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The Spatial Influence on Vocabulary Acquisition in an Immersive Virtual Reality-Mediated Learning Environment

Baoxin Feng, Zhejiang Normal University, China
https://orcid.org/0000-0003-1953-0338

Lee-Luan Ng, Universiti Malaya, Malaysia*
https://orcid.org/0000-0001-6741-6201

ABSTRACT

This study aims to investigate whether VR-assisted language learning facilitates EFL learners' vocabulary learning and memory retention. One hundred seventy-seven Chinese undergraduate EFL learners were divided into VRG (VR-assisted instruction group) and CIG (conventional instruction group). Participants in the VRG (n = 75) were provided with immersive VR devices, whereas the others (n = 102) learned in conventional classrooms with instructors. The results illustrate that the spatial design of virtual environments may be related to lexical memory performance. Target words that are placed in positions where they are interacted with more frequently tend to perform better in terms of being memorized. It also suggests that words corresponding to items placed between 60-180 cm of the ground are better retained. Subsequent interviews revealed that VR technology helps learners encode information based on spatial location. The VR technology's visual, aural, and textual stimulation also help learners subconsciously remember the vocabulary items.

KEYWORDS

CALL, EFL, Memory Retention, Virtual Reality, Vocabulary Learning

1. INTRODUCTION

Virtual reality (VR) technology has been extensively used in the field of education, with favorable results in terms of multimodal communication (De Freitas, 2008) and knowledge instruction (Dickey, 2010; Bignell, 2011; Low, Khoo & Chua, 2011). However, as VR technology developed, its usage in different research varies. Research has shown that the impact of immersive virtual reality (IVR) technology on English as a Foreign Language (EFL) learners is significantly higher than desktop-based virtual reality (Cho, 2018). In addition, the use of Helmet-Mounted Display (HMD) in IVR technology enables the tracking of the user's gestures and body movement and stimulating a 360-degree scene, which is close to reality. This technological advancement provides more possibilities for designing and developing language learning scenarios. Through panoramic cameras or 3D scene development platforms, users can experience the actual scenarios depicted in VR.

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Meanwhile, the influence of globalization on the economic development of developing nations like China has indirectly increased the relevance of English language skills in the professional sector (Mo & Huang, 2021). Some educational institutions in China are exploring the potential of VR technology in equipping learners with vital language skills, such as speaking (Xu, 2021) and listening (Wang, 2020). However, there is a paucity of studies on the use of VR to teach English vocabulary. Vocabulary has always been considered a critical element of English language learning. Pupils, who lack sufficient vocabulary, are unable to comprehend others or convey their own thoughts (Ahour & Dogolsara, 2015). Many empirical studies have shown the impact of vocabulary knowledge on the development of EFL learners' reading comprehension and pronunciation skills (Perfetti, 2010). Lee (2023) highlighted the significance of consistent exposure to L2 vocabulary for its retention, particularly highlighting the scarcity of opportunities for EFL learners to regularly apply acquired vocabulary. Consequently, investigating effective vocabulary learning approaches to counteract forgetting becomes pivotal for learners who are devoid of a native language environment. Moreover, recent research also emphasizes two pivotal factors influencing vocabulary retention: contextual information richness and word exposure frequency (Teng, 2019). The findings of another study demonstrated the role of spatial learning in encoding target vocabulary, thus bolstering retention (Costuchen, Vayá & Dimitrova, 2022). The findings from the study illustrated that the spatial factor affects the retention of vocabulary learnt. These collective findings underscore the potential benefits of constructing an enriched contextual space that enhances retention for learners and encourages meaningful engagement. Therefore, in light of the emergence of virtual reality technology, it enables instructors to tailor design spatial environments that provide immersive user experiences and support vocabulary retention.

This research attempts to explore the creation of a VR environment for English vocabulary acquisition based on IVR technologies, with the goal of determining its influence on vocabulary memory efficiency and retention among Chinese learners of English. Meanwhile, it is crucial to understand which VR-related aspects play a part in this process. Two research questions are presented to address this focus:

RQ1: What are the differences in vocabulary retention when using VR versus using conventional instruction?
RQ2: What are the spatial-related factors in virtual environment that affect learners' vocabulary learning?

2. IVR-ASSISTED VOCABULARY LEARNING

The concept of Immersive Virtual Reality (IVR) originates from the technology dealing with "the sensory-immersive type of virtual environment ", and it is said to be originally designed to benefit NASA's astronaut training program (Biocca & Delaney, 1995, p.57). The significance of IVR is due to its focus on the user's involvement within the virtual world, particularly the capturing of body motions. Not only does it allow users to enter the virtual environment from a first-person perspective, but also interact with the environment through physical actions. Researchers like Kaplan-Rakowski & Wojdynski (2018) stated that complete immersion in a natural communication setting is one of the most effective strategies for learning a second language. Real-life immersion is not always a viable or accessible option for EFL students in non-English-speaking countries due to a lack of resources (Freed, 1998). IVR, on the other hand, provides an alternative technique for EFL learners to immerse themselves in life-like virtual environments (Legault et al., 2019). The continuous enhancement of VR technology has directly driven research that explores the use of IVR in language learning.

Since 2016, researchers have been conducting studies related to vocabulary learning using VR devices that capture head movements. Researchers have also extensively explored the impact of virtual reality (VR) on vocabulary acquisition and retention. Ebert, Gupta, and Makedon (2016)