

# Metaverse Effect: Exploring Students' Vocabulary Achievement, Retention, and Perceptions in Virtual Environments

Elif AY KAYA

English Language Education

Ondokuz Mayıs University

Samsun, Türkiye

elifay3408@gmail.com

0000-0003-1978-2893

(Corresponding Author)

Ceylan YANGIN ERSANLI

English Language Education

Ondokuz Mayıs University

Samsun, Türkiye

ceylany@omu.edu.tr

0000-0002-4180-4027

**Abstract**—This study sought to examine the effects of Metaverse-based EFL lessons on students' vocabulary achievement, retention, and perceptions. The participants consisted of 16 EFL high school students who were attending 11th grade during the 2023-2024 academic year in Türkiye. Adopting a sequential explanatory mixed methods research design, this study collected both quantitative data and qualitative data. The quantitative data was collected by vocabulary pre-test, post-test, and delayed post-test, while the qualitative data was obtained through semi-structured interviews to provide more clarification of the quantitative results. The quantitative data was analyzed using descriptive and inferential statistics on the SPSS program, while the qualitative data underwent content analysis. The findings revealed that students' vocabulary achievement improved after the implementation. However, comparing post-test and delayed post-test results yielded a small but moderately significant decrease in students' vocabulary retention. The increase in vocabulary achievement in quantitative findings was corroborated by the codes obtained through semi-structured interviews. Accordingly, students perceived that the Metaverse-based EFL classes, which incorporated visual and multimodal resources, as well as competition and interaction, effectively improved their vocabulary growth. In addition, students had positive perceptions of Metaverse as they perceived it as a supplementary educational setting beyond the classroom, which was both relaxing and enjoyable due to its game-like nature. Moreover, it was reported that the use of avatars enhanced their confidence and overall enjoyment. Nevertheless, students identified several drawbacks of the Metaverse, including issues such as overheating of the phone, intermittent voices, and invisibility of some learning materials. This study also offers pedagogical implications for English language teachers regarding the use of Metaverse.

**Keywords**—English as a foreign language, Metaverse, Perceptions, Virtual reality, Vocabulary

## I. INTRODUCTION

In the ever-changing field of education, the combination of technology and teaching methods has led to the development of creative approaches to learning languages. Virtual learning environments are a remarkable tool that is transforming the way English language education is understood and provided [1]. Virtual Reality (VR) is an advanced technology that provides realistic and interactive surroundings, which can greatly improve the process of learning a new language [2]. VR offers distinct advantages for English language instruction by enabling the creation of authentic, captivating, and immersive

situations that are typically absent in conventional approaches [2-4]. VR can enhance language skills by providing realistic simulations of real-life interactions and cultural contexts, leading to a better understanding and longer-lasting retention of language abilities. Imagine a boundaryless classroom, where students from all parts of the world gather in a virtual environment, engaging with one another and native speakers using realistic avatars, all from the comfort of their residences. These encounters not only bolster vocabulary learning [1, 5-8] and grammar understanding [9] but also promote pronunciation [10], listening abilities [11], and conversational proficiency [12]. Through the use of virtual worlds, educators may surpass conventional limitations and provide interactive and tailored language learning experiences that equip students for the international arena [13,14, 15]. Similarly, the Metaverse is an immersive three-dimensional (3D) virtual world whereby multi-user avatars interact and typically form an artificial society [16]. The rising utilization of virtual reality technology has led to a growing interest in the educational possibilities of the Metaverse [17]. Educators have a great chance to utilize Metaverse as an educational tool, offering pupils a captivating and interactive learning environment that can be customized to their specific requirements [18]. Although the Metaverse has been around for several decades, it is widely recognized to be in its first phases and there is a lack of concrete evidence to assess its educational worth [7, 17], especially in the Turkish K-12 context. Therefore, this study sheds light on the potential of Metaverse in enhancing vocabulary achievement, retention, and perceptions of high school English as a Foreign Language (EFL) students. It aims to achieve this by combining theoretical insights with practical experiences.

## II. THEORETICAL BACKGROUNDS & LITERATURE REVIEW

### A. Situated Learning

Situated learning is based on the notion that knowledge is substantially impacted by the activity, context, and culture in which it is employed [19]. In Goel et al.'s definition, situated learning is "a change in mental models that happens through social interaction in a given context" (p. 218) [20]. Stories, reflection, cognitive apprenticeship, collaboration, coaching, multiple practice, articulation skills, and technology are the key components of situated learning [20]. In his work, [21] expanded upon the notion of contextual learning by



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investigating its successful implementation in educational environments and stressed the significance of establishing educational settings that accurately mimic the intricacies of real-life scenarios. According to [21], the application of situated learning in the classroom requires incorporating content, context, community, and engagement. He advocated for the use of authentic activities that closely resemble real-life challenges and tasks, social negotiation where students engage in dialogue and collectively build knowledge within a learning community, and reflective practice where students establish connections between their actions and the resulting outcomes. From this standpoint, an additional benefit of learning in the Metaverse arises from the situated learning hypothesis, which posits that learning is more probable when knowledge is contextually pertinent to pupils [22, 23].

### B. Experiential Learning

Experiential learning, as conceptualized by [24], is a dynamic process in which information is generated via the conversion of first-hand experience. The process consists of four stages: concrete experience, reflective observation, abstract conception, and active experimentation. This iterative methodology emphasizes the significance of experiential learning and introspection, fostering enhanced comprehension and memory retention.

The theory of experiential learning is based on the contributions of influential scholars from the 20th century who emphasized the importance of experience in understanding human learning and development. These scholars include John Dewey, Kurt Lewin, Jean Piaget, William James, Carl Jung, Paulo Freire, Carl Rogers, and others [24]. The experiential learning process is depicted as an idealized learning cycle or spiral in which the learner engages in a recursive process of experiencing, reflecting, thinking, and acting [25]. This process is responsive to the learning setting and the subject matter being learned. Observations and reflections are founded upon immediate or tangible experiences. The user's thoughts are processed and condensed into abstract ideas, which can then be used to derive new implications for action. These implications can be actively examined and utilized as principles in generating new experiences [25]. In the context of experiential learning, the teacher's function shifts to that of a coordinator of educational material and a facilitator of students' experiences [24]. Similarly, virtual learning environments like Metaverse provide a social setting and framework for achieving language learning objectives by showcasing efforts and experiences [22]. Moreover, the Metaverse offers students the convenience of accessing information in many contexts and allows them to engage with learning materials through an avatar, offering digital educational support and immersion [23].

### C. Vocabulary Learning and Learners' Perspectives of Virtual Reality

Recent research on the incorporation of virtual environments has uncovered encouraging prospects in the domain of L2 teaching and learning. Accordingly, utilizing virtual environments such as the Metaverse for language instruction can augment students' acquisition and long-term retention of vocabulary, while also rendering language

learning more captivating, participatory, and community-centered [1]. Another study by [24] encompassed 57 students from two universities in South Korea who engaged in courses that incorporated Metaverse platforms for diverse educational activities. The study revealed that students valued the supplementary and comfortable learning environments offered by the Metaverse, which went beyond conventional classroom settings. The immersive characteristics of Metaverse platforms significantly heightened students' level of engagement, motivation, and contentment with their learning encounters. [5] conducted a study using a quasi-experimental design with 64 male intermediate school students. The experimental group of students was exposed to a VR game called "House of Languages" where they interacted with objects and characters to acquire new vocabulary. The study revealed that pupils who utilized the VR game had a notably higher level of enhancement in language acquisition as compared to those who employed conventional approaches. In another empirical investigation conducted by [8], a total of 49 seventh-grade students in Taiwan were divided into two distinct groups: an experimental group that utilized the VR application called Mondly VR with head-mounted displays rendered on mobile devices, and a control group that observed a video demonstration of the application on personal computers. Following the intervention, participants who engaged in VR revealed a notable increase in vocabulary acquisition and retention in comparison to the control group, who watched videos. Furthermore, based on the findings of the questionnaire on vocabulary learning facilitated by VR, a significant number of VR users reported that the VR-based learning experience was enjoyable, stimulating, and advantageous.

The users valued the diverse range of support options and the ability to interact in real-time offered by the virtual reality application.

The research conducted by [7] investigated the capacity of VR to enhance the acquisition of English for Specific Purposes (ESP) vocabulary among female postgraduate students in Saudi Arabia. The study comprised a sample of 20 individuals who utilized virtual reality headsets to interact with immersive 360-degree films. The data demonstrated a notable enhancement in the post-test scores as compared to the pre-test, suggesting that the use of VR movies effectively improved the students' ability to remember ESP vocabulary. [6] compared the vocabulary learning of EFL students using a VR visual novel game to a PC version. The VR and PC versions of Angels and Demigods, a sci-fi visual novel game, were tested on thirty Grade 12 high school students. The VR group had a considerably higher vocabulary translation delayed post-test mean score than the PC group. Students had a positive opinion of the virtual game, as they stated that playing it had inspired them to make predictions about the meaning of words.

In general, the literature indicates that Metaverse environments offer immersive and interactive experiences that greatly improve vocabulary acquisition, and retention and positively affect perceptions of language learners. Nevertheless, most of the research is limited to higher education and lacks qualitative data. Especially in the Turkish K-12 context, there is a scarcity of mixed-method research that simultaneously explores learning outcomes and thoroughly

analyzes student perspectives through interviews. Therefore, this study aims to contribute to the literature by investigating the Metaverse effect on students' vocabulary learning, retention, and perceptions. The study aims to address the following research questions:

- Does the Metaverse-based EFL lesson significantly improve high school students' vocabulary achievement and retention?
- What are the high school EFL students' perceptions of taking an English class in a Metaverse environment?

### III. METHODOLOGY

#### A. Research Design

This study adopted an explanatory sequential mixed method design which commences with collecting and analyzing quantitative data, followed by the collection and analysis of qualitative data to provide more clarification or elaboration on the quantitative findings obtained in the initial phase [26] as illustrated in Fig. 1.



FIGURE 1. EXPLANATORY SEQUENTIAL DESIGN (ADAPTED FROM [26]).

#### B. Participants

This study involved the participation of one class from a state high school in Samsun, Türkiye, using the convenience sampling approach described by [27]. The teacher of the class, who was also one of the researchers, did the research alongside her students. The sample comprised 16 female EFL students who were enrolled in the 11th grade at the time of the study. According to the Common European Framework, their level of English proficiency was classified as B1. None of the participants acknowledged prior usage of Metaverse for language learning before.

#### C. Data Collection and Instruments

The ethical approval for data collection was acquired from the Ondokuz Mayıs University Social and Humanities Ethics Committee. Data gathering involved the utilization of three distinct data instruments: a vocabulary achievement test, a semi-structured interview, and a Spatial.io website as a tool for the Metaverse-based EFL lesson. Following the dissemination of information to parents and students regarding the purpose and potential outcomes of the study, students who expressed their willingness to take part in the implementation were asked to engage in the data-gathering process. Students first took the pre-vocabulary achievement test, attended the English lesson in the Metaverse environment, and completed a post-test. Following the analysis of the quantitative data, an individual semi-structured interview was conducted with students to gain deeper insights into their perceptions of Metaverse-based EFL lessons.

#### 1) Vocabulary Achievement Test

The instructor who is one of the researchers created a vocabulary achievement test to be taken before and after the intervention. The order of the questions was randomized for the post-tests to impede memorization. To ensure validity, the test was evaluated by two English language teachers at the same high school for content validity. The test included 20 multiple-choice questions whose target words were selected from the reading texts on two distinct extreme sports that align with the unit subject (Appendix A). Each item had a value of five points, and the highest possible score a student could achieve was 100. The time allotted was 20 minutes for each test.

#### 2) Semi-Structured Interview

To investigate students' perspectives on the influence of the EFL lesson in the Metaverse environment on their vocabulary acquisition, the researchers created a semi-structured interview consisting of four questions: 1. What are the positive aspects of learning English in a virtual environment? 2. What are the negative aspects of learning English in a virtual environment? 3. How can you explain the effect of the English lesson in a virtual environment on your vocabulary learning? 4. Would you like to continue learning English in a virtual environment? Could you please explain the reasons behind your answer? A total of ten students willingly participated in these interviews, with each session lasting for ten minutes. As the participants were non-native English speakers, the interviews were conducted in their native language so that they could express their ideas more comfortably and accurately. All the interviews were audio-recorded and transcribed in the Microsoft Office Word program for the data analysis procedure.

#### D. Spatial.io for a Metaverse environment

Spatial is a platform where creators design and distribute interactive social experiences in 3D for web, mobile, and virtual reality. It utilizes the capabilities of virtual and augmented reality to construct immersive and interactive environments that can improve remote collaboration, innovation, and social interaction [28]. Participants can engage with three-dimensional objects, exchange screens, and utilize spatial audio to facilitate more authentic conversations. The platform prioritizes delivering a user-friendly experience with features such as customizable avatars and seamless navigation inside the virtual environment. Spatial offers customers the ability to generate spaces in both the commercial and free editions of the platform. The complimentary version provides the capability to generate three fundamental spaces and provide invitations to three individuals for the privately created spaces. Nevertheless, to extend invitations to more users, it is necessary to transition to Spatial+ and incur a monthly charge. Since our study required the participation of 16 individuals, we opted to utilize the premium edition of Spatial+ and created a space using the Isle Gallery template.

#### E. Procedure

##### 1) Pre-Intervention

A lesson plan (Appendix B) was developed by researchers to be utilized in the Metaverse setting, aligning with the unit



theme and desired unit outcomes. Accordingly, it was anticipated that students would acquire and apply vocabulary related to extreme sports by engaging in discussions and different learning activities. Before the teacher set up a metaverse environment (Fig. II) with educational resources based on the lesson plan, a student orientation was held during class hours in a Metaverse orientation space created by the teacher.



FIG. II. EFL CLASSROOM IN A METAVERSE ENVIRONMENT

For this activity, students initially installed the spatial.io program on their mobile devices and proceeded to register within the system. Subsequently, each individual generated their personalized avatar and converged on the Metaverse space by accessing the space hyperlink established by their instructor. Within this area, they uncovered fundamental functionalities such as transitioning between rooms, assuming seated and standing positions, and utilizing the microphone and chat system. The pre-intervention procedure was completed following the administration of a pre-vocabulary achievement test in the classroom.

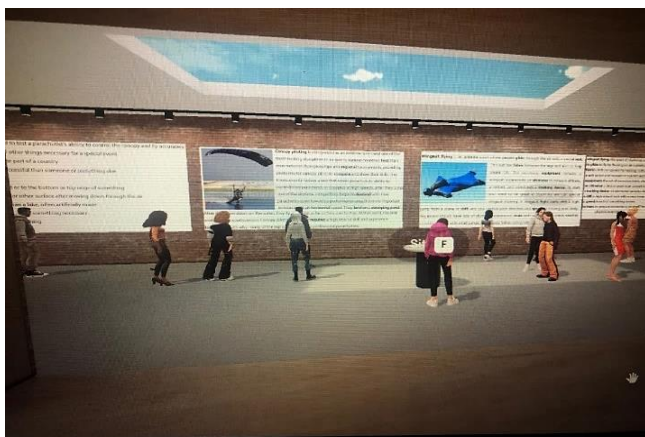


FIGURE. III. SCREENSHOTS OF DISCUSSION AND READING ACTIVITIES

## 2) During Intervention

The following evening after the orientation, students convened in the Metaverse once more to participate in an EFL class that was carefully crafted to help them acquire the target vocabulary items through various activities and integrated skills. The teacher instructed English and ensured that every student could actively participate in each activity (Fig. III and Fig. IV) without experiencing confusion while navigating. The

classes were held outdoors and consisted of two sessions totaling 90 minutes.

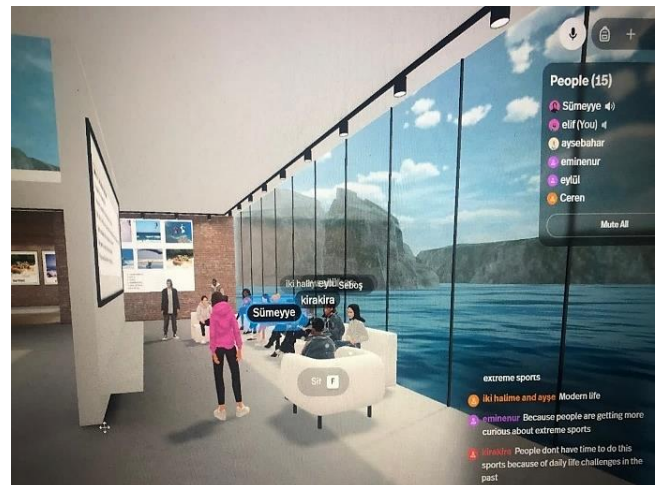


FIG. IV. SCREENSHOTS OF DISCUSSION AND READING ACTIVITIES.

## 3) After-Intervention

Following the completion of the intervention, the students were given a vocabulary post-test to assess any potential changes in their vocabulary acquisition after participating in an EFL class in the Metaverse environment. 20 days following the instruction, a delayed post-test was given to the students to observe the postponed impact of the intervention on students' acquisition of vocabulary. After doing a quantitative analysis, 10 students who volunteered were selected to participate in a semi-structured interview. The purpose of the interview was to acquire a more comprehensive understanding of how the implementation affected their vocabulary learning and their perceptions.

## F. Data Analysis

Quantitative data were analyzed via the SPSS program. Initially, descriptive statistics were conducted to uncover the average scores of the vocabulary tests. Afterwards, the normality of the pre-post and delayed vocabulary test data was checked through the Shapiro-Wilk test to determine whether to use parametric or non-parametric tests. As all the data were distributed normally, a paired samples t-test was performed to compare the means of pre-test and post-test scores as well as post-test and delayed post-test scores. Subsequently, Cohen's d was computed as the effect size to evaluate the extent of the observed difference in the paired samples t-test [29]. Cohen's d for paired samples is determined by dividing the mean difference of pre-test and post-test scores by the standard deviation of those differences. The mean difference signifies the average alteration in scores, whilst the standard deviation indicates the diversity of such alterations. This formula classifies Cohen's d as follows [29]:

- Small effect (about 0.2): The distinction is perceptible however limited.
- Medium effect (about 0.5): The disparity is significant and likely consequential.
- Large effect (about 0.8 or greater): The disparity is significant and likely has practical importance.

For the qualitative data analysis, transcribed interviews were analyzed through thematic analysis which is used to

uncover, analyze, and interpret patterns of meaning, known as 'themes', within qualitative data [30]. The analysis of the interview data involved open coding [31]. The investigator sought the assistance of an independent evaluator to assess the dependability of the qualitative data and to reach an intercoder agreement [32]. Upon reviewing interview transcripts, two coders determined that the key themes and codes they had identified were congruent.

#### IV. FINDINGS

Given the sequential explanatory mixed-methods design of this study, the quantitative and qualitative data are given in distinct sections.

##### A. Quantitative Findings

A Shapiro-Wilk test was applied to check the data's normality distribution, it revealed that all data showed a normal distribution ( $p=.58$  for the pre-test,  $p=.13$  for the post-test, and  $p=.06$  for the delayed post-test). Descriptive statistics were applied to reveal the mean scores of pre-post and delayed vocabulary tests. Table I illustrates the results of descriptive statistics.

TABLE I. DESCRIPTIVE STATISTICS OF VOCABULARY PRE-TEST, POST-TEST, AND DELAYED POST-TEST SCORES

Tests	M	N	Std. Deviation	Std. Error Means
Pre-test	59.37	16	12.09	3.02
Post-test	81.87	16	13.64	3.41
Delayed post-test	76.25	16	15.00	3.75

Table I shows that the average score of students' vocabulary achievement in the post-test and the delayed post-test is greater than their average score in the pre-test. Nevertheless, the mean score in the delayed post-test was lower than the post-test scores. To determine the statistical significance of this discrepancy, a paired-sample t-test was utilized. Table II demonstrates the paired samples t-test results.

TABLE II. PAIRED SAMPLES T-TEST FOR VOCABULARY PRE AND POST-TEST

Paired Differences							
Pre-test and Post-test	Mean	SD	SE	t	df	p	D
	-22.50000	11.25463	2.81366	-7.997	15	.000	-1.99

As evident from Table II, the paired-sample t-test yielded a p-value of .000, indicating that the difference between the pre-test ( $M=59.37$ ) and post-test ( $M=81.37$ ) scores was statistically significant. Evidence suggests that students' vocabulary attainment had a notable enhancement after implementing the EFL lesson in the Metaverse environment. The effect size for the Metaverse intervention was determined to be quite substantial, with a computed Cohen's d value of -1.99. The negative value of Cohen's d merely signifies the direction of score changes (an increase from pre-test to post-test) and does not modify the conclusion that the intervention was extremely effective. In the meantime, three weeks following the students' completion of the vocabulary post-test, a vocabulary delayed post-test was administered to students. This analysis aimed to assess the influence of an EFL course in the Metaverse setting on the retention of vocabulary. A paired samples t-test was employed to compare the average scores between the pre-test and delayed post-test as well as the post-test and the delayed post-test. Table III shows the paired samples t-test results for vocabulary post-test and delayed post-test.

TABLE III. PAIRED SAMPLES T-TEST FOR PRE-AND DELAYED POST-TEST AND POST-TEST AND DELAYED POST-TEST

Paired Differences							
	Mean	SD	SE	t	df	p	d
Pre-test and Delayed Post-test	-16.87500	8.73212	2.18303	-7.730	15	.000	-1.93
Post-test and Delayed Post-test	5.62500	8.53913	2.13478	2.635	15	.019	0.65

As explained in Table III, there is a significant difference between the pre-test scores ( $M=59.37$ ) and delayed post-test scores ( $M=76.25$ ) since the p-value is .000, which indicates a growth in vocabulary achievement after Metaverse intervention. The effect size ( $d=-1.93$ ) demonstrated a very strong significance. However, Table III clearly shows a statistically significant decline in students' vocabulary retention when comparing delayed post-test results ( $M=76.25$ ) to immediate post-test results (81.87), as indicated by a p-value of .019, which is lower than the threshold of .05. The effect size for this significance was calculated as .65 indicating a moderate level of significance.

##### B. Qualitative Findings

After the Metaverse intervention, there was a noticeable change in students' vocabulary achievement in the quantitative component of the study. Researchers collected and analyzed qualitative data from learners to further understand how their vocabulary development improved. Ten EFL students were each given a semi-structured interview to achieve this goal. The outcomes of the interviews, examined using thematic analysis, yielded several topics and categories about the learners' attitudes and perceptions towards the influence of the Metaverse on their vocabulary achievement. Table IV displays the generated themes and codes with their frequencies.

TABLE IV. THEMES, CODES, AND FREQUENCIES OF STUDENTS' PERCEPTIONS

Themes	Codes	Frequencies
<b>Improving Vocabulary</b>	Multimodal materials	7
	Competition	5
	Visual Materials	5
	Interaction	4
<b>Advantages</b>	Enjoyable classes	10
	A sense of gaming immersion	10
	Using avatars	5
	Providing a learning environment outside the school	3
	Comfortable learning environment	3
<b>Disadvantages</b>	Overheating of the phone	7
	Intermittent voices	5
	Invisibility of some learning materials	4
<b>Future intentions of using Metaverse</b>	Using Metaverse as a supplementary tool for enjoyable EFL lessons	10

Students emphasized the significance of the Metaverse in improving their acquisition of vocabulary. The learners asserted that a Metaverse classroom, equipped with diverse multimodal learning activities, facilitated their acquisition of vocabulary items in a more memorable manner. Furthermore, it has been claimed that engaging pupils in competitive activities in Metaverse environments has a beneficial impact on their vocabulary acquisition, making it enjoyable and enduring. The following quotations elucidate the codes with clarity:

*"I believe that the range of activities encouraged our vocabulary growth. Visual memory therefore leads us to a certain point, but we studied the reading material, watched videos, constructed phrases, spoke... All of them together gave the phrases more permanency. I cannot thus declare solely visual memory."* (Student 8)

*"...Stated otherwise, whether visual or auditory memory, we recalled the word using multiple memory strategies. For the gallery walk exercise, for instance, the vocabulary acquisition was more memorable with images; yet, in the reading activity, interpreting the text using the dictionary you prepared and debating the questions with our friends taught the words quite effectively."* (Student 4)

*"My favorite part was the sentence-building competition where we had to use the new words within the allotted time. Everybody finished the race at a high level of competition."* (Student 9)

Some students credited the expansion of their vocabulary to the visual nature and interaction between students and between students and the teacher. The following extracts provide support for these viewpoints:

*"I think the design of the Metaverse classroom was very excellent. You did a really good preparation for it. First of all, visuality is essential; so, the word is not only something to memorize; rather, you choose appropriate images there, especially the ones you place at the beginning of the texts, etc. They enable the words to take shape in our minds."* (Student 9)

*"Well, it was like this: I discovered certain words I didn't know; my friends wrote their meanings in the chat section, also you clarified it; then we discussed our opinions."* (Student 5).

The second theme regarding the advantages yielded several codes including enjoyable classes, a sense of gaming immersion, using avatars, providing a learning environment outside the school, and a comfortable learning environment. All interviewees recognized that participating in an EFL class in the Metaverse environment heightened their level of enjoyment, and they experienced a sensation akin to engaging in a digital game. One of the learners highlighted that:

*"It caught my attention more because it was set up like a game. Our avatars were really cute. We could navigate and even dance... That's why I had a great time."* (Student 5)

Another important finding was found about the benefits of using avatars. Student 1 and Student 9 expressed themselves as below:

*"It was nice; at last, it seemed to me, we were expressing our inner selves outside."* (Student 1)

*"Usually, most people do not wish to switch on their cameras because nobody is constantly available. In this sense, I believe avatars are far superior; so, it is far more beneficial to create avatars in virtual classrooms."* (Student 9)

Metaverse was thought to provide a supplementary and comfortable learning environment for English learning outside the school. The following passages from the interviews capture the respondents' viewpoints:

*"It helped us to learn in a positive sense and allowed us to be in the same environment outside of school."* (Student 3)

*"Learning would be better done away from those desks. Our classroom is rather hot in the summer; and cold in the winter. Learning in a classroom can be somewhat uncomfortable because of physical elements; sometimes, it is difficult to get up and get ready for school; hence, learning in Metaverse was more pleasant."* (Student 10)

Although students observed numerous advantages, the Metaverse, like other technological applications, encountered technical challenges. Most of the students had similar technical problems mostly overheating of their phones, and sometimes intermittent voices and invisible learning materials. They explained these problems:

*"Honestly, the app makes the phone hot; in fact, I was unable to type on the screen because the phone was too hot. Things heated up as you probed for details. Beyond that, there were instances when your voice sounded choppy as if you had consumed helium gas."* (Student 6)

The application sometimes experienced disconnections and slowdowns, even with an internet connection. When I was watching the video, I had sound and no picture, and some of the questions you pasted on the wall looked blurry to me. (Student 4)

When students were asked about their intentions of using the Metaverse for English learning in the future, they expressed that they would be willing to use it as a supplementary tool. However, they maintained that it could not serve as a substitute for in-person instruction. One of the learners expressed that:

*"It's fun and interesting when it happens once in a while, but I don't think it's helpful when it happens all the time. It detaches you from reality and changes our perception of reality."* (Student 4)

*"I like in-person instruction; therefore, I really wouldn't want it to be ongoing. Long-term learning English online would be somewhat challenging since I cannot spend too much time staring at phone screens. Also, we are stuck here and can't move around much, so it's not ideal."* (Student 2)

All in all, students' reflections demonstrated positive perceptions of the Metaverse for English learning and clarified the reasons behind their vocabulary development.

## V. DISCUSSION

Following a sequential explanatory mixed methods approach [26] this study aimed to examine the impact of the Metaverse intervention on students' vocabulary learning, retention, and perceptions. The findings of the first research question which was "Does the Metaverse-based EFL lesson significantly improve high school students' vocabulary achievement and retention?" revealed that students had a statistically significant increase in their vocabulary learning



after the Metaverse intervention. This result is in tune with those of previous studies [5, 1, 6, 7, 8] which indicated that students' vocabulary learning was enhanced through immersion in virtual worlds. The finding suggests that acquiring English language skills in immersive and engaging settings might significantly improve pupils' vocabulary growth. The present study demonstrated that the experiential characteristics of the Metaverse environment offered concrete experiences [24] wherein students interacted with language in an enjoyable, informal, and exploratory setting, facilitating the assessment of their knowledge through interactive activities [33, 34]. Students' discussions about their learning during the initial session break may have facilitated self-reflection [24] on their educational experiences, while the subsequent activities in the Metaverse could provide opportunities for them to apply newly acquired vocabulary items in a different context through active experimentation [24]. In addition, based on the interview results the positive effects on the participants' vocabulary learning could be attributed to the multimodal, interactive, and authentic environment of the Metaverse [35, 13, 21]. Students' responses during interviews indicated that they perceived their learning as facilitated by social engagement [21] with peers during the online sessions. Furthermore, students identified the inclusion of visual materials in the reading text and vocabulary gallery and the competitive atmosphere fostered by a vocabulary game in the Metaverse environment as beneficial factors for enhancing their vocabulary skills. This finding indicates that by utilizing a meticulously crafted curriculum, a diverse array of activities commonly performed in physical classrooms can be efficiently executed in virtual classroom settings such as Metaverse. Nevertheless, it is important to acknowledge that implementing this strategy and designing the space necessitates significant dedication and labor on the part of teachers. On the other hand, the benefits of Metaverse-based EFL learning may not always contribute to vocabulary retention, as indicated by the findings of this study. While the decrease in their vocabulary-delayed post-test scores was small compared to the immediate post-test scores, it was nonetheless considered statistically significant. A probable explanation for this reduction may be the declining novelty impact linked to the Metaverse. The initial exposure to the Metaverse-based learning environment likely heightened students' motivation and engagement due to the novelty of the immersive technology, thereby contributing to their improved performance on the immediate post-test. This finding is consistent with [36], suggesting that the novelty effect can enhance student engagement and motivation. Nevertheless, as the novelty effect diminished, pupils may have returned to their typical learning behaviors or attitudes, likely decreasing their engagement with the content. The decrease in involvement may have hindered vocabulary consolidation into long-term memory, leading to the fall noted in the delayed post-test. Furthermore, in line with cognitive load theory [37], students might have experienced cognitive load from technical challenges or the immersive nature of the Metaverse [38]. Though the immediate test results suggest this load wasn't overwhelming enough to impair short-term performance, the decline in delayed test results might point to insufficient long-term encoding due to cognitive overload during learning [38].

However, in the absence of spaced reinforcement to strengthen long-term retention, a loss in retention is anticipated, irrespective of cognitive load.

The second research question sought to reveal students' perspectives on Metaverse-based EFL learning concerning its benefits and drawbacks. According to the salient patterns arising from the interview data regarding the advantages, the perceived advantages of taking English classes in the Metaverse setting were related to the fun component, game element, multimodality, avatar personality, and accessibility beyond the confines of the school. The findings align with the outcomes of previous studies conducted in the Metaverse domain [35, 13, 2, 7]. Furthermore, pupils mentioned that having a comfortable learning environment was another benefit. This finding is in accord with recent studies [5, 23]. These findings highlight the potential of virtual learning environments as a viable alternative to traditional classroom settings. Although the Metaverse environments have certain advantages, students have identified several technical challenges as their drawbacks. The poor sound quality, overheating of the phone, and invisibility of some learning materials were the main challenges experienced during the classes. This finding is consistent with the studies conducted by [35, 13, 36], which show that low sound quality, exacerbated by reverberating noise, hindered the process of completing tasks. The technical challenges identified in this study are significant barriers to effective language learning in Metaverse environments. Inferior sound quality might hinder comprehension and pronunciation practice, both essential for vocabulary learning in EFL environments. When learners have difficulty hearing instructions or contextual examples clearly, their capacity to connect with the subject and fulfill tasks declines [35, 13, 36]. This is especially difficult in virtual settings, where effective communication is essential for sustaining immersion and concentration. The overheating of devices disturbs the learning process and induces irritation among pupils, resulting in eventual disengagement. Students dependent on smartphones may perceive constraints due to their devices' performance, diminishing their inclination to engage in subsequent virtual learning sessions. The issue of certain students being unable to view learning materials during live sessions, while the teacher and other students can access the content without trouble, underscores a significant shortcoming of the platform. This mismatch may be ascribed to variations in device capability, network stability, or platform compatibility. This problem results in a disjointed experience that may perplex learners and impede their capacity to integrate concepts or develop vocabulary proficiently. In the long term, these obstacles may undermine the perceived efficacy of Metaverse-based learning, potentially decreasing student motivation and engagement. This disengagement may adversely affect learning outcomes, as continuous interest and active participation are crucial for language acquisition, especially for vocabulary retention. To enhance sound quality, Metaverse platforms ought to integrate sophisticated audio processing capabilities, including echo cancellation and noise reduction. Educators and learners could utilize external devices such as premium headphones or microphones to improve the auditory experience. Promoting the utilization of desktop or laptop computers, when practicable, may alleviate problems

such as device overheating. Schools could contemplate offering access to more advanced equipment for students. Metaverse platforms can utilize adaptive technology to modify content resolution and complexity based on the device and internet capabilities of each user. These results resonate with the challenges reported in recent research [39] regarding infrastructure and user accessibility. Besides, offering downloadable or lightweight versions of educational materials may act as a contingency for pupils facing content visibility challenges. Researchers and educators can partner with Metaverse platform developers to directly tackle these difficulties, promoting user-friendly interfaces and enhanced support for educational applications. Assuring technical reliability would not only improve engagement but also cultivate favourable perceptions among learners, resulting in enhanced learning outcomes and continued utilization of these new platforms. Finally, the interview findings revealed that students preferred utilizing Metaverse as an additional resource to their conventional classes rather than relying on it as their primary source since students believed that extended engagement in virtual environments may result in detachment from reality. Traditional learning environments, in contrast, are thought to provide concrete, in-person interactions that are frequently regarded as more substantial and genuine. Furthermore, students' excerpts emphasize the physical exertion and diminished mobility linked to virtual education. Prolonged utilization of gadgets in virtual environments may result in eye strain, exhaustion, and discomfort, diminishing sustained involvement. However, conventional classrooms enable students to participate in physical activities, navigate their environment, and communicate interactively, promoting a more stimulating and conducive learning experience. It is consistent with a recent study [36], which highlights that Metaverse-based learning should serve as a complement to traditional instruction, given the significance of physical presence and interactive engagement. Last but not least, all the aforementioned reasons for favouring Metaverse-based learning as a supplementary tool can be linked to the students' cognizance of the advantages of in-person classes following an extended period of online classes during the COVID-19 pandemic. The pandemic resulted in extended durations of online study, rendering students physically inactive at home and depriving them of the social interactions customary in educational environments. These elements likely enhanced their appreciation for the physical and social dimensions of traditional classrooms, which not only facilitate their academic development but also promote their emotional and social well-being. Besides, this transition might have increased their recognition of the concrete benefits of physical classroom environments, including direct peer and teacher assistance and an organized educational setting. To optimize the advantages of both methodologies and to ensure students' well-being, educators can implement a blended learning paradigm, periodically including Metaverse sessions to enhance particular skills (e.g., vocabulary development) while preserving conventional instruction for fundamental learning tasks. Echoing recent study findings [34], a blended approach integrating Metaverse and traditional methods could provide a more effective and engaging learning experience.

## VI. CONCLUSION

This study investigated the effect of Metaverse-based EFL learning on high school students' vocabulary learning, retention, and perceptions. The results showed that Metaverse can improve students' vocabulary development and may create positive feelings toward situated learning in interactive and immersive environments. EFL learners can acquire practical knowledge through hands-on activities in the target language, utilizing the distinct characteristics of the Metaverse. This approach promotes student involvement and communication, maximizes active learning, and facilitates immersive collaboration. Nevertheless, the findings of this study highlight the need to acknowledge that Metaverse environments, like any other technology application, are not exempt from technical issues. Hence, 3D space designers must provide the required enhancements, while educational users should develop lesson plans that take these issues into account. Furthermore, another key finding is that even though the participants in the study recognized the advantages and improved learning results, they preferred using Metaverse as an additional resource in regular classes rather than relying on it as the main method of instruction. They continued to prioritize in-person instruction as the fundamental basis of their educational experience. Therefore, EFL teachers should integrate Metaverse into their classes by customizing it to students' needs and preferences. Last but not least, in-service and pre-service English teachers should be educated on the utilization of the Metaverse in the realm of language instruction. This study is not devoid of certain limitations. Initially, the findings are constrained to the data collected from a small convenience sample inside a high school environment, which inherently restricts the generalizability of the findings. Consequently, the outcomes may not apply to all educational settings. Subsequent research ought to emphasize larger and more heterogeneous populations to corroborate and enhance these findings. An expanded participant pool, encompassing students from various age groups, educational settings, and cultural backgrounds, would yield a more thorough comprehension of the efficacy and obstacles of immersive learning. This study examined the impact of one-time intervention with a single group. Expanding the duration of the implementation and including a control group can enhance both internal and external validity. Besides, the novelty factor associated with the Metaverse platform can potentially undermine this study's external validity. Therefore, longitudinal studies could provide additional insights into the enduring impacts of utilizing Metaverse in an EFL setting. Prospective studies may implement a longitudinal design to assess the enduring effects of Metaverse-based learning, offering insights into the sustainability of its benefits and the possible diminishment of the novelty effect. Additionally, researchers might undertake comparison studies involving two groups of learners—one group introduced to the Metaverse as an innovative tool and another with past exposure or familiarity. This design would facilitate the isolation of the novelty factor's impact and yield more substantial evidence for the platform's efficacy. Lastly, integrating cognitive load questionnaires into forthcoming studies may facilitate evaluating whether immersive environments, such as the



Metaverse, induce cognitive overload and its impact on learning results.

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#### AUTHORS` CONTRIBUTIONS

Conceptualization, E.A.K., and C.Y.E; methodology, E.A.K., and C.Y.E; investigation E.A.K, original draft preparation, E.A.K, visualization, E.A.K, review and editing C.Y.E. All authors read and approved the final version of the manuscript.

#### CONFLICT OF INTEREST

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

#### DATA AVAILABILITY

The data supporting the findings of this study are available upon request from the authors.

#### ETHICAL STATEMENT

This article followed the principles of scientific research and publication ethics. Ethical consent for data collection was obtained from the Ondokuz Mayıs University Social and Humanities Ethics Committee.

#### DECLARATION OF AI USAGE

No generative AI tools were used for content creation in this manuscript (e.g., drafting, rewriting, or generating ideas).

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APPENDICES

APPENDIX A: VOCABULARY TEST

Name-Surname: \_\_\_\_\_ Score: \_\_\_\_\_

1. To enter the competition, you will \_\_\_\_\_ a valid ID and registration form.

- a) reject
- b) require
- c) abandon
- d) provide

2. The defending champion will play her first match of the \_\_\_\_\_ tomorrow.

- a) festival
- b) tournament
- c) concert
- d) exhibition

3. As the plane started to \_\_\_\_\_, passengers fastened their seatbelts.

- a) elevate
- b) ascend
- c) descend
- d) accelerate

4. Many students \_\_\_\_\_ the seminar to learn more about job opportunities.

- a) attend
- b) organize
- c) neglect
- d) cancel

5. The trip gave me a chance to \_\_\_\_\_ a different culture and lifestyle.

- a) ignore
- b) require
- c) experience
- d) describe

6. Climbing Mount Everest is an \_\_\_\_\_ sport that requires a lot of preparation and courage.

- a) extreme
- b) simple
- c) ordinary
- d) moderate

7. John is an \_\_\_\_\_; he loves activities like bungee jumping and skydiving.

- a) adrenaline junkie
- b) nature enthusiast
- c) history buff
- d) bookworm

8. Athletes from various countries come to \_\_\_\_\_ in the international games.

- a) assist
- b) observe
- c) compete
- d) collaborate

9. You need special \_\_\_\_\_ like ropes and helmets to go rock climbing.

- a) instructions
- b) equipment
- c) clothing
- d) training

10. \_\_\_\_\_ is a type of parachute sport that involves navigating a canopy through a series of gates and obstacles.

- a) Hang gliding
- b) Canopy piloting

- c) Base jumping
- d) Sky surfing

11. \_\_\_\_\_ involves jumping from a high place and gliding through the air with a special suit.

- a) Paragliding
- b) Wingsuit flying
- c) Skydiving
- d) Base jumping

12. The eagle seemed to \_\_\_\_\_ effortlessly through the sky.

- a) stumble
- b) glide
- c) sprint
- d) dash

13. An \_\_\_\_\_ is used by pilots to measure the altitude of the aircraft.

- a) altimeter
- b) thermometer
- c) anemometer
- d) barometer

14. The hikers stood at the edge of the \_\_\_\_\_, admiring the view below.

- a) plateau
- b) cliff
- c) slope
- d) dune

15. Wearing a \_\_\_\_\_ is important when riding a motorcycle to protect your head.

- a) vest
- b) helmet
- c) scarf
- d) jacket

16. He wore a formal \_\_\_\_\_ to the business meeting.

- a) suit
- b) uniform
- c) outfit
- d) ensemble

17. That movie was really \_\_\_\_\_; I didn't understand the plot at all.

- a) intriguing
- b) weird
- c) conventional
- d) predictable

18. After reaching the top, we began to \_\_\_\_\_ the mountain carefully.

- a) ascend
- b) descend
- c) encircle
- d) traverse

19. The \_\_\_\_\_ of the car was too high for the narrow, winding roads.

- a) velocity
- b) frequency
- c) speed
- d) agility

20. It takes years of practice to \_\_\_\_\_ the art of playing the violin.

- a) master
- b) overlook
- c) explore
- d) simplify



## APPENDIX B: METAVERSE-BASED EFL LESSON PLAN

**Class and Level:** 11<sup>th</sup> Grade, B1  
**Duration:** 90 minutes  
**Number of students:** 16  
**Materials:** spatial mobile app, pre-loaded VR content related to extreme sports, digital worksheets with vocabulary and reading exercises  
**Tools:** mobile phones or PC

**Aims & Objectives:**

- To expand vocabulary related to extreme sports (*canopy piloting, glide, altimeter*).
- To practice reading, listening, speaking, and writing skills.
- To engage students in discussions about extreme sports.
- To develop students' ability to express opinions and preferences.

**STAGES:****Warm Up: (15 minutes)**

- The teacher enquires about the students' knowledge of extreme sports.
- Students engage in a concise discussion regarding the nature of each sport and the motivations behind individuals' participation in these activities.
- The teacher presents a brief video clip depicting individuals engaged in two distinct extreme sports and prompts students to determine the reasons for the participants' preference for these activities.

**Vocabulary Introduction (10 minutes)**

- Students take a gallery walk to see the pictures of extreme sports (e.g., wingsuit flying, rafting, parkour).
- Students play a matching game where they match the vocabulary with the correct picture and write the answers on the chat section or use their microphones.

**Reading Activity: (20 minutes)**

The teacher divides the class into two groups and assigns them to read different texts on extreme sports, subsequently requiring them to answer the comprehension questions posted on the wall. Students can use the interactive lexicon provided by the teacher on the neighboring walls to confirm the definitions of unknown words. Upon finishing their initial text, the groups go to the subsequent text. Upon conclusion of the activity, the instructor collects either written or spoken feedback from the pupils.

**Production: (40 minutes)****Sentence Building Game: 20 minutes**

Students analyze the target vocabulary in the reading materials by scrutinizing the associated images exhibited on the wall. They will thereafter endeavor to develop sentences employing the desired vocabulary. They compete against one another to complete the task within a fifteen-minute timeframe. Students employ digital sticky notes to share their feedback.

**Sharing Opinions: 20 minutes**

Students assemble in the discussion corner and select a subject from the choice board to express their viewpoints. The choice board contains nine options, including *Talk about an extreme sport you would like to try. Talk about popular sports in your country. Talk about the sport that you are good at. Talk about why people do extreme sports.* Students who choose the same option are paired and present their dialogues in front of their friends.

**Wrap UP: (5 minutes)**

T encourages students to disclose one new insight they acquired regarding extreme sports and their opinions on the application of VR in education.

**Homework:** Students are tasked with researching an additional extreme sport that is not currently addressed in the classroom. They are also required to create a brief digital poster presentation for the subsequent lesson.