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Exploring the Application of Virtual Reality in Facilitating EFL Vocabulary Acquisition: An Analysis Using Bloom's Taxonomy

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ABSTRACT

To prepare their citizens for global social, economic, and political contexts, people, including Chinese, are pursuing English as a specialised foreign course. They believe that mastering this language will offer them an advantage in business as well as international relations. Vocabulary plays a central role in language learning, influencing not only communication skills but also reading comprehension, writing ability, and overall academic performance. When learning a new language, speakers of foreign languages frequently battle with a limited vocabulary in general. Thus, this research intends to explore the impact of VR on EFL vocabulary acquisition among Chinese university students concerning different levels of Bloom's taxonomy of cognitive learning. For this purpose, a qualitative research approach using a case study research design has been employed. Semi-structured interviews with Chinese EFL students were carried out who had different proficiency levels and experiences with VR-based learning. The findings of the study confirmed the impact of VR in improving the vocabulary acquisition of Chinese EFL learners, aiding cognitive processing from low-order to high-order via multimodal input, adaptive application, and immersive conceptualisation. Students reported benefits such as increased motivation, engagement, and confidence, though some indicated challenges linked to technological familiarity and learning preferences. This will help EFL teachers integrate VR or similar technologies into their teaching to maximise Chinese students' vocabulary acquisition and retention, while addressing variations in tool design and learner readiness.

Keywords: Bloom's Taxonomy; EFL Learner; Virtual Reality; Vocabulary Acquisition

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1. Introduction

The past forty years have seen an exceptional acceleration of English as a Foreign Language (EFL) education in China due to the country's open-door policy and its rapid growth in the economy. In China, the practice of teaching EFL dates back a little over a century. English teachers in China have embraced a range of contemporary English teaching techniques to support students' learning processes, as opposed to continuing with more conventional methods of instruction [1].

Within the field of English as a Foreign Language (EFL), language acquisition is a complicated cognitive process that integrates several abilities, including vocabulary learning. The fundamental building blocks of language are found in vocabulary, and both language production and understanding are impossible without them [2]. A large vocabulary not only facilitates precise speech but also significantly contributes to reading comprehension and writing skills [3].

Moreover, the development of grammar is also mostly driven by vocabulary knowledge [4]. The variance in GPA is largely explained by general vocabulary size, which accounts for 47% of the variance [5]. For EFL learners, vocabulary development is a significant determinant of their language competency and communicative ability, whereby it supports grammatical development and cognitive processes associated with language learning [6]. Based on this, the present study investigates the influence of the use of Virtual Reality (VR) technology on supporting EFL vocabulary acquisition in a higher education context.

Conventional language learning methodologies have traditionally relied on techniques such as language labs, seminars, and textbooks. However, integrating cutting-edge technologies, such as virtual reality (VR), has become increasingly well-known recently as a potentially revolutionary tool for language instruction. With its vivid and interactive features, virtual reality has the potential to provide language learners with a unique opportunity to interact with the target language in real-world, dynamic, and simulated circumstances. By utilizing a computer-generated three-dimensional background, VR enhances learning engagement and fosters a sense of presence. This will help Chinese EFL students to overcome the limitations of conventional classroom settings.

2. Research Background

2.1. Review of Recent Studies

As reflected in the previous studies, EFL students in China still face several challenges in vocabulary learning. There is a linguistic gap between Chinese and English [7]. This makes certain English words conceptually more challenging for Chinese learners. Moreover, factors such as teaching methods, vocabulary size, and the lack of real-world practical language usage make it challenging for Chinese EFL learners to expand their lexical repertoire [8]. Speaking difficulties among Chinese EFL learners are directly linked to a variety of psychological variables, as well as insufficient vocabulary, a lack of knowledge of grammar rules, difficulty with reading, and other challenges [9].

Most recently, virtual reality has become the focus of a growing body of research, specifically in language instruction. Researchers have demonstrated the effectiveness of virtual reality in creating immersive environments for language learning [10,11]. These studies demonstrated how virtual reality can enhance language skills by offering engaging and participatory experiences. This also helps people understand abstract concepts.

Various studies have been reviewed in the relevant field to look into the impact of Bloom's taxonomy on language acquisition. A study emphasized the utilization of higher-order cognitive capacities for language acquisition [12]. Along the same line, another study provided empirical evidence supporting the use of Bloom's taxonomy in guiding instructional techniques as well as assessing language competency, including various language skills [13]. When researching grammatical knowledge linked with high-order thinking, Researchers deemed Bloom's Taxonomy to be an appropriate paradigm [14].

2.2. Problem Statement and Research Gap

The current situation indicates that Chinese EFL students still lag in terms of both the depth and breadth of English vocabulary. There is a notable gap between the vocabulary learners have learned and the vocabulary they apply [15]. Virtual reality has been shown in earlier research studies to enhance the language learning of EFL students, particularly in the area of vocabulary. To determine how the cognitive processes involved in vocabulary acquisition

align with Bloom's Taxonomy levels, further research is needed. Additionally, in the context of Chinese EFL learners, previous studies seem to be very limited.

Bloom's Taxonomy provides a new perspective on vocabulary learning, considering the integration of VR into EFL training in China[16]. Thus, the agenda of the study is twofold. First, investigate the usefulness of virtual reality (VR) in aiding vocabulary acquisition, and then assess vocabulary acquisition concerning cognitive processing by applying Bloom's Taxonomy.

2.3. Theoretical Framework

Bloom's Taxonomy is one of the most widely used frameworks in educational psychology[17]. It divides cognitive skills into six sequential stages: recall, understanding, application, analysis, synthesis, and evaluation. This helps in classifying and analysing the breadth and complexity of learning objectives This taxonomy provides an ordered way to understand the complexity of the cognitive processes involved in learning, which makes it particularly helpful for assessing the stage of language acquisition Because learning vocabulary in an EFL course requires higher-order thinking, Bloom's Taxonomic Model can be used to accurately and impartially evaluate its impact. Thus, Bloom's Taxonomy has been employed as a theoretical framework for the present study, and the schematic model of the study is presented in **Figure 1**.

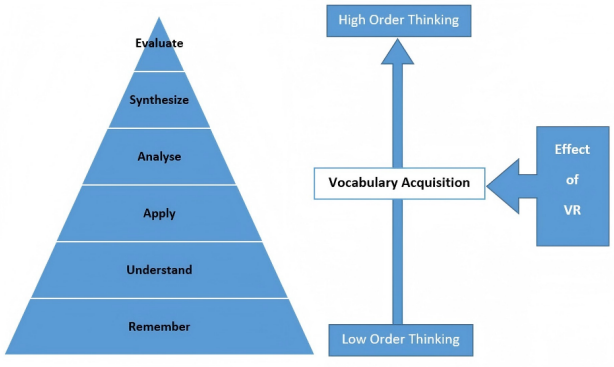

Figure 1. Schematic Model of the Study.

2.4. Research Objectives and Research Questions

The prime goal of this present study is to evaluate the impact of VR on EFL vocabulary acquisition concerning different levels of Bloom's taxonomy. For this purpose, the study will focus on answering the following research questions:

1. How do Chinese EFL learners perceive the impact of VR incorporation on their vocabulary acquisition?
2. How do virtual reality learning activities align with the various Bloom's Taxonomy levels in the context of vocabulary acquisition among Chinese EFL university students?

2.5. Significance of the Study

Revamping Teaching Strategies for EFL Teachers: The study's findings can contribute to the enhancement of EFL pedagogy by exploring the synergies between virtual reality and vocabulary acquisition. As this evaluation is conducted under the framework of Bloom's taxonomy, it will enable EFL teachers to integrate VR activities into their teaching strategies, thereby fostering vocabulary development at various cognitive levels. This information is crucial for developing more effective, engaging, and student-centered language learning programs.

Addressing Vocabulary Challenges for Chinese EFL Learners: This study focuses on the specific difficulties EFL students in China encounter with vocabulary learning. It is essential to understand how language variations, cultural differences, and teaching styles impact vocabulary acquisition to design treatments that specifically meet the needs of Chinese learners. In this regard, this study will gather students' perspectives on how VR can be effectively utilized to maximize their benefits. This contributes to the development of more focused approaches to improve vocabulary training efficacy in EFL courses.

Guiding Curriculum Design and Educational Policies: The results of this study may help curriculum developers and educational policymakers as they create EFL programs. The results could impact the creation of curricular frameworks that prioritize the incorporation of cutting-edge technology, aligning with Bloom's Taxonomy, and consequently promote a comprehensive approach to language acquisition. Not only EFL programmes, but curriculum planners can integrate VR or similar technology in their general language courses as well for better cultivation of language as a skill[18]. Policymakers can gain insight into how to invest more in the technological advancement of educational courses.

Technology Integration in EFL Contexts: While previous research has mostly examined the impact of different technologies on general language learning, this study focuses on the cognitive mechanisms involved in vocabulary acquisition through virtual reality. This advances our understanding of the possible advantages of VR technology for cognition in a more complex way. The simulated environment of VR can provide a real-life experience for EFL learners to concretise their abstract learning and gain confidence to face the real world.

3. Method

3.1. Research Design

To find the answers to pre-defined research questions and reach the objective of the study, a qualitative research approach has been adopted. Qualitative research can thoroughly examine the perceptions, behaviors, and experiences of the sample[19]. The study uses case studies (using multiple cases), employing a semi-structured interview with EFL students from a Chinese university. This will enable in-depth investigation while providing the flexibility to explore specific areas of English as a Foreign Language (EFL) vocabulary acquisition.

3.2. Participants

The participants are Chinese university EFL students of non-English majors. Chinese EFL students are invited via email to participate in the recruitment process; the contact details for these students were obtained from the official registers of Chinese colleges and universities. In addition to a consent form authorized by the Research Ethics Committee, the email also includes an explanation of the study's purpose and methods.

Out of a total of twenty-five students from various colleges and universities in Beijing, Zhejiang, and Chongqing who consented to take part in the research, twelve were chosen purposively based on the following criteria:

- Participants with a range of language competence levels, from intermediate to advanced, as determined by self-reported proficiency levels, were guaranteed a diverse set of experiences and viewpoints.
- Target participants from Chinese educational institutions or language programs that have included VR in their EFL curriculum.
- Participants who have actively participated in VR-based language learning activities.

The detailed students' profiles are presented in **Table 1**.

Table 1. Participants Details.

Participant Code	Age	Gender	English Proficiency	Major Subject
P1	23	Male	Intermediate	Engineering
P2	24	Male	Intermediate	Humanities
P3	23	Female	Advanced	Science
P4	25	Male	Advanced	Humanities
P5	23	Female	Intermediate	Engineering
P6	24	Male	Intermediate	Science
P7	24	Female	Advanced	Chinese Literature
P8	25	Female	Advanced	Science
P9	24	Female	Intermediate	Arts
P10	23	Female	Advanced	Chinese Literature
P11	25	Male	Intermediate	Humanities
P12	24	Female	Advanced	Engineering

3.3. Instrument

To explore the intricacies of the participants' in-depth ideas and experiences connected to the use of VR in EFL concerning vocabulary acquisition, semi-structured interviews have been utilized. The questions will be organized according to the levels of Bloom's Taxonomy, investigating participants' recall, understanding, application, analysis, synthesis, and evaluation of English vocabulary through VR. The semi-structured interview schedule has been validated by three experts from the relevant field. The theme-wise distribution of the questions for the semi-structured interview schedule is presented in **Table 2**.

Table 2. Distribution of Items.

Basis	Sub-Theme	Item No.
Section 1: VR in English Vocabulary Learning	Overall perception, experiences, challenges.	Q1, Q2, Q3, Q4, Q5, Q6
Section 2: Bloom's Taxonomy Levels	Recall	Q7
	Understanding	Q8
	Application	Q9
	Analysis	Q10
	Synthesis	Q11
	Evaluation	Q12

The interview was conducted one-on-one via video call on WeChat, and a total of twelve questions were produced as guided questions (see **Appendix A**). Every interview has been recorded, and then a transcription has been done very carefully.

3.4. Data Analysis

First, the Chinese-to-English translations of the transcribed data have been carried out and further confirmed by another researcher who is a language expert. Following familiarization with the data, the process led towards the creation of preliminary codes and the extraction of themes and sub-themes. There was openness towards emerging themes from the data, but Bloom's Taxonomy served as a baseline framework during the analysis. The final themes reflected both data-driven patterns and alignment with Bloom's six cognitive levels. The coding process was supported by NVivo software. This method is suitable for identifying, analysing, and documenting themes or any kind of pattern within the qualitative data [20]. A theme-wise, detailed analysis of the data is presented in the next section.

3.5. Ethical Considerations

As previously stated, each participant is briefed about the purpose of the study before their written agreement is obtained. Maintaining participant confidentiality is essential from an ethical standpoint. Strict confidentiality guidelines have been implemented to ensure the security of EFL students' personal information. Participant anonymity has been preserved in all data records, including video recordings, observational notes, and interview transcriptions. The right to privacy of participants has been respected, and a friendly and encouraging environment has been preserved to promote an open and truthful conversation.

4. Research Findings

The study's sample comprises five male and seven female subjects, ranging in age from 23 to 25 years. Their English proficiency level is either intermediate or advanced. To provide a range of viewpoints, samples are purposefully chosen from different subject areas. The major subjects covered are science, humanities, engineering, Chinese literature, and the arts. During their training, they all acknowledged that they have participated in or were involved in English activities where VR has been used as a medium of teaching and learning.

4.1. Experience of Using VR in English Vocabulary Learning

All ten EFL students participated in different VR activities during the EFL classes, which impacted their English vocabulary level to a great extent. Some of them mentioned very interesting yet challenging VR activities, which are mentioned in **Table 3**. This will help delve deep into VR practices to explore their innovativeness and effectiveness.

4.2. Initial Thoughts of EFL Learners about Using VR for Learning English Vocabulary

In this section, the researcher tried to capture the initial thoughts of the EFL students before using VR in their learning process. Most of them admitted that at the beginning, they were not sure how VR could aid in their English study and were very sceptical. P3 stated, "I had no idea how using a headset would improve my understanding of the English language." Various emotions like excitement, apprehension, uncertainty, and nervousness were reflected in the interview. Most of them were new to using high-tech tools like VR in the educational field. This made them very curious because they had no previous idea about how it was going to work.

P7 answered, "To tell the truth, I felt a little intimidated. I had never used virtual reality before. I questioned if it would be overly advanced or difficult." However, they also had a positive outlook on using VR to learn vocabulary in the EFL course. P8 very aptly said, "I was cautiously optimistic. The thought of using VR for English vocabulary was interesting, but I wondered if it would be practical. I hoped it would live up to the hype and not just be a gimmick." This covers everything that was going on in their minds before using VR for learning English vocabulary.

Table 3. VR Experiences of the Participants.

Participant	English Proficiency Level	VR Experience
P11	Intermediate Level	"Yes, I have used VR in my English learning. I tried a virtual tour where I explored an English-speaking city. It was cool to hear native speakers using everyday vocabulary. It felt like I was right there!"
P2	Intermediate Level	"I joined a virtual classroom in English using VR. We did language exercises, and the teacher used a virtual board for new vocabulary. It was interactive, and I could see and hear everything clearly."
P9	Intermediate Level	"My English vocabulary improved with VR. There's an app where you visit different places and answer questions in English. I learned new words related to places, directions, and everyday situations."
P1	Intermediate Level	"Yes, I used VR to learn English vocabulary. There's a language app where you explore a virtual library, clicking on objects to learn their names in English. It helped me remember words better."
P3	Advanced Level	"I've been using VR for English interviews. There's a program simulating job interviews in English. It challenges me to use advanced vocabulary in real-life situations, enhancing my professional language skills."
P4	Advanced Level	"I engaged in a virtual debate group where we discussed complex topics in English. The discussions pushed me to use advanced vocabulary to express my ideas. It was both challenging and rewarding."
P7	Advanced Level	"I explored a virtual English museum where each exhibit had descriptions and quizzes. It was like a treasure hunt for words! This interactive way of learning made vocabulary stick in my mind."
P5	Intermediate Level	"Using VR, I attended a simulated English conference. It was an immersive experience with professionals discussing industry topics. I encountered a wide range of specialized vocabulary, enhancing my language skills in my field."
P12	Advanced Level	"I joined a VR language exchange program where native English speakers and learners connect. We discussed various topics, and it helped me practice using advanced vocabulary in real conversations."
P6	Intermediate Level	"I used VR for a virtual language exchange cafe. We practiced ordering food, discussing movies, and everyday topics. It was fun, and I picked up a lot of new vocabulary related to daily life."

4.3. Overall Perception of EFL Students about the Impact of VR on English Vocabulary Acquisition

According to the responses to the interview, the majority of the EFL students (75 percent) found a positive impact of using VR on their English vocabulary acquisition, while 16 percent of the students remained neutral. However, a small section (9 percent) of them found the application of VR useless. These responses are graphically represented in **Figure 2**.

Those who opined that VR has significantly boosted their vocabulary also mentioned that it has increased the retention of newly learned English words. One (P4) said that it helped her to structure a sentence with more ease. P1 mentioned an interesting aspect: VR provided the context for the English vocabulary that helped him use these English words in real-life day-to-day scenarios. P5, who had engineering as a major, replied, "Attending a simulated English conference virtually exposed me to industry-specific terms and phrases. Now, I feel more confident discussing my field in English." This underscores the relevance of using VR in vocabulary learning for students coming from different career backgrounds with their specific needs. A few of them mentioned that VR sessions helped them learn at their own pace without hampering the normal class lectures.

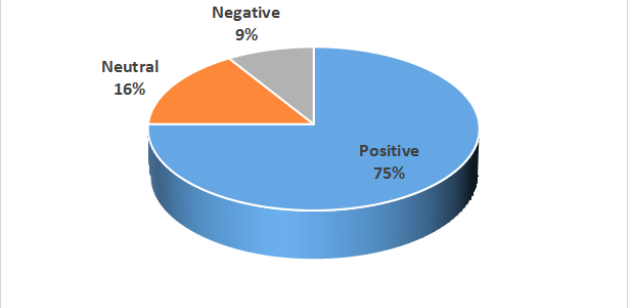

Figure 2. Impact of VR on Vocabulary Acquisition.

Some of the participants didn't find the use of VR effective for vocabulary acquisition. Though they admitted that while using VR, they found the lessons very innovative, interesting, engaging, and motivating, the overall outcome is not drastically higher than the conventional teaching methods of EFL. However, one student (P10) found VR a distraction in the course of learning and a waste of time, effort, and money. Upon further probing, it appeared that the participant was overwhelmed by the technological interface and lacked prior exposure to immersive tools, which may have contributed to discomfort and disengagement. This highlights how individual learning styles and technological familiarity can affect the perceived efficacy of VR.

4.4. Challenges Faced While Using VR for Vocabulary Learning

Although the findings reflect the positive vibes of using VR in EFL vocabulary learning, students also mentioned a few difficulties they encountered during the process. The major shortcoming was the technical issues related to the VR application. According to them, navigating the VR menus and controlling them was initially confusing for them. Many of them said that they struggled with the initial setup of the VR gear. A few of them encountered disorientation, headaches, and motion sickness while using VR gear. One particular aspect that they stressed was that they felt isolated during these VR sessions because most of the activities were one-to-one. These were less personal and lacked a sense of community. Moreover, they felt the human touch was missing as most of the applications and interfaces were machine-led. P11 specifically said, "One challenge was the lack of feedback on pronunciation. To overcome this, I started recording myself during VR language exchange sessions and sought feedback from native speakers outside the virtual environment to refine my pronunciation."

4.5. VR Activities Used in Recalling and Remembering English Vocabulary

This is evident from the responses and experiences shared by the EFL students who had participated in VR activities. VR improves vocabulary recall by creating vivid memories. It has also significantly enhanced vocabulary retention. Therefore, Chinese students can recall English words in diverse contexts. Through VR, students can associate words with virtual objects or scenarios that create a strong mental link, which helps them to remember the words effectively. This indicates the use of memory strategies such as visualisation and contextual association, whereby learners map vocabulary onto objects or actions in immersive scenes. One participant (P2) added, "The feedback from virtual teachers, combined with interactive lessons, reinforces the new words, making it easier for me to remember and use them in future conversations." Moreover, the engaging and interactive language games and quizzes make the vocabulary-remembering process enjoyable and motivating for foreign language students.

4.6. VR Supports in Understanding English Vocabulary Concepts and Meanings

Not only did the interviews indicate that the participants remembered the vocabulary, but they also showed that VR deepened their comprehension of the learned English words. VR converts abstract vocabularies into concrete concepts by creating simulated contexts. This enables students to infer the meanings of words from visual cues, scenarios, and contextual interactions, which fosters deeper semantic processing beyond memorization, allowing students to move from a surface-level to a deeper understanding through inference and situational context. P6 aptly explained, "It goes beyond rote memorization, allowing me to comprehend how words are used in different contexts, strengthening my overall understanding." One mentioned the VR language games that engaged him in deciphering meanings, thus making a deep connection between words and their meanings.

4.7. VR Activities to Apply English Vocabulary in Practical Contexts

What is the use of remembering and understanding English vocabulary if Chinese EFL learners cannot use it in real-life situations? VR significantly helps the students apply the learned English words in a practical context through its simulation, as stated by the interviewee. Virtual cafeterias, supermarkets, interviews, travel, and other such simulated situations allow the EFL students to practice their vocabulary

and make them confident enough to speak English in real life. One career aspirant (P12) said, "VR simulations of job interviews helped me practice using professional vocabulary in realistic settings." This suggests that the VR tasks allowed students not only to recall memorized vocabulary but also to adapt their tone and phrasing according to the demands of different communicative contexts.

4.8. VR Activities to Analyse English Vocabulary

Analysis is a more complex and higher-order cognitive process. VR also encourages students indirectly to analyze English vocabulary by presenting it in various situational contexts. It is reflected in the answers given by the Chinese EFL students. "Debating virtually on diverse topics helps me break down vocabulary components and grasp their meanings more comprehensively" (P3). "Discussing job-related topics and scenarios helps me dissect words and phrases, understanding their structure and usage within the professional workplace environment" (P4). Thus, VR allows them to analyse and understand how English vocabulary is used somewhat differently in professional and casual settings. Another student (P5) added, "Through virtual market experiences, I analyse English vocabulary by interacting with virtual products and descriptions, breaking down words, and negotiating phrases to understand their structure and practical usage."

4.9. VR Facilitating the Synthesis of Different Vocabulary Elements

Interviews with Chinese EFL students revealed that VR played an excellent role in synthesizing different vocabulary elements to articulate their ideas and expressions effectively in various situations. Most importantly, it guides the students to organize their vocabulary meaningfully to create meaningful and structured sentences. This is crucial for effective communication in English. P7 said, "I used interactive language puzzles in VR. I used all the vocabulary knowledge to solve the complex linguistic challenges." At the same time, VR offers the scope to combine newly learned words to produce English narratives and descriptions. This will again promote originality and creativity in language use.

4.10. VR Supporting Evaluation of English Vocabulary

VR can be considered an effective medium to evaluate the English vocabulary of Chinese EFL students. In terms of meaning and structure, students reported that virtual reality assessed their vocabulary learning. P10 said, "Actually, my overall language competency has improved. I could check it by exercising in different contextual situations." Students assessed their vocabulary through simulated tasks that required self-monitoring and adjustment. Participants reported revising their vocabulary use after receiving feedback or reflecting on errors. It provided students with a wide range of simulated situations to evaluate the accuracy and applicability of their vocabulary use. Similarly, P8 stated, "By using and getting feedback on the accuracy and relevance of words in professional contexts, I improved my language abilities and now I can communicate more confidently in the workplace." This suggests the involvement of metacognitive strategies such as evaluation and self-regulation.

5. Discussion

5.1. Overall Effect of VR on Chinese EFL Learners' Vocabulary Acquisition

As stated in the study, exploring the impact of virtual reality on the vocabulary acquisition of Chinese learners was the main intention of the study. Results indicated that seventy percent of the participants perceived VR as an effective tool in developing their vocabulary in the English language. A similar study found that EFL students who used VR games gained more vocabulary than others [21]. Though the majority of them were a little hesitant at first about the possible advantages of VR in the context of vocabulary, they still seemed excited. On the other hand, they had a positive mindset about VR being beneficial for them during their English for Foreign Language (EFL) course. Ultimately, they used VR during their course with great effect. This, in turn, makes VR a well-liked teaching and learning tool, as it can enhance the learning outcomes of the students it offers [22].

The interview showed how a virtual city tour provides them with the opportunity to converse with native speakers. With the use of such audio, text, and visual assistance, virtual reality (VR) might offer multimedia learning tools that help

students see, comprehend, and build knowledge[23]. Thus, VR's context-based social engagement facilitates language proficiency. As a result, students are exposed to crucial vocabulary acquisition cognitive processes, which involve the provision of visual cues when target words are employed in conjunction with commonly occurring words. In addition to learning these different collocations, they will also be introduced to the valence of verbs, which will help students become even more familiar with syntactic patterns.

The most commonly addressed topics when it comes to using desktop virtual reality (VR) for language learning are motivation and self-efficacy[24,25]. The virtual job interview provided the much-needed professional context where EFL students could enhance their professional language skills by using appropriate vocabulary. This made them highly confident in their field of study and motivated them by providing intelligible information and purposeful engagement via context-based learning.

Many times, the interviewee mentioned that the VR medium is very interactive and a fun way to exercise their vocabulary. Beyond simply allowing students to engage with one another in a 3D space, virtual reality (VR) also enables students to interact with items in the VR world to learn more, explore, and expand their knowledge[21]. This helped them retain the newly learned words for a longer time. By presenting and hearing high-frequency concepts in relevant contexts, it seeks to aid students in learning them. They encounter tactile as well as visual stimuli when acquiring vocabulary in the virtual English language learning environment[26,27].

As noted earlier, VR enhances vocabulary retention by enabling multimodal engagement. This includes visual representations, auditory feedback, and physical interaction within a simulated environment. These combined inputs create richer encoding opportunities compared to text-only or video-based methods. The immersive, interactive nature of VR promotes active learning, enabling learners to focus less on rote memorisation and more on linking words to actions, objects, and contexts. In virtual environments, the products or items that words refer to are not just textual but also visually represented. When using virtual reality, students enjoy the illusion of being in a different world. It is this manufactured sense of quasi-reality that causes them to refocus their attention from memorization of word forms to associations with concrete objects, enabling them to perceive lexical items as image-based hints and stimulate more responses to them during the learning process. A study found that VR users learn and retain language more effectively than only video viewers[28]. This is because it provided multimodal assistance and improved student engagement through real-time interaction and feedback, contextualizing vocabulary acquisition.

It has helped structure sentences more easily, provided context for English vocabulary, and made students feel more confident discussing their field in English. Another plausible reason could be that engaging with a teacher (virtual) who speaks fluent English encouraged students to expand their useful vocabulary, acquire the words they were looking for, and use them in fictitious situations, all of which improved their learning efficiency. This highlights the relevance of using VR in vocabulary learning for students from different career backgrounds, as it caters to their specific needs and helps them use English words in real-life scenarios.

Virtual reality can be utilized to make learning more engaging and enjoyable, to increase motivation and attention[29]. In the present study, participants affirmed that the lessons were innovative, interesting, engaging, and motivating. Studies carried out in real classrooms using the 3D virtual environment revealed that because the students were genuinely interested in learning, they tended to be more open, self-assured, creative, and understanding[30,31]. However, one student (P10) found VR a distraction and a waste of time, effort, and money. On the same note, no statistically significant gains in vocabulary acquisition by VR were found in a study[32].

The study found that some students mentioned that VR sessions were beneficial in allowing them to learn at their own pace without disrupting traditional class lectures. As a result, high achievers can access content more quickly and thoroughly, and poor achievers are spared from keeping up with challenging work[33]. This method is different from the old classroom mindset, which frequently penalized both high and low achievers by forcing students to complete assignments as a single, cohesive unit. Therefore, VR seems to encourage individualised instruction, especially for students with special needs or gifted students.

This shows that the primary intention of the study, offering and engaging an efficient strategy like VR to improve EFL learners' vocabulary acquisition, was accomplished.

The researcher of a study asserts that the main building block for second language acquisition is vocabulary development [34]. The linguistic context is crucial for the learning of vocabulary. EFL teachers struggle to create conversational contexts to achieve higher learning outcomes, even knowing that words are best learned when they occur in related contexts. The study's recommendation for virtual world learning aims to offer a solution for this challenge.

5.2. Effect of VR on Cognitive Processing in Vocabulary Acquisition under the Lens of Bloom's Taxonomy

All learning objectives at all levels of Bloom's taxonomy can be accessed through the use of virtual reality or augmented reality software [35]. The findings of the present study demonstrated how EFL learners can climb Bloom's taxonomic pyramid by utilizing VR, which offers unique learning opportunities and a dynamic learning environment. The entire spectrum of Bloom's Taxonomy's cognitive skills, from lower recall to higher-order evaluation, creation of knowledge, and communication, was reported by the students, similar to the results of a study [36].

This is evident from the interview: VR has improved the retention of newly learned English words so drastically that Chinese EFL learners can easily recall the English vocabulary. The findings of a study reveal that virtual reality (VR) technology offers an optimal setting for extended contextual learning experiences and deep language immersion, improving the phonological, structural, grammar-related, and syntactical understanding of English as a Foreign Language (EFL) learners [37]. Additionally, reading aloud while playing the task-solving games helps improve word recall. As a result, they can start and go through a situation-specific chunking process in which words and associated expressions are gathered and then constructed into larger, more meaningful pieces rather than being learned separately in a decontextual routine. Chunking improves vocabulary knowledge, especially in terms of word choice and fluency.

The participants anonymously admitted that the visual representations of the VR activities helped them to grasp the English vocabulary meaningfully by comprehending its context. This reduced the burden of rote memorisation of foreign words. When learning a foreign language, having a useful, practical vocabulary is extremely crucial to the development of an overall authentic application of vocabulary knowledge [38]. To summarize, the VR application was an excellent working tool for students since it allowed them to engage with the vocabulary at a higher level while also exercising the words in authentic settings by situating them in a specific context, image, occasion, or action. As a result, it improved the process of comprehending and remembering word meanings [39]. Furthermore, among the keywords they discovered as part of the context, their secondary vocabulary for synonyms and abstract words grew [28]. Overall, the VR software provided chances for word use in real-world contexts by placing vocabulary into the context of discourse, experience, pictures, and action. This improved the clarity and retention of word meanings [39]. Especially for words with abstract meanings, it became easier for students to learn new words and enhance their practical skills [28].

As reported by EFL students, VR gave them plenty of opportunities to apply their English vocabulary in a variety of real-life scenarios. This, in turn, greatly increased their confidence. The constructivist approach can support this as it encourages higher-order cognitive skills like application and reasoning as opposed to only rote learning [40]. Here, 'application' refers to students' ability to transfer learned vocabulary into novel, practical scenarios, such as job interviews or travel planning, which goes beyond simply recalling memorised words. Students were observed adjusting vocabulary tone and complexity to match different social contexts, indicating adaptive use. This differentiates application from basic recall, and precedes higher-order processes like evaluation or analysis.

In some tasks, they had to choose proper words that were best suited for professional settings or casual contexts. In this context, the participants used different VR activities to analyse their vocabulary knowledge in different contexts. The framework of Bloom's taxonomy in contextual learning helps them in internalizing syntactic patterns and principles.

VR is found to be an effective tool for Chinese EFL students not only to develop vocabulary but also to express thoughts and phrases in different contexts. Students used virtual reality (VR) to construct sentences in the proper order and write words logically. Both of them are necessary for accurate conversation. Using interactive language puzzles helped one of the study's students overcome language barriers quickly. Moreover, while writing English stories and

narratives, students can use virtual reality. This expands their imagination and allows them to express their feelings. This way, VR also boosts the processes of vocabulary acquisition, including phonetics, morphology, syntax, semantics, and pragmatics.

A study reports that 3D virtual learning environments can be used to evaluate vocabulary learning [41]. The present study also found that students can assess their progress in vocabulary acquisition by applying it in simulated situations concerning accuracy, relevance, context-specificity, and fluency. Their involvement sharpens their focus on sentence structures by getting them to examine sentence components, determine their grammatical functions and validity, and then refresh their syntactic memory.

5.3. Shortcomings of Using Virtual Reality

The study found that while VR in EFL vocabulary learning was beneficial, a few students encountered some technical issues. They found the menus and controls confusing and struggled with the initial setup of the VR gear. VR technology is constantly evolving to provide user-friendly interfaces and applications. However, as technology advances at lightning speed, the more users get used to it, the more its utility can be availed of. They also felt isolated during one-on-one sessions, which were less personal and lacked a sense of community. According to previous findings [42], using VR may have unfavourable physiological and physical side effects such as worry, stress, addiction, isolation, and mood swings. The human touch was missing due to the machine-led interface. One challenge was the lack of feedback on pronunciation. To overcome this, students recorded themselves during VR language exchange sessions and sought feedback from native speakers outside the virtual environment to refine their pronunciation. In this respect, it should not be forgotten that EFL teachers must scaffold their students whenever required to maximise their vocabulary acquisition through VR.

6. Conclusion

To summarise the whole study, the integration of virtual reality into EFL courses gave numerous opportunities to enhance the vocabulary acquisition of Chinese students. Not just superficially, even when explored using the framework of Bloom's taxonomy, VR proved to be an effective medium to foster low to high cognitive processing during the acquisition of English vocabulary. Students were so excited to participate in virtual reality technology that it kept them interested and motivated. Due to its ability to meet various learning demands, contextualized vocabulary acquisition through VR will draw more and more attention despite having a few limitations. The implications of this research go beyond the local Chinese context and add to the international discourse on creative language learning.

7. Limitations & Suggestions For Future Studies

However, there were certain restrictions while conducting this study. The small sample size is one of the constraints. Therefore, it is advised that bigger, more varied sample sizes be used in future research projects to increase their generalizability. Another limitation lies in the variation of VR tools used by participants, ranging from tourism-based simulations to academic or professional scenarios. It is possible that these tool-specific differences may have influenced the perceived relevance or effectiveness of vocabulary acquisition. Moreover, all participants did not have equal levels of comfort/familiarity with VR technology. This could affect how they engaged with the learning tasks and responded during interviews. Therefore, future studies should consider standardising the types of VR activities used by participants to reduce variability in task demands. In addition, assessing students' baseline familiarity with technology prior to the intervention could help identify potential barriers to engagement and inform targeted scaffolding strategies.

Apart from this, future research must look at VR's long-term effects on EFL instruction. Future studies may also look into how other language abilities, particularly productive ones like speaking and pronunciation, are developed and used. This would give practitioners a more thorough grasp of how VR might support EFL learners' overall language development and enable them to make well-informed decisions about incorporating VR into the curriculum. By exploring new dimensions, improving techniques, and looking into a variety of learner demographics, researchers who are interested in the relationship between virtual reality, Bloom's Taxonomy, and language acquisition might expand on the discoveries that were made.

Author Contributions

Conceptualization, Y.S.; methodology,Y.S.; validation, Y.S.; formal analysis, Y.S.; investigation, Y.S.; resources, Y.S. and H.H.I.; data curation, Y.S.; writing—original draft preparation, Y.S.; writing—review and editing, S.H.; visualization, S.H.; supervision, S.H.; project administration, S.H. All authors have read and approved the final manuscript.

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This study has been approved by the Shaoxing Institute of Technology.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data that supports the findings of this study is available from the all authors, upon reasonable request.

Conflicts of Interest

No potential conflict of interest was reported by the authors.

Appendix A

Kindly provide the following background information about yourself

Name:

Age: Gender:

English proficiency level:

Major Subject:

I appreciate you taking part in this interview. We value your honesty, and the interview will focus on your experiences with virtual reality (VR)-based language learning as well as the cognitive processes associated with vocabulary acquisition.

Section 1: VR in English Vocabulary Learning

1. Have you ever used Virtual Reality (VR) as a part of your English language learning activities? If yes, please describe your experience briefly.
2. What are your initial thoughts or feelings about using VR for learning English vocabulary?
3. Can you describe any specific VR activities or applications you have engaged in for vocabulary acquisition in English?
4. Overall, how do you believe the use of VR has impacted your English vocabulary acquisition? Please provide specific examples.
5. Have you faced any challenges or difficulties while using VR for vocabulary learning? If yes, please describe them and how you have addressed them.
6. Do you have any preferences or specific types of VR activities that you find most beneficial for learning English vocabulary? Please explain.

Section 2: Bloom's Taxonomy Levels

7. How do you think VR activities have helped you in recalling and remembering English vocabulary? Can you provide specific examples?
8. In what ways do you feel that VR supports your understanding of English vocabulary concepts and meanings? Share any experiences that stand out to you.
9. Have you noticed any instances where VR activities have allowed you to apply English vocabulary in practical contexts or real-life situations? Please elaborate.
10. From your perspective, how do VR activities contribute to your ability to analyze English vocabulary, breaking it down into components or understanding its structure?
11. Can you share examples of how VR has facilitated the synthesis of different vocabulary elements or the creation of new ideas and expressions in English?
12. In your opinion, to what extent does VR support your evaluation of English vocabulary, helping you assess its relevance, accuracy, or effectiveness?

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