. Considering these positive influences of VR and AR, there is a strong need for adult education researchers and practitioners to pay attention to the use of VR and AR for the purpose of improving learning and its practice.

Therefore, the purpose of this research is (1) to clarify the concept of VR and AR by reviewing related literatures, (2) to examine how these technologies can be applied and utilized in the field of adult education through case studies, and (3) to suggest possible future direction and implications for research and practice in adult education.

## Research design

In this article, we reviewed the previous literature in term of VR and AR to suggest new insights and possible future directions in the field of adult education. To pursue this research purpose, we reviewed extant resources on VR and AR, including scholarly articles, books, and websites. Considering the fact that there have been limited scholarly publications on VR and AR because of its newness, non-scholarly resources are included in this research to provide a comprehensive understanding on this topic. Furthermore, we provided several application cases to illustrate the potential possibilities of VR and AR in the field of adult education and learning, which utilized VR and AR technologies to facilitate employees' learning and training in the workplace.

## Literature Review

In this section, we provide an overview of VR and AR. In particular, we discuss their concepts and applications in various fields so as to suggest future direction in the field of adult education.

## The Concept of Virtual Reality and Augmented Realty

Even though this technology has continuously been developed at a steady pace, it has just recently drawn growing attention from educators and trainers concerning the possible ways VR could enhance educational practices and outcomes. In the long history of VR development, multiple ways of defining VR have been provided. Some have defined VR in a narrow way by putting the emphasis on the use of a certain technology or device (e.g. headgear, glove). Others, however, criticized this approach because it is a greatly limited perspective without any consideration of interactions or complexities between the user and virtual environments (Fuchs, Moreau, & Guitton, 2011). In conceptualizing VR, there are fundamental aspects of VR converging from the multiple approaches: VR is (a) the utilization of computer-generated images or simulation, (b) building an immersive virtual environment, and (c) stimulation of sensorial interfaces (e.g. sound, vision). Simply put, VR is an immersive experience and interaction with a virtual environment that is achieved by multimedia or computer-generated simulations and sensorial stimulations in order to help promote proactive learning in adult learners.

The new and innovative technology in VR is usually implemented with eye-catching and fancy devices, such as VR helmets, glasses, and gloves. Although many people mostly think of a nicely-designed helmet when thinking of virtual reality, there are multiple types of devices used to increase the immersion and presence of users by taking advantage of different senses, including the senses of sight, sound, smell, and touch (Guttentag, 2010). Therefore, adult learners may use a wide range of devices to facilitate their learning.

Similar to VR technology, augmented reality (AR) is another emerging technology that integrates real life with modified and enhanced images or sound. In the field of AR, computer-generated images or augmentation and existing reality are harmonized to make further meanings and interactions. This AR is generally achieved by using mobile devices to provide a composite experience or view through digital components and the real world. AR provides users with enriched experiences, greater engagement, and a powerful capacity to change people's perceptions of the world. Unlike VR, AR ensures more freedom and an open space learning environment because it usually does not require wearing devices such as a head-mounted display (HMD).

## Application of Virtual Reality and Augmented Realty in Various Fields

Understanding the existing VR and AR technology systems in different fields can help provide new insights and future direction of VR/AR uses in adult learning and education. First used for

military and medical purposes, the application of VR and AR expanded to many fields, including commercial and entertainment industries.

Military has used AR and VR to overcome the limitations of real training environments. During combat, virtual maps and 360°-view camera-imaging can improve a soldier's navigation and battlefield perspective. Researchers examined the use of AR in the adaptive tutoring system so that soldiers can do hands-on applications in realistic physical environments. In the medicine and health care field, VR and AR systems help medical practitioners train, diagnose, and treat individuals in numerous situations. For example, VR and AR have been used for diagnostic and therapeutic purposes with minimum surgical interventions (McCloy & Stone, 2001).

Many companies have begun advertising VR and AR applications in industries such as automotive driving assistance (White, Schmidt, & Golparvar-Fard, 2014). AR allows any type of designer (e.g., car, buildings, etc.) to perform and experience a product's design and operation before completion. Lynne Murray, head of design and marketing at software developer Holition, also believes that AR allows customers to try on watches and bracelets virtually through virtual mirror software, which helps increase sales and marketing effects (Clawson, 2009).

The entertainment industry also embraced VR and AR systems, using them for virtual museums, movies, sports telecasting, amusement park, augmented reality TV, and theatric performances. AR and VR allow people to engage with the exhibits by wearing virtual reality glasses. Travelers also utilize VR and AR technology to see informational displays in regard to a location, historical events, landscapes, and information provided by previous visitors. AR is also used for game purposes such as Pokémon Go. Scholars have found that VR-based games can potentially help those aging with a disability by providing task-specific training and physical activities (Miller et al., 2013). Research in the games arena influences not just the entertainment field but also different organizations that could benefit from new educational technologies.

**Corporate Application Cases of Virtual Reality and Augmented Realty**

Recently, VR and AR have been recognized as a powerful technology in enhancing employee performance and responsibility within the context of the corporate training and education. Several researchers suggest that the use of VR- and AR-based training can have significant advantages over traditional training methods. For example, the use of AR/VR technologies would present greater access to educational resources and foster group experiences for encouraging communication, competition, and cooperation (Popovici & Marhan, 2008). Moreover, VR- and AR-based training is believed to facilitate workplace learning which

improves employee performance, competency-based skills, and cognitive abilities (Sabine, Bockholt, & Keil, 2011). This approach also serves as a mediator between the virtual world, the real world, and the users, which can allow employees a self-directed learning experience and practice (Chittaro & Ranon, 2007). In this context, many organizations try to adopt VR and AR as a way to train employees in a more immersive learning environment.

**Case 1.** Walmart is a good example of VR application in workplace learning. The VR training programs, conducted in their nationwide Walmart Academies, focus on training floor managers and workers through various case scenarios, including floor maintenance and holiday rushes. Benefits of the VR training program include acquiring the opportunity to experience in-store scenarios and address customer complaint situations in the virtual environment. Walmart reports that the retention of employees' knowledge from the VR training was significantly higher compared to those who took the training in a traditional way.

**Case 2.** Bosch has embarked on a path to train their technicians through an AR mobile facility. In the mobile training facility, employees are provided with virtual information of the inner functioning of a car engine, which is intended to enhance technicians' knowledge of automotive structure and performance. The training program utilizes a blended approach comprising classroom instruction and the mobile AR training. Applying AR technology allows changing learning strategies into the blended training which is facilitating the employee's reflective thoughts, including how to implement the ideas into their work environments. In this learning environment, employees are able to be involved in a self-directed learning process anywhere and anytime using their electronic devices.

## Implications of Virtual Reality and Augmented Reality for Adult Education and Learning

As one of the latest technological advancements in the Industry 4.0 era, researchers expect that VR and AR will lead many initiatives to enhance technology embedded learning solutions for adult learners (Hummel, 2017). The immersive nature of these new technologies facilitate a greater learner involvement, motivation, and absorption through more advance features of the interactive functions of the VR and AR technologies. One good example is that VR and AR provide a way to easily learn complex concepts visually (e.g., molecules at a microscopic scale in VR and 3D environment) (Blaha, 2016). Bye (2016) simply states the radical change of this immersive educational innovation is that "VR has the potential to more fully express and explore the full complexity of the human experience, usher us from the Information Age to the Experiential Age, and catalyze a new renaissance that unlocks the latent potentials of our creativity and imagination" (para 1). Moreover, Extended Reality (XR) encompassing VR and

AR is emerging as well. This reality embraces the whole gamut from 3D objects, 360-degree video, augmented, virtual, to mixed realities (Hackl, 2017). Industry experts claim that XR is now penetrating not only various industry fields such as news media, healthcare, film, and retail, but also educational fields. Within XR environments, all kinds of realities converge to facilitate a seamless experience of very versatile learning environments and allows prompt switching between the real world and the virtual world for improved learning. Reflecting on this emerging trend of VR, AR, and XR, it is evident that technology-immersive learning methods will be popular in adult education fields (Patterson, 2017).

As an implication of encountering the new technological world of VR and AR, we strongly recommend that administrators, faculty, and instructors in adult education fields should pay keen attention to these new immersive technologies and seek effective ways of utilizing them for educating adult learners in various continuing-education settings. For research, scholars should investigate which type of VR/AR and what kind of VR/AR apps are most effective to deliver adult learning programs. Also, researchers should investigate how VR/AR-based learning improves adult learners' learning competencies as the future workforce is in great need of adult employees with high self-learning capabilities to survive in an ever-changing technological world.

## Conclusions and Recommendations for Future Research

This research explored multiple conceptualizations of VR and AR and identified a wide range of applications in diverse fields (e.g., gaming, entertainment, marketing and advertisement, medical, sports, military, and arts) to provide potential applications for adult learning and the field of adult education. Through our discussions, we expect that adult learners and scholars may find this research useful as they strive to get to know the new immersive technologies and identify more efficient and effective ways of utilizing them in training and educating adult learners. In this sense, we encourage researchers to investigate what aspects of VR and AR are appropriate for promoting and facilitating learning depending on adult learners' characteristics or learning styles. Also, identifying the benefits and limitations of certain types of VR and AR used in adult education contexts will provide valuable guidelines and reference tools for existing practices of VR- and AR-based education and learning.

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