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Integrating Virtual Reality into English Education: Exploring Technology Acceptance and Learning Outcomes

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According to a BBC report, 2016 marked the year when virtual reality (VR) transitioned from concept to reality[1]. VR has emerged in various fields and is highly effective in many ways. The implementation of VR technology in teaching and learning has gradually become popular. Through the 3D realistic learning environment, learners are immersed in the virtual environment. Language education needs to create an immersive English learning environment and atmosphere. Therefore, in order to understand the substantial benefits of integrating VR into English language acquisition, this research will adopt the VR teaching materials to Freshman English Courses. For students who will participate in the use of VR technology to learn English, the pre-test, post-test, and surveys will be analyzed. Through the analysis of questionnaire data, explore whether the VR model is effective in enhancing learning interest and motivation, and evaluate the effectiveness of enhancing language ability learning. This research is based on the Technology Acceptance Model, using Pivot Report and SPSS software to analyze the results of the tests. Pearson correlation coefficient analysis will be also adopted to explore the three aspects of the usage of VR: (a) Does VR really work for enhancing learning motivation and interest?; (b) To explore the feasibility of VR in the educational field analyzed by the Technology Acceptance Model (TAM, Technology Acceptance Model); and (c) Learning effectiveness of the participants. The results of this research will provide references for language teachers who would like to implement innovative teaching, enrich teaching materials, and enhance learning effectiveness.

Keywords: Virtual Reality (VR), Technology Acceptance Model (TAM), immersive learning, learning motivation

Introduction

Yuan Ze University is the first officially designated bilingual university in Taiwan. It actively implements both English and programming language education, adopting a dual-track approach to enhance students' language and digital competencies, thereby strengthening their international competitiveness. In addition to required programming courses, the university places a strong emphasis on English education. At the undergraduate level, English general education courses account for 8% of the total required credits—ranking the highest among universities in Taiwan. Besides the English-major program, which is conducted entirely in

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[1] 2016: the year when VR goes from virtual to reality https://www.bbc.com/news/technology-35205783

English, many professional courses across other departments are also taught in English, clearly demonstrating Yuan Ze University's commitment to English education.

Over the years, the university has dedicated itself to innovative teaching methods. However, how to further advance English instruction remains a key concern for English-taught course instructors. In 2018, the researcher integrated Virtual Reality (VR) materials into the freshman English curriculum. This initiative was covered by media reports at the time and became one of the highlights of that year's Freshman English Camp. To further explore the impact of VR on English teaching, the researcher formally incorporated VR materials into freshman English classes starting in 2024. Pre- and post-tests, along with satisfaction surveys, were administered to analyze the effectiveness of integrating VR into instruction through the lens of the Technology Acceptance Model (TAM), with the aim of investigating various dimensions of technology acceptance and learning outcomes. This research received no external funding.

Research Motivation and Objectives

In 2001, Marc Prensky coined the term "Digital Natives" to describe the generation that has grown up surrounded by digital technologies. For this younger generation, high-speed fiber-optic technology and digital connectivity have become essential parts of everyday life. In addition to digital teaching materials and flipped classrooms, the growing prevalence of Virtual Reality (VR) has sparked considerable interest among scholars and educators in examining its potential as an innovative learning environment across diverse educational disciplines. In the realm of language education, VR is increasingly recognized as a valuable tool that can enhance classroom engagement and support immersive learning experiences (Parmaxi, 2020).

Yuan Ze University's Higher Education Sprout Project includes a subprogram on "Enhancing Teaching Innovation and Improving Instructional Quality," within which "Digital Education" specifically addresses applications of VR/AR in teaching. The use of VR technology in education is becoming increasingly widespread. By creating realistic 3D learning environments, VR enables immersive experiences, which are particularly valuable in language education where creating an all-English immersive learning atmosphere is critical.

To evaluate the tangible benefits of integrating VR into English language instruction, this study incorporates VR-based materials into freshman English courses. Pre- and post-tests, as well as satisfaction surveys, are administered to students who participated in VR-enhanced English learning. The data collected through questionnaires are analyzed to examine whether VR increases learning interest and motivation, and to assess its effectiveness in enhancing language proficiency.

This research adopts the Technology Acceptance Model (TAM) as its theoretical framework. Using pivot analysis and SPSS software, t-tests and Pearson correlation analyses are conducted to explore three key aspects of the VR-integrated instructional approach:

(a) Whether it enhances students' learning motivation and interest,

(b) The feasibility of VR-based digital education through the lens of TAM, and

(c) The actual learning outcomes achieved by students.

The findings of this study aim to serve as a reference for faculty members at Yuan Ze University, supporting innovative teaching practices, enriching instructional materials, and improving overall teaching effectiveness.

Literature Review

The Technology Acceptance Model (TAM) was first introduced by Davis in 1986 (Davis, 1986). He posited that the use of new technologies is determined by individuals' behavioral intentions. TAM proposes that the use of new information technologies is influenced by external variables and two belief constructs: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). These two beliefs affect the Attitude Toward Using the technology, which then influences Behavioral Intention to Use and Actual System Use. These five constructs form the core components of the TAM model (see Figure 3). TAM has often been applied to analyze the adoption and acceptance of new technologies in the market or related fields (David et al, 1989).

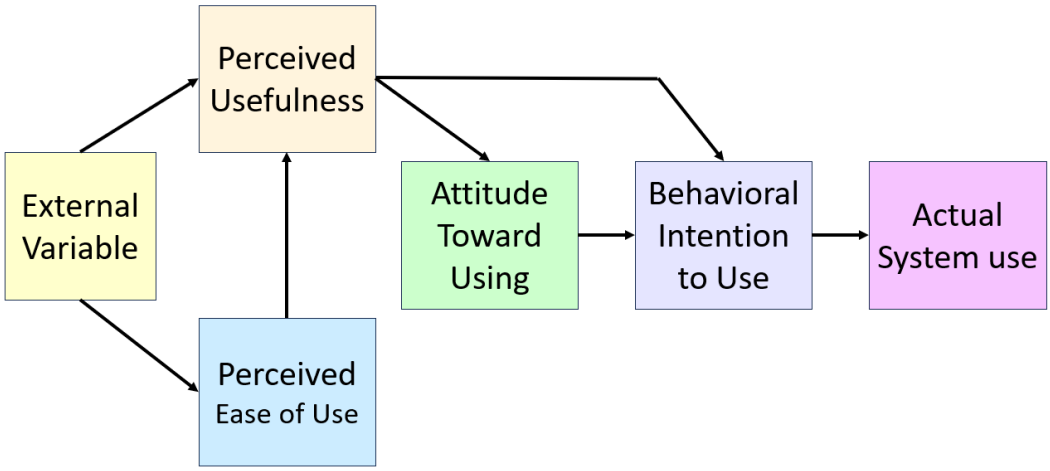

Figure 1. Technology Acceptance Model (TAM) adapted from Davis et al. (1989).

Many scholars regard TAM as a complete yet streamlined framework for analyzing users' acceptance of new technologies in various contexts, such as online banking technologies (Dalcher & Shine, 2003; Choi & Totten, 2012; Ha & Stoel, 2009), mobile commerce (Bruner & Kumar, 2005), and video games (Pando-Garcí a, Periañez-Cañadillas, & Charterina, 2016). Virtual reality (VR) technology has been increasingly applied to enhance English learning amongst students, aiming to boost learning efficiency and performance (Hodgson ET AL., 2019). Man et al. (2025) confirmed a VR technology acceptance model (TAM) to fulfil the learning outcome.

Virtual Reality (VR), a term coined by Jaron Lanier, founder of VPL Research Inc. in 1984, refers to computer-generated 3D environments that simulate virtual worlds. Users wearing VR headsets can immerse themselves visually, experiencing a sense of presence as if they were physically in the environment (Vergara, 2017). Users can freely choose directions and viewpoints to explore various scenes in a 360-degree space (Yeonhee, 2018). VR has been widely adopted in media, live streaming, and the gaming industry, with gaming being one of the most popular applications.

Martel and Muldner (2017) conducted a mixed-method study comparing three control schemes in first-person VR games, measuring their effects on player experience, performance, and immersion. VR has also been applied in cultural heritage preservation. For instance, in 2018, the International Council of Museums (ICOM) designated the theme of International Museum Day as Hyperconnected Museums: New Approaches, New Publics, exploring how diversified technological advancements in the IoT era can help museums not only retain traditional audiences but also expand their reach to younger generations. These include digital archiving of artifacts, multimedia light and sound displays, and new interpretive techniques.

In recent years, VR has also been widely used in commercial marketing. For example, while virtual house tours have existed for years, the COVID-19 pandemic in 2020 drastically impacted many industries, including real estate. Due to the need to avoid gatherings, in-person house visits dropped by over 10%, while the use of VR for virtual property tours significantly increased. Some researchers also presented a systematic review of 88 studies on the use of Virtual Reality (VR) in language learning. The analysis showed that immersive virtual environments were the primary approach used, with university students as the main users. VR tools improved learning outcomes, boosted motivation, and were well-received by learners (Huang, et al., 2021).

The application of VR in education is also expanding, especially in high-risk teaching environments such as chemistry, aviation, weapons training, medicine, and industrial fields (Huang & Liaw, 2018). To reduce errors and risks, many teaching programs have integrated VR (Huang et al., 2018). For instance, Peixoto, Pinto, Krassmann, and Melo (2019) conducted a pilot study in which seven English teachers at the English Institute of Vila Real used VR materials instead of traditional audio recordings for listening practice. Results showed high satisfaction ratings (on a 7-point scale): students rated their learning experience with VR at 6.81, and teachers rated their teaching experience with VR at 6.86. However, the study only evaluated satisfaction with listening activities and did not further analyze actual learning outcomes.

In 2018, the University of Washington invited students learning Korean as a second language to use VR for vocabulary acquisition. By increasing the sense of spatial presence and enhancing immersive memory, the study showed that using the Method of Loci (MOL), based on memory encoding techniques, improved learning effectiveness with an average score of 7.64. In terms of satisfaction with language learning through VR, the average score was 5.79 compared to 4.97 for traditional computer-based learning (Yeonhee, 2018).

Similarly, a study at the University of Maryland had 40 participants perform the same tasks either on a computer screen or using a Head-Mounted Display (HMD). Results showed that participants using HMDs to build a “memory palace” achieved 8.8% better memory performance (Krokos, Plaisant, & Varshney, 2019). Practical recommendations were also provided to enhance secondary school students’ inclination towards utilizing VR technology to enhance their efficiency and performance in learning English (Man, et al., 2025).

This study primarily explores the integration of VR technology into a university-level general English course. In this study, VR serves as the external variable. Its ability to enhance learning motivation and outcomes is considered its perceived usefulness, while the ease of use in operating VR technology is regarded as perceived ease of use. These two beliefs influence students’ attitudes toward using VR. Their behavioral intention refers to their willingness to adopt VR as a tool for learning. Lastly, the study analyzes students’ actual use of VR in the learning process.

Research Methodology

This study was conducted in a real classroom setting. The course instructor curated available VR teaching materials and designed themed worksheets to implement an intensive short-term course during the Freshman English Camp. After the semester began, the same research themes were integrated into the Freshman English curriculum. Students used 3D immersive VR headsets in combination with their smartphones to experience innovative learning through virtual environments and to engage with VR-based English learning content.

Research Participants

A total of 291 first-year students were invited to participate in this study, including 109 females and 183 males. Participation in this study was voluntary and anonymous. Before beginning the questionnaire, participants read an informed consent statement and agreed to participate by proceeding with the survey. According to the ethical guidelines of Yuan Ze University, research of this nature, involving minimal risk and anonymous voluntary participation, is exempt from formal review by an Institutional Review Board (IRB). This study was conducted in accordance with the ethical standards of the Declaration of Helsinki and its subsequent amendments. Consent to Publish declaration: Not applicable. The distribution of their academic departments is shown in Table 1.

Table 1
The Distribution of Their Academic Departments

Academic Departments	Number of students
Electrical Engineering	68
Information Communication	37
Computer Science and Engineering	31
Industrial Engineering and Management	29
Mechanical Engineering	26
Finance	22
Chemical and Materials Engineering	20
Information Management	17
Applied Foreign Languages	14
International Business	11
Business Administration	10
Electronic Engineering	3
English Program for Management	2
Art and Design	1
Total	291

Research Instruments

The research methodology adopts a questionnaire as the main instrument to collect students' feedback on their learning experiences. The questionnaire is based on the five dimensions of the Technology Acceptance Model (TAM) and utilizes a five-point Likert scale, ranging from "Strongly Agree," "Agree," "Neutral," "Disagree," to "Strongly Disagree." Each option is assigned a score from 5 to 1, respectively. The higher the score, the greater the level of agreement, indicating a stronger sense of acceptance or recognition.

After completing the questionnaire design in August 2024, three experienced English teachers were invited to review and validate its content for expert validity. A total of 121 students (61 female and 60 male

students) from two classes in the Freshman English Camp participated in the pre-test. To analyze the reliability and validity of the collected responses, this study adopted Cronbach's α coefficient to assess the reliability of the questionnaire items. A coefficient higher than 0.5 indicates acceptable reliability, with higher values reflecting greater reliability. The reliability coefficients of the questionnaire dimensions are shown in Table 1. All values exceeded 0.9, indicating that the questionnaire possesses a high level of reliability (see Table 2).

Table 2
Reliability Analysis Results

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.951	.950	17

Validity is also a key indicator for evaluating the appropriateness of a scale. In this study, factor analysis was conducted, including Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. The results reached a statistically significant level, with the KMO value reaching 0.923, indicating a high level of sampling adequacy for this study (see Table 3).

Table 3
Reliability Analysis Results

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.925
Bartlett's Test of Sphericity	Approx. Chi-Square	1611.933
	df	136
	Sig.	.000

This study employed independent sample t-tests using the statistical software SPSS to examine gender differences in the acceptance of VR-integrated instruction. Paired sample t-tests were also conducted to assess students' learning outcomes before and after the intervention. Finally, Pearson's correlation coefficient was used to analyze the degree of students' acceptance of VR technology based on the Technology Acceptance Model.

Research Procedure

After completing the reliability and validity analysis of the questionnaire, the integration of VR technology into English instruction was officially implemented during the 2024-2025 academic year. First, 291 participating students received instruction in English vocabulary through traditional PowerPoint-based teaching. One week after each session, a test was administered. This process was repeated four times, and the average of the test scores was recorded. The same group of students then learned English vocabulary using VR technology. Following the same structure—lessons followed by a test one week later—this was also repeated four times, and the average score was calculated. The improvement in performance between the two teaching methods was then compared. After completing the four VR-integrated lessons, all 291 students filled out a feedback questionnaire. The questionnaire examined the following aspects related to the external variable—VR instruction:

(1) Whether it increased learning interest, representing Perceived Usefulness

(2) The ease of using VR, representing Perceived Ease of Use

(3) How both perceptions influenced students' Attitude Toward Using VR for learning

(4) Their Behavioral Intention to adopt VR technology in future learning

(5) Their Actual System Use.

The researcher selected online 3D educational materials. Through the use of VR headsets and Bluetooth controllers connected to students' smartphones, learners were able to experience the immersive virtual environment. They had control over the viewing angle and pace of instruction. Each session lasted 20 to 30 minutes and involved the learning of approximately 40 to 50 vocabulary words. The materials and equipment used are listed in figure 2.

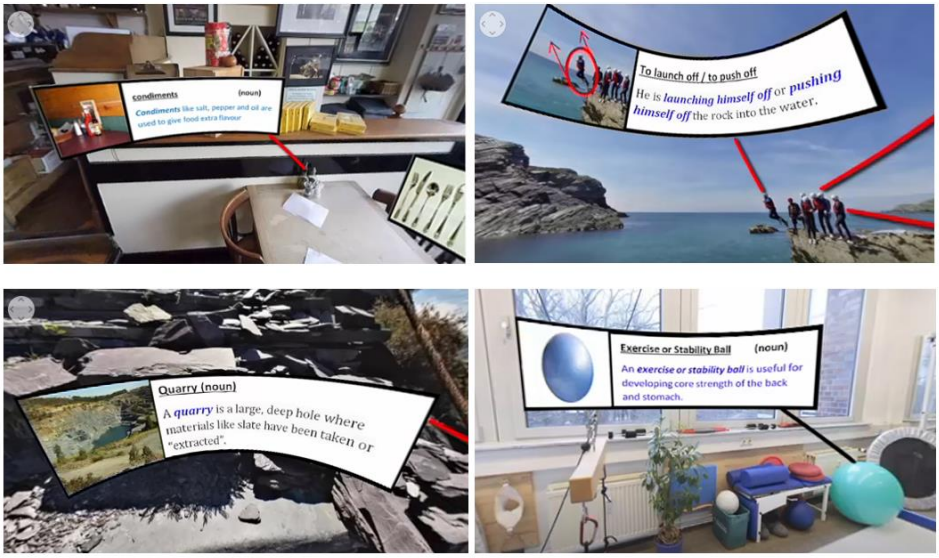

Figure 2. Virtual Reality Online English Learning Materials.

Research Results

During the first implementation of VR-integrated English instruction, a questionnaire was administered to assess participants' prior experience with VR. The results showed that 56% of female students and 48% of male students had never watched a VR video; additionally, 73% of female students and 69% of male students had never used a smartphone to watch VR videos. The questionnaire results also revealed that 93% of the participants had never used VR to learn English, and only 13% of the students owned their own VR headsets. This indicates that the overall usage rate of VR for viewing educational content remains relatively low.

Research Findings

During the activity, students' acceptance of VR videos varied. Some experienced temporary dizziness due to the immersive nature of the videos. Others, while engaging in task-based learning aligned with the 360-degree panoramic effects, had to constantly turn around to locate vocabulary within the video, which may have caused slight discomfort. According to the questionnaire on preferred video duration, the average optimal viewing time reported by students was 13.43 minutes, suggesting that a range of 10 to 15 minutes is generally acceptable.

The effectiveness of VR learning showed highly positive results. A paired sample t-test was conducted to compare students' average test scores before and after instruction. When vocabulary was taught using PowerPoint presentations projected on a classroom computer screen, the pre-test average score was 69.37. After learning vocabulary through VR videos and equipment, the post-test average rose to 81.11. This reflects an improvement of 11.739 points. The t-test yielded a significance level of 0, confirming that the difference in scores was statistically significant (see Table 4).

Table 4
Improvement between Pre-test and Post-test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	BEFORE	69.37	291	12.887	.755
	AFTER	81.11	291	11.914	.698

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
				Std. Error Mean	95% Confidence Interval of the Difference				
		Mean	Std. Deviation		Lower	Upper			
Pair 1	BEFORE - AFTER	-11.739	6.840	.401	-12.528	-10.950	-29.278	290	**.000**

Regarding the dimensions of the Technology Acceptance Model, the integration of VR instructional materials as an external variable in English courses resulted in the following levels of satisfaction with perceived ease of use. The satisfaction score for the ease of operating VR videos using a headset combined with a smartphone was 4.08 (figure 3).

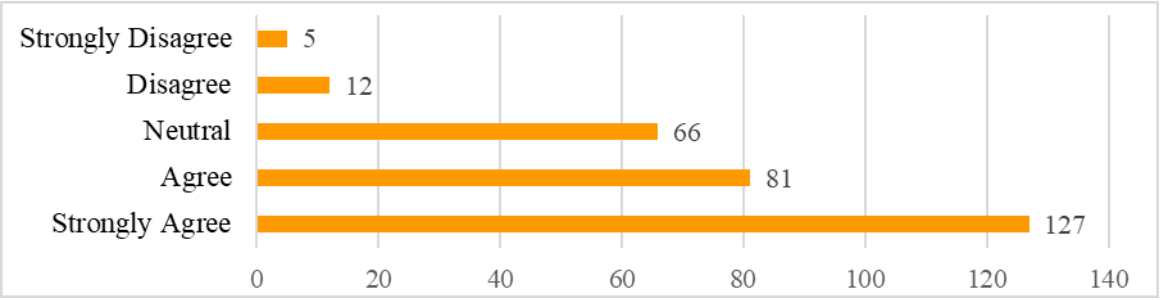

Figure 3. Satisfaction with perceived ease of use.

Regarding the satisfaction levels for Perceived Usefulness, the average satisfaction score for the immersive effect of the VR videos and the score for the realistic experience provided by the VR videos was 4.12 (figure 4).

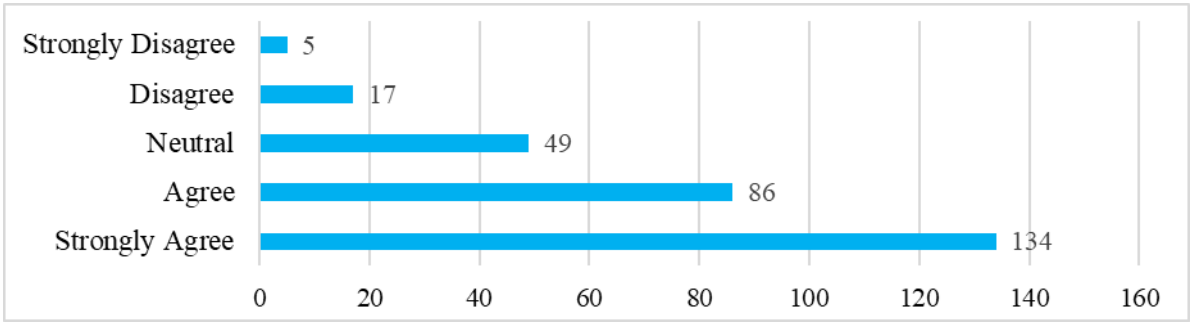

Figure 4. Satisfaction with perceived usefulness.

Regarding the satisfaction levels for Attitude Toward Using are as follows. The average satisfaction score for enjoying the use of VR materials to enhance learning concentration and increasing learning enjoyment through VR videos was 4.26 (figure 5).

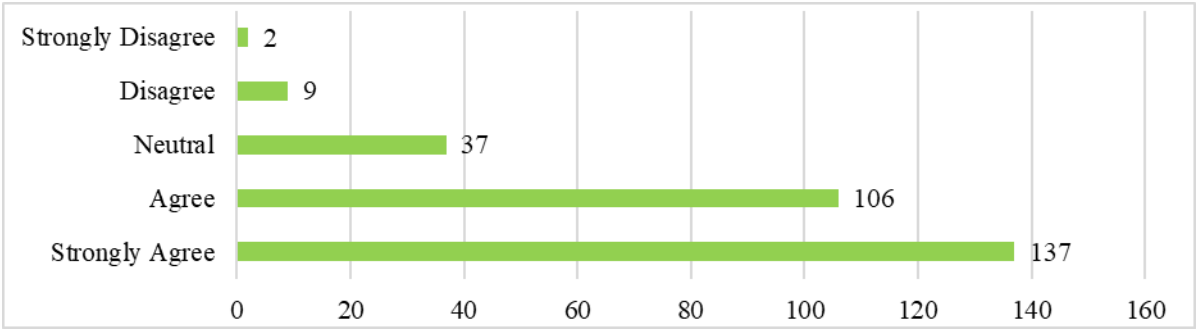

Figure 5. Satisfaction with attitude toward using.

The satisfaction levels for Behavioral Intention to Use score for the willingness to continue using VR videos to learn English and the willingness to use VR videos for educational purposes was 4.43 (figure 6).

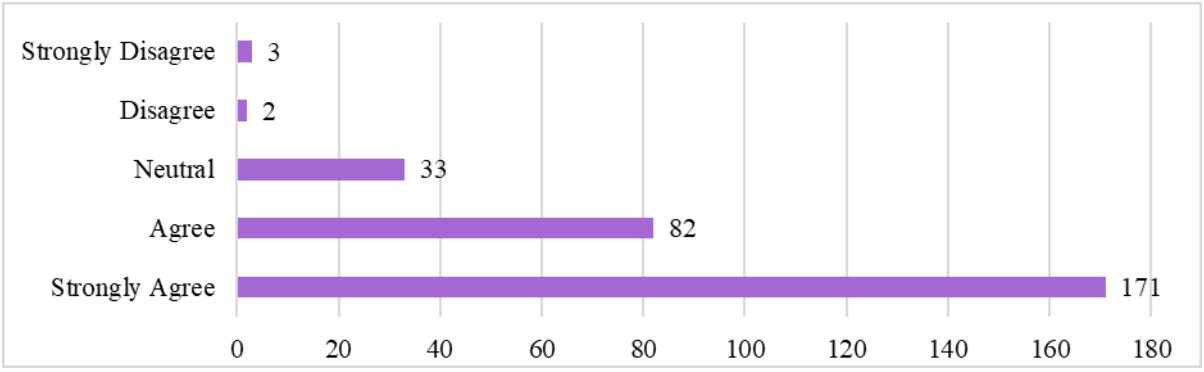

Figure 6. Satisfaction with behavioral intention to use.

To examine whether there is a gender difference in the acceptance of using VR videos for educational purposes, this study employed an independent samples t-test. The results showed that the average satisfaction score for male students was 4.44, and for female students, it was 4.41. The two-tailed t-test yielded a

significance value of 0.717, indicating no significant difference between male and female students in their acceptance of VR use in education (see Table 5).

Table 5
The Differences between Male and Female Participants

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
VR Application in Education	Male	183	4.44	.842	.062
	Female	108	4.41	.724	.070

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	.434	**.511**	.363	289	**.717**	.035	.097	-.156	.226
Equal variances not assumed			.377	251.804	.707	.035	.093	-.149	.219

Regarding Actual System Use, the average score for "I consistently complete the classroom worksheets each time I use VR materials in English class" and the score for "I am very eager to continue using VR for learning" was 4.49 (figure 6).

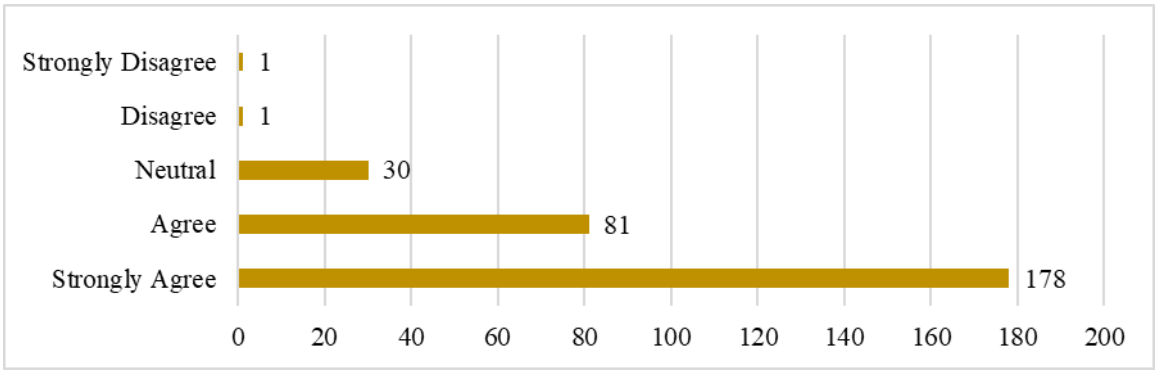

Figure 6. Satisfaction with Actual System use.

To explore the relationships among various dimensions, this study employed Pearson correlation analysis to examine learners' acceptance of VR-based instruction. The Pearson correlation coefficient is a statistical measure used to confirm the strength of the linear association between variables. Generally, a correlation coefficient below 0.3 is considered low, between 0.3 and 0.7 is moderate, and above 0.7 is high. This study presents the questionnaire items that show high correlations in detail.

The researcher illustrates these highly correlated indicators in the following figure, which explains the acceptance level and mutual influence coefficients of Davis's Technology Acceptance Model (see Figure 7). The analysis revealed the following findings:

(1) The realism of VR videos is highly correlated with increased concentration, willingness to use VR for learning English, and the ease of operating VR headsets combined with smartphones. (2) The ability of VR materials to enhance concentration is highly correlated with the immersive effect of VR, willingness to use VR for learning English, and consistently completing English worksheets during each VR lesson. (3) Willingness to learn English through VR is highly correlated with completing English worksheets in every VR lesson. (4) Willingness to use VR for educational learning is highly correlated with VR videos enhancing learning enjoyment and with the expectation to continue learning via VR. (5) The expectation to continue learning through VR is highly correlated with the ease of operating VR headsets combined with smartphones. (6) The ease of operating VR headsets with smartphones is not only highly correlated with the realism of VR videos, but also with the immersive effects of VR videos, increased learning enjoyment, and the expectation to continue learning through VR. (7) The immersive effect of VR is highly correlated with increased learning enjoyment, enhanced concentration, and the ease of using VR headsets paired with smartphones. (8) Using VR instruction to enhance learning enjoyment and the relative ease of using handheld controllers to operate VR videos are correlated. In addition, these are highly correlated with the immersive effect of VR, the ease of use of smartphones combined with VR headsets, and the willingness to incorporate VR into educational instruction.

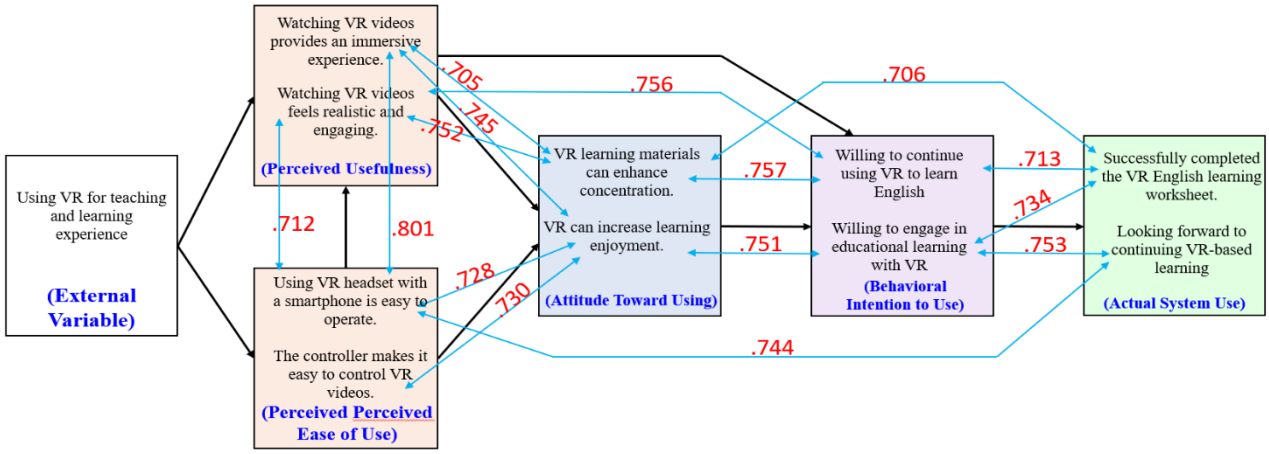

Figure 7. Technology Acceptance Model.

Conclusions and Recommendations

Research Conclusions

This research project analyzed the learning situation and effectiveness of using VR technology in language education teaching settings. Feedback from the final questionnaire confirmed that students' integration of VR technology into language education achieved the following benefits:

(a) Enhancement of Learning Motivation: Students' motivation and enjoyment in learning English vocabulary through VR were significantly increased, with a satisfaction score of 4.26 on the questionnaire.

(b) Improvement of English Proficiency: The VR virtual learning environment immersed students in a fully English 3D space, allowing complete integration into the teaching environment and substantially improving vocabulary test scores. The average pre-test score was 69.37, and the post-test average was 81.11,

showing an improvement of 11.739 points. The paired sample t-test yielded a significance value of 0, indicating that the improvement was statistically significant.

(c) VR Video Duration: The optimal VR video length was found to be between 10 and 15 minutes.

(d) Technology Acceptance Model: Students demonstrated a high level of acceptance of VR technology integrated into language education. Satisfaction scores were as follows: Perceived Ease of Use scored 4.08 and 3.95; Perceived Usefulness scored 4.12 and 4.10; Attitude Toward Using scored 4.16 and 4.26; Behavioral Intention to Use scored 4.36 and 4.43. Among these, the willingness to use VR videos for educational learning showed no significant gender difference, as confirmed by an independent samples t-test. Actual System Use scored 4.02 and 4.49, with the highest satisfaction (4.49) for "very eager to continue learning with VR." Overall, the use of VR materials effectively enhanced both learning willingness and outcomes. Additionally, Pearson correlation coefficient analysis verified the positive influence of the Technology Acceptance Model applied to VR teaching applications.

Suggestions for Future Research

Based on the results of this study, the positive acceptance and learning effectiveness of VR technology in teaching suggest that it can be widely applied in language education. Through its immersive and spatial construction features, VR can enhance learning outcomes and deepen memory retention of the learned content. However, this study has the following limitations, with recommendations for future adjustments:

(a) Due to the limited budget for VR headset equipment, some students reported dizziness or discomfort while watching VR videos, or experienced low resolution, which may have affected the questionnaire results. Additionally, the use of students' smartphones paired with VR headsets for viewing 3D videos may be influenced by differences in network speed and streaming smoothness, potentially impacting learning satisfaction and accuracy of results. For long-term use of VR in educational settings, it is recommended to invest in higher-resolution VR head-mounted displays and control external variables to ensure consistent conditions, thereby improving teaching efficiency.

(b) Limited availability of ready-made online materials constrained this study, as there were few options for 3D videos, which may have influenced learning feedback and effectiveness. For sustained integration of VR technology into curricula, it is recommended to develop cross-disciplinary 3D teaching materials tailored to optimize content quality.

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