

Development and Evaluation of a Virtual Reality-Based Mandarin Language Learning System Enriched with Chinese Cultural and Geographical Contexts

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Abstract

In Junior High School Sepuluh Nopember Sidoarjo has a superior program, namely International Class, in this type of class there is Mandarin learning. However, in reality, students who take junior high school have low language skills, especially in Mandarin. Because conventional learning materials tend to be boring for students. The purpose of this study is to improve students' understanding of the use of Virtual Reality technology in learning Mandarin. The method used in this study is using Experimental Design (Pretest-Posttest Control Group Design) and uses the N-Gain test theory. After testing using this method, the results obtained were an increase in learning outcomes of 22% from learning that initially used conventional learning to learning based on Virtual Reality technology. This increase indicates that the use of Virtual Reality (VR)-based learning media has a positive impact on improving students' understanding of the material being studied.

Keywords: Virtual Reality, N-Gain, Pretest and Posttest.

I. INTRODUCTION

Junior High School (SMP) is one of the formal education in Indonesia. At the SMP level, it is taken for 3 years of study. The education received by students will be able to change the pattern of thinking and creativity to improve students' abilities. The design made by the government in the field of education with the operational basis of the curriculum. When discussing quality, it cannot be separated from teaching and learning activities. Teaching and learning activities in schools are the most fundamental activities [1]. Schools are facilities that accommodate students and foster students to have abilities, intelligence, and skills. Junior High School of Sepuluh Nopember Sidoarjo has a superior program, namely the International Class. In this type of class there is Mandarin language learning. In the context of learning Mandarin as a foreign language, various studies show that low student proficiency is often caused by limited contextual exposure, lack of motivation, and less interactive learning methods [2]. Because conventional learning materials tend to be boring for students. So that students of SMP Sepuluh Nopember Sidoarjo are generally only given lessons on recognizing letters and pictures.

The curriculum is a goal to achieve the desired competencies and the curriculum is also a tool to assess the extent to which the effectiveness of the series of learning

systems implemented by the government can be delivered well by teachers and can be understood by students.

In fact, technology in the world of education continues to develop and give rise to new innovations. For example, Virtual Reality (VR), VR technology has been used in learning various subjects at SMP Sepuluh Nopember Sidoarjo, especially Mandarin. The learning system using VR technology has received a good response from students so that VR technology can help students to increase their insight and update Mandarin-related materials taught by teachers. In general, virtual reality is a technology that simulates imitations such as images or videos in the scope of imagination that are made like the real world (virtual reality). The images or videos are made with three-dimensional quality using a computer that makes users feel like they are directly physically involved in the environment. Virtual Reality (VR) technology shows the virtual world like something real to users so that it gives a realistic impression.

The environment has a 2D form which will later be visualized in 3D. The use of VR can be implemented into several practices. These practices can be in the form of job training, vehicle driving simulations, learning in school institutions. The function of using virtual reality technology is to save costs, save time and save energy, as well as increase students' understanding of learning materials. How Virtual



Reality technology works is by using a smartphone to store VR applications and Virtual Reality glasses to display results or as a display for VR. Learning using visual media (audio, images or videos) is increasingly developing. Virtual Reality technology in learning is increasingly developing, this aims to increase student learning motivation. Due to the lack of students' ability in using technology. Gamification combined with multimedia such as virtual reality provides encouragement to learn because there is a feeling of excitement and interactivity [3]. The use of virtual technology carried out in this study has differences or innovations from previous virtual reality technology. The results of the study showed that the Mandarin language learning system based on virtual reality technology significantly improved students' language proficiency, especially in terms of comprehension and pronunciation. In addition, the integration of cultural and geographical elements successfully improved cross-cultural understanding, learning motivation, and student engagement during the learning process. This study indicates that a virtual reality-based approach is able to provide a more contextual and effective learning experience than conventional methods. This study aims to answer several main questions related to the use of virtual reality technology in Mandarin learning, namely: how does virtual reality affect students' engagement and learning motivation, how are students' perceptions and user experiences when using this technology in a learning context, and to what extent is virtual reality effective in supporting understanding and mastery of Mandarin in a more immersive and interactive way.

II. LITERATURE REVIEW

In previous research [4] Muhammad Mannir Ahmad Getso and Kinn Abass Bakon conducted research on Virtual Reality in Education: The Future of Learning. The system developed in this study is to develop simple virtual reality technology. The system is built using the React VR Framework which can be run in a browser. VR offers many unique benefits when used in education. First and foremost, by adapting VR into modern education, it offers new tools for educators and provides new ways to reach more students. The purpose of VR is to enhance, motivate and stimulate students towards certain events and at the same time also allow students to do direct experience in learning. Learning motivation has a very important role in learning, both in the process and in achieving learning outcomes [5]. But what is more interesting about VR in education is the fact that it can be used to simulate and allow learners to practice procedures without the risks involved. There are 3 challenges to compare VR technology with its pedagogical practices and theories: Cost, Usability, Fear of Technology and there are attributes that make individual perceptions of technology applicable to understanding technology in the world of Education. VR technology can help students apply their theoretical knowledge to real industry problems. Autodesk Showcase software allows students to create 3D models in CAD and use them in a virtual environment. The system developed by the researchers has

features to display images, videos, and sounds that can be accessed by users. The results of the VR system are very detailed and versatile so that they can be applied to several application titles. However, the VR system continues to change and improve to be better along with the advancement of increasingly advanced technology.

In previous research [6] conducted by Gede Thadeo Angga Kusuma, I Made Agus Wirawan, I Ketut Resika Arthana explained that this research aims to develop a virtual reality-based learning media application about the introduction of fish types. The development of this application is intended to facilitate the learning process in kindergartens about the introduction of aquatic animals, especially fish. There are 10 types of saltwater fish and 10 types of freshwater fish that will be introduced to kindergarten students. The development of this application is expected to attract children's interest in learning about the types of fish in our environment. The development of this virtual reality-based learning media application uses the ADDIE model. This ADDIE model consists of 5 stages, namely Analysis, Design, Development, Implementation, and Evaluation. By considering this model, the developed product can be completed with good quality. This can be achieved because this model allows developers to evaluate and revise each stage that is completed. The results of the user experience test of 89.8% indicate that this virtual reality-based learning media application is considered very good. Therefore, this application can be used as a supporting media for introducing types of fish in the teaching and learning process in kindergarten on the theme of aquatic animals with the sub-theme of fish.

In previous research [7] F A Monita and J Ikhsan had the aim of this research, namely to determine the validity of VR-IPA, to determine the practicality of VR media from science lessons. This research was developed with the ADDIE model with the following stages:

1. Design Analysis
2. Developing the System
3. Evaluating the System

In the previous study [8] conducted by Rahmawati aimed at This community service program was implemented with the aim of introducing AR as one of the learning media that can improve the interest and English skills of elementary school students and improve the English vocabulary of elementary school students. Muhammadiyah Karangwaru Elementary School was chosen as the place for the program implementation and the service team chose 35 fourth grade students as participants in this program. The implementation of the program was divided into three stages, namely the preparation stage, the implementation stage, and the evaluation stage. The results of the descriptive statistical analysis showed that the average pretest value of the English vocabulary of fourth grade elementary school students participating in the training was high (mean = 87.00; SD = 11.64; SE = 1.97), and the posttest results showed an increase to very high (mean = 91.71; SD = 10.77; SE = 1.82). In addition, it is also known that the asymp. sig (2-tailed) is 0.014, smaller than < 0.05 , so it can be concluded that "Ha is accepted". Thus, it can be

concluded that Augmented Reality can be used as a medium for learning English vocabulary.

The innovation is that this VR application can be used by a maximum of 50 students simultaneously and learning materials can be filled with several modules at once. In the research currently being developed, there are pretest and posttest practice questions filled out by students in the control class and experimental class. The purpose of this study is to improve students' understanding of the use of Virtual Reality technology in learning Mandarin with a focus on culture and geography. However, the gap in the research currently being conducted is that it is still being used at the Junior High School level. This increase indicates that the use of Virtual Reality (VR)-based learning media has a positive impact on improving students' understanding of the material being studied in relation to the results of previous research, namely with the title Development of Virtual Reality Science (VR-IPA) Learning Media For Science Learning which was developed was considered suitable for use in science learning. This can be seen from the very good validity, very good practicality, and very good student responses. Thus, Virtual Reality technology can be an innovation in the development of learning media because it can make students enthusiastic about learning and provide real experiences for students.

III. RESEARCH METHOD

In this study, two different types of treatments will be applied to test the effectiveness of a learning method or system. The treatments will be divided into two main groups, namely the control class and the experimental class. The control class is a group that does not receive any special intervention or treatment, so that the learning method used continues to follow the standard procedures that have been applied previously. Meanwhile, the experimental class will be given a new treatment that is to be tested for its effectiveness, for example the use of 3D design-based learning technology or a particular teaching method. To measure the impact of this treatment, the study will use an experimental method with a design [9]. In this case, the division of the control class and the experimental class has been determined. The level of understanding and ability in each class has been determined since the beginning of school. In this case, the existence of an Intelligence Quotient (IQ) ability test, with the existence of an IQ test, it is expected that there will be no gap between International Class 1 and International Class 2 which are used as samples for the research conducted. Intelligence Quotient (IQ) is an ability possessed by a person in the form of intelligence, the more a person knows a science, the better the level of intelligence of a person. Intellectual intelligence (IQ) is an innate or hereditary trait from a family that is carried since birth and is inherent in a person, so it is one of the factors that plays a role and influences the achievement or learning outcomes of students [10].

Table 1. Treatment of Control Class and Experimental Class

Class	Pre-test	Treatment	Post-test
Control	O ₁	X ₁	O ₂
Experiment	O ₁	X ₂	O ₂

Information:
O1: Pre-test given to the control class group
O1: Pre-test given to the experimental class group
X1: Treatment (Not using virtual reality technology)
X2: Treatment (using virtual reality technology)
O2: Post-test given to the control class group
O2: Post-test given to the experimental class group

From the Table 1 it can be explained that before the trial of learning using Virtual Reality (VR) based applications. VR applications for learning Mandarin vocabulary introduction, both pre-tests were first carried out to determine students' scores before being given treatment. Then in the experimental class, treatment was given using virtual reality-based applications in introducing Mandarin vocabulary. While in the control class, learning was applied with the usual method, namely without using virtual reality. After the trial stage was completed, a post-test was carried out to determine students' scores after the trial. From these data, a comparison of scores will be obtained between students who learn using virtual reality technology and students who learn without using virtual reality technology or conventional learning.

A. Research Population
In this study, the location chosen was students from Junior High School of Sepuluh Nopember Sidoarjo and this study used students from class VII International 1 and class VII International 2. The population at Junior High School of Sepuluh Nopember Sidoarjo was 776 students.

B. Research Sample
The sample of this study took data from class VII International 1 students as many as 30 students and class VII International 2 as many as 30 students. For class VII International 1 used as a sample of control class data and for class VII International 2 used as a sample of experimental class.

C. Data Analysis Techniques
In this study, the researcher used a classical theory approach, namely using the N-Gain test.

1. Normality Testing
Normality Test is a test carried out with the aim of finding the distribution value of data in a group of data or variables, whether the distribution of the data is normally distributed or not. The Normality Test is useful for determining whether the collected data is normally distributed or taken from a normal population. Based on the empirical experience of several statistics experts, data that is more than 30 numbers (n > 30), can be assumed to be normally distributed.

2. Hypothesis Testing

Hypothesis testing is a statistical procedure that can be used to determine whether an assumption or conjecture about a population has an accepted or rejected result based on the sample data provided. This process involves formulating a null hypothesis (H_0) stating that there is no difference or relationship, and an alternative hypothesis (H_1) stating that there is a difference or relationship. states that there are differences or relationships between variables.

3. Percentage Test of Student Improvement

The percentage test of student value improvement is an assessment designed to determine the extent of learning value improvement in Mandarin vocabulary introduction through the use of virtual reality. This evaluation is conducted by comparing two types of classes, namely the experimental class and the control class. The comparison is made both before and after the implementation of the virtual reality-based learning treatment, in order to measure the effectiveness of the approach in enhancing student performance.

D. N-Gain Theory

N-Gain, or "Normalized Gain", is a very useful concept in educational research. The N-Gain test is often used to assess the effectiveness of a learning or intervention in improving student learning outcomes. This method is a strong basis for evaluating the extent to which a learning program contributes to student understanding. The N-Gain score ranges from -1 to 1. Positive values indicate an increase in student learning outcomes after learning, while negative values indicate a decrease in student learning outcomes. Data analysis was carried out by calculating the N-Gain for each group where the data collection technique used a test, with the number of students used being 60 students [11]. The following Formula 1 is an equation formula that can be used to calculate the N-Gain score.

$$NGain = \frac{Posttest\ Score - Pretest\ Score}{Ideal\ Score - Pretest\ Score} \quad (1)$$

The N-Gain Score Acquisition Category can be determined based on the N-Gain value in the form of a percentage (%). Table 2 is a table of the division of the N-Gain value acquisition categories according to Melzer in Syahfitri, 2008:33 in his paper.

Table 2. Interpretation of N-Gain Score Effectiveness

N-Gain Score	Category
$g > 0,7$	High
$0,3 \leq g \leq 0,7$	Medium
$g < 0,3$	Low

In collecting test results, researchers use a data collection method in the form of Experimental Design (Pretest-Posttest Control Group Design), to process data using the N-Gain test.

E. ADDIE Model

The ADDIE model is widely recognized as an approach that using systematic principles, where the learning or training

planning process is divided into several structured stages. Each stage in this model is arranged sequentially and logically, so that the work flow becomes more organized. The output or results of each stage will be used as input for the next stage, thus creating continuity and consistency in the entire design process. The ADDIE model has five stages that must be taken: Analysis, Design, Develop, Implement, and Evaluate (Figure 1). These five stages are taken systematically. In the ADDIE model, the framework used is structured for instructional development and is equipped with evaluation and revision at each stage [12]. In compiling this article, the method used is descriptive qualitative because it will describe and describe the concept and implementation of the ADDIE model. The development of teaching materials for writing explanatory texts based on experience using the ADDIE model begins with analyzing the needs of educators and students obtained from the results of observations and interviews.

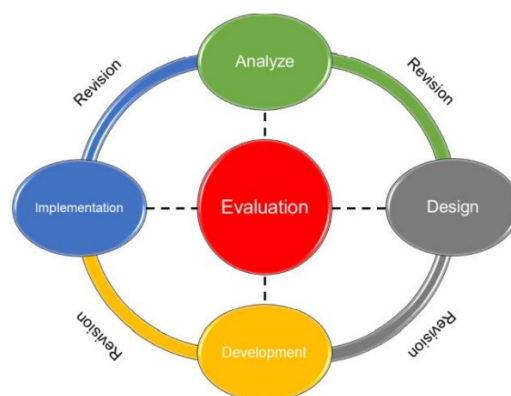


Figure 1. ADDIE Model Development Flow

The following are details of each stage:

1. Analyze

At this stage, a product needs analysis is carried out, consisting of performance analysis, student analysis, fact analysis, concept principles and procedures of learning materials, and analysis of learning objectives.

2. Design

At the design stage, product development planning is carried out based on the results of the analysis in the previous stage. The design stage includes:

- Preparation and selection of teaching materials carried out through a review of core competencies and basic competencies. This review aims to determine relevant materials, organize learning time allocation, and formulate appropriate learning indicators.
- Designing learning scenarios that are arranged in line with the learning methods that will be used, so that the learning process can take place effectively and in a focused manner.
- Designing learning media based on learning competencies.
- Designing evaluation tools for learning media that aim to assess the effectiveness and suitability of the media for learning objectives.

3. Development

In the development stage there are two important goals, namely producing products and choosing the best product. At this stage the design from the previous stage is realized into a media form that is ready to be implemented.

4. Implementation
At the implementation stage, the product that has been designed and selected from the previous stage is applied.

5. Evaluation
At the evaluation stage, an evaluation is carried out on the results of product implementation. Then the product must be revised according to the evaluation results or needs that have not been met.

One of the main advantages of this model lies in its development procedure which has been clearly structured, systematic, and follows a logical sequence of stages. This makes this model very suitable and often chosen as an approach in research and development activities, especially because it provides structured guidance in each step. However, the ADDIE Model also has several weaknesses. One of them is the relatively long time needed in the implementation process. This is due to the evaluation process that is carried out continuously at each stage, as well as the need to conduct analysis of student characteristics and analysis of overall performance [12].

F. Environmental Historical Places in China

The following is a list of 10 implementations of historical places that can be applied in learning Mandarin, namely the Great Wall of China, Forbidden City, Summer Palace, Terracotta Warriors, Temple of Heaven, Shanghai Bund, Wild Goose Pagoda, Mount Thai, Jing'an Temple, and Li River.

G. Mandarin Vocabulary

The following Table 3 are 50 Mandarin vocabulary words found in the application designed by this researcher. The vocabulary includes an introduction to Hanzi letters used for the material that will be taught to students. Hanzi is the original Mandarin letter itself. Pinyin and Hanzi are one unit (one package) [13].

Table 3. Mandarin Vocabulary

No	Mandarin Language	Pinyin	English Language
1	砖	(Zhuān)	Brick
2	墙	(Qíáng)	Wall
3	城堡	(Chéngbǎo)	Fortress
4	树	(Shù)	Tree
5	城门	(Chéngmén)	Gate
6	楼梯	(Lóutī)	Ladder
7	步道	(Bùdào)	Footpath
8	船	(Chuán)	Boat
9	公共汽车	(Gōnggòng qìchē)	Bus
10	灯杆	(Dēng gān)	Light poles
11	哨所	(Shàosuǒ)	Guard Post

No	Mandarin Language	Pinyin	English Language
12	旗子	(Qízi)	Flag
13	垃圾桶	(Lèsè tǒng)	Rubbish bin
14	盆栽	(Pénzāi)	Pots
15	花	(Huā)	Flower
16	主堡	(Zhǔbǎo)	Main Fortress
17	香炉	(Xiānglú)	Incense Burning Place
18	草	(Cǎo)	Grass
19	木门	(Mùmén)	Wooden Door
20	公路	(Gōnglù)	Highway
21	花瓮	(Huā wèng)	Flower Urn
22	石灯	(Shí dēng)	Stone Lamp
23	井	(Jǐng)	Well
24	盾	(Dùn)	Shield
25	储藏室	(Chúcáng shì)	Storage
26	奠基石	(Diànjīshí)	Cornerstone
27	武器	(Wǔqì)	Weapon
28	桥	(Qiáo)	Bridge
29	柱子	(Zhùzi)	Pillar
30	石门	(Shímén)	Stone Door
31	窗户	(Chuānghù)	Window
32	花园	(Huā yuán)	Garden
33	城堡	(Chéng bǎo)	Castle
34	门	(Mén)	Door
35	屋顶	(Wūdǐng)	Roof
36	地板	(Dìbǎn)	Floor
37	露台	(Lùtái)	Terrace
38	玻璃窗	(Bōlí chuāng)	Glass Window
39	雕像	(Diāoxiàng)	Statue
40	灯笼	(Dēnglóng)	Lantern
41	池塘	(Chítáng)	Pool
42	壁画	(Bihuà)	Wall Painting
43	水	(Shuǐ)	Water
44	船	(Chuán)	Boat
45	轮子	(Lúnzi)	Wheel
46	椅子	(Yǐzi)	Chair
47	土地	(Tǔdì)	Land
48	云	(Yún)	Cloud
49	山	(Shān)	Mountain
50	灯笼	(Dēnglóng)	Lantern

The purpose of this study is to improve student's understanding in learning Mandarin vocabulary. As a tool to improve understanding of the material, researchers use virtual reality technology. An understanding of Chinese culture,

especially in terms of historical buildings, needs to be given to junior high school students as an effort to broaden their insights into global culture, instill an attitude of respect for cultural diversity, and support the formation of tolerant and internationally-minded characters and be able to recognize some vocabulary in history.

H. Device Specifications

There are device specifications that must be prepared to support the creation of VR applications using MilleaLab software as shown in Table 4.

Table 4. Device Specifications

Information
Processor Intel i5/i7 equivalent processor
Windows 8/10 Operating System – 64 Bit
Minimum RAM 4GB or above
Internal or external graphic card

I. Research Questions

The use of Virtual Reality (VR) technology in Mandarin learning has shown positive impacts in three main aspects. First, in terms of engagement and motivation, VR technology is able to create an immersive and interactive learning experience, thus encouraging increased student participation and higher learning interest compared to conventional methods. Second, based on student perceptions and user experiences, the majority of students consider that VR-based learning provides a more enjoyable experience, is easy to understand, and increases comfort in the learning process. Third, in the context of Mandarin learning, VR provides a contextual and realistic learning environment, which is very effective in introducing cultural elements and practical language use, thus supporting the achievement of language competence more comprehensive.

IV. RESULT AND DISCUSSION

In this sub-chapter, it will be explained how to use and determine the results of the trial of the application use by students. This is to have the aim so that the examiner can find out the feasibility of the virtual reality application, especially in the Mandarin language subject that has been developed. In this test, 2 types of class methods are used, namely the control class and the experimental class. The control class and the experimental class have different treatments. The control class will be given the usual learning method, namely using a conventional system using books, while the experimental class uses a learning system using a virtual reality (VR) application. Later, from these two methods, a comparison will be made between conventional learning or using virtual reality (VR) technology. This study used a sample at SMP Sepuluh Nopember Sidoarjo by selecting 2 (two) different types of classes, namely international class 1 and international class 2. The sample in this study used 60 students in grade VII, 30 students from class VII International 1 and 30 students from class VII International 2. The following are the results of the

testing that has been carried out from the application of the control class and the experimental class using the implementation of the pre-test and post-test. This research can also be developed in other schools at lower or higher levels.

A. Control Class Testing

In the control class, conventional learning treatment will be given, with this, first students in the control class will be given pre-test questions and then given post-test questions. The following are the results of the pre-test and post-test in the control class.

1. Results of the Pre-Test in the Control Class

In this study, the objects in the control class were 30 students. The results of the pre-test data processing for the control class had the lowest score, namely 20, and the highest score, namely 80.

Table 5. Results of the Pre-Test in the Control Class

	Frequency	Percent	Valid Percent
Valid 20-30	10	33.3	33.3
31-40	4	13.3	13.3
41-50	11	36.7	36.7
61-70	3	10.0	10.0
71-80	2	6.7	6.7
Total	30	100.0	100.0

Based on Table 5 above, the total frequency value is 30 and has a percentage value of 100%, so the distribution result is normal.

2. Results of the Post-Test Trial of the Control Class

In this study, the objects in the control class were 30 students. The results of the post-test data processing for the control class had the lowest score, namely 40, and the highest score, namely 100.

Table 6. Results of the Post-Test Trial of the Control Class

	Frequency	Percent	Valid Percent
Valid 40-50	7	23.3	23.3
51-60	4	13.3	13.3
61-70	7	23.3	23.3
71-80	9	30.0	30.0
81-90	2	6.7	6.7
91-100	1	3.3	3.3
Total	30	100.0	100.0

Based on Table 6 above, the total frequency value is 30 and has a percentage value of 100%, so the distribution result is normal.

B. Experimental Class Testing

In the experimental class, learning treatment using virtual reality applications will be given, with this, first students in the experimental class will be given pre-test questions and then given post-test questions. The following are the results of the pre-test and post-test in the experimental class.

1. Pre-Test Results in the Experimental Class

In this study, the objects in the control class were 30 students. The results of the pre-test data processing for the

experimental class had the lowest score, namely 50, and the highest score, namely 80.

Table 7. Pre-Test Results in the Experimental Class

	Frequency	Percent	Valid Percent
Valid 50-64	1	3.3	3.3
60-64	9	30.0	30.0
70-74	19	63.3	63.3
75-80	1	3.3	3.3
Total	30	100.0	100.0

Based on Table 7 above, the total frequency value is 30 and has a percentage value of 100%, so the distribution result is normal.

2. Post-Test Results in the Experimental Class

In this study, the objects in the control class were 30 students. The results of the post-test data processing of the experimental class had the lowest score of 70 and the highest score of 100.

Table 8. Post-Test Results in the Experimental Class

	Frequency	Percent	Valid Percent
Valid 70-74	2	6.7	6.7
80-84	7	23.3	23.3
90-94	12	40.0	40.0
95-100	9	30.0	30.0
70-74	2	6.7	6.7
Total	30	100.0	100.0

Based on Table 8 above, the total frequency value is 30 and has a percentage value of 100%, so the distribution results are normal. After knowing the results of the pretest and posttest values from the control and experimental classes, normality tests, hypotheses, and comparative test results were carried out.

C. Normality Test

The Kolmogorov-Smirnov normality test is a non-parametric hypothesis test to test whether a group of data is normally distributed. The normality test is carried out to help the accuracy in conducting hypothesis tests. Hypothesis testing can only be carried out if the variables to be analyzed are normally distributed, therefore a normality test is needed [14]. In this study, researchers conducted a normality test of the questionnaire data processed using the SPSS application. The results of the normality test are shown in Table 9 below.

Table 9. Normality Test Results
One-Sample Kolmogorov-Smirnov Test

	Unstandardized Residual
N	30
Normal Parameters ^{a,b}	
Mean	.0000000
Std. Deviation	3.10368861
Most Extreme Differences	.135
Absolute Positive	.135
Negative	-.079
Test Statistic	.135
Asymp. Sig. (2-tailed) ^c	.175
Sig.	.177

Monte Carlo Sig. (2-tailed) ^d	99% Confidence Interval	Lower Bound	.168
		Upper Bound	.187

From the data in Table 9 above, the value is 0.175, if the significant value is greater than 0.05, the distribution result is normal.

D. Hypotheses Testing

Hypotheses testing or statistical testing is a test of a statement whose truth is still in doubt (not certain) [15]. Hypothesis testing in this study used the T test using the SPSS application for data processing. The results were obtained as in Table 10 below.

Table 10. Hypotheses Test Results

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	31.398	4.583		6.851	.000
Pengaruh BelajarVR	-.005	.146	-.007	-.036	.971

The basis for making the T-test decision from the table above has a Ho result accepted because the X variable has a significance value of 0.971, this is proven by the results of sig of $0.971 > 0.05$. However, the X variable has no effect on the Y variable (Formula 2).

Formula: Score sig < 0,05 (2)

Information:

- The t-count value < t-table means there is no influence of the variable on other variables.
- X = Effect of learning using VR
- Y = Influence of conventional learning

Basis for making decisions based on probability:

- If the probability value is > 0.05 then Ho is accepted
- If the probability value ≤ 0.05 then Ho is rejected

E. Value Comparison Test

The calculation of the comparative value test in this study used the SPSS application with results as in Table 11 and Table 12 below:

Table 11. Average Value of Control Class

Descriptive Statistics					
	N	Min	Max	Mean	Std. Deviation
NGain Score	30	-.20	1.00	.4503	.20674
NGain Percent	30	-20.00	100.00	45.0278	20.67401
Valid N (listwise)	30				

Table 12. Average Value of Experimental Class

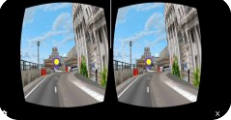
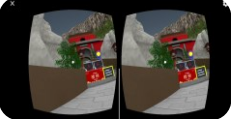
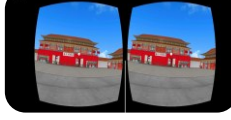
Descriptive Statistics					
	N	Min	Max	Mean	Std. Deviation
NGain Score	30	.25	1.00	.6717	.26404
NGain Percent	30	25.00	100.00	67.1667	26.40370
Valid N (listwise)	30				

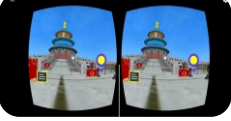
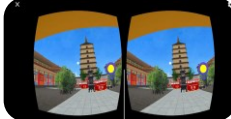
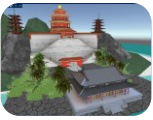
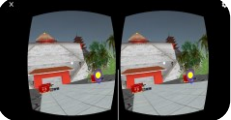
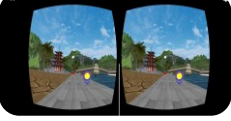
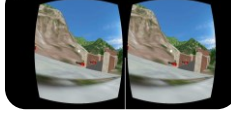
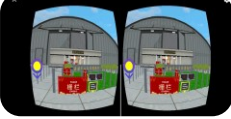
Based on the data displayed in the control class and experimental class tables, it is known that there is an increase in the average value between the two groups. The average value obtained by students in the control class is 45.0278, while the average value in the experimental class using Virtual Reality (VR) technology in the learning process reaches 67.1667. Comparison of the two values shows a difference of 22.14 points or equivalent to an increase of around 22%. This increase indicates that the use of Virtual Reality (VR)-based learning media has a positive impact on increasing students' understanding of the material being studied in relation to the results of previous research, namely with the title Development of Virtual Reality IPA (VR-IPA) Learning Media for Science Learning which was developed was considered suitable for use in science learning. This can be seen from the very good validity, very good practicality, and very good student responses. Thus, Virtual Reality technology can be an innovation in the development of learning media because it can make students enthusiastic about learning and provide real experiences for students. Therefore, it can be concluded that the application of VR technology in learning has the potential to significantly increase the effectiveness of the teaching and learning process compared to conventional methods. In practice, the application of Virtual Reality technology in Mandarin language learning opens up new opportunities for teachers and educational institutions to design more engaging and effective learning experiences.

F. Virtual Reality Mockup Display Results

The model is made in 3D form, researchers take the form of the model from various sources on the internet, such as Google Maps and Google Images. Making 3D objects done using MilleaLab software. The 3D design is made as similar as possible so that users can enjoy virtual reality technology in an immersive and real way (Table 13).

Table 13. Virtual Reality Mockup Display Results

No	Place	3D Design	Mockup Virtual Reality
1	Bund Shanghai		
2	Mount Thai		
3	Jing'an Temple		
4	Forbidden City		

No	Place	3D Design	Mockup Virtual Reality
5	Temple of Heaven		
6	Wild Goose Pagoda		
7	Summer Place		
8	Li River		
9	Great Wall of China		
10	Terracotta Warriors		

V. CONCLUSION

In the research that has been conducted, the following conclusions were obtained Based on the results of the pre-test and post-test, the control class has a frequency value of 30 and a percentage value of 100% of the processed data. Based on the results of the pre-test and post-test, the experimental class has a frequency value of 30 and has a percentage value of 100% of the data that has been processed. Based on the normality test, it has a value of 0.175 which is greater than the significant value of 0.05. so the distribution result is normal. Based on the hypothesis test using the T test, the Ho result is accepted because the variable X has a significant value of 0.0971 which is greater than the significant value of 0.05. Based on the Descriptive Statistic value, the control class has a mean value of .4503 and the Descriptive Statistic value of the experimental class has a mean value of .6717. Based on the processing of pretest and posttest data, the control class and experimental class in Mandarin language learning based on virtual reality technology have higher scores than conventional learning by 22%. However, this study has limitations, namely

that technology is still used at the Junior High School level. And the suggestion for further research is that the use of virtual reality applications can be developed by using Joysticks to interact with users on the application and can use other methods that are expected to provide better results.

REFERENCES

- [1] Diah Lestari, M. A. (2023). Kurikulum Merdeka: Hakikat Kurikulum. *Journal of Information Systems And Management*, 4.
- [2] Liu, W. (2023). A systematic review of the use of virtual reality in teaching Chinese as a foreign language. *Journal of China Computer-Assisted Language Learning*, (0).
- [3] Adam, S., Marfuah, M., Afifah, U. F., & Abdullah, A. (2024). Augmented Reality based Gamified Mandarin Learning Application. *Sistemasi: Jurnal Sistem Informasi*, 13(6), 2780-2788.
- [4] Muhammad Mannir Ahmad Getso, K. A. (2017). Virtual Reality in Education: The Future Of Learning. *International Journal of Information System and Engineering*, 5, 10.
- [5] Eva Julyanti, I. F. (2021). The Effect of Motivation on Student's Learning Outcomes. *Jurnal Pembelajaran dan Matematika Sigma (JPMS)*, 7, 6.
- [6] Gede Thadeo Angga Kusuma, I. M. (2018). Virtual Reality for Learning Fish Types in Kindergarten. *international Journal of Interactive Mobile Technologies*, 11.
- [7] F A Monita, J. I. (2020). Development Virtual Reality IPA (VR-IPA) learning media for science learning. *Journal of Physics: Conference*, 8.
- [8] Rahmawati. (2021). Penggunaan Augmented Reality sebagai media pembelajaran kosakata Bahasa Inggris siswa sekolah dasar. *Prosiding Seminar Nasional Program Pengabdian Masyarakat*.
- [9] Armen Ma'ruf, N. I. (2020). Pengembangan Mjateri Online Pada Mata Diklat. *Proceding Literasi Dalam Pendidikan di Era Digital Untuk Generasi Milenial*, 10.
- [10] Sari, R. I. (2022). Analisis Kemampuan Numerik Ditinjau dari Intelligence Quotient(IQ) Siswa Kelas VIII SMP. *Journal of Sustainable Innovation on Education, Mathematics and Natural Sciences*, 5.
- [11] M Rokhati Harianja, M. Y. (2024). Uji N-Gain pada Efektivitas Penggunaan Game dengan Strategi SGQ untuk Meningkatkan Berpikir Komputasi dalam Literasi Energi. *Jurnal Intelektualita: Keislaman, Sosial, dan Sains*, 8.
- [12] Astri Asmayanti, I. C. (2020). Model Addie Untuk Pengembangan Bahan Ajar Menulis Teks Eksplanasi Berbasis Pengalaman. *Seminar Internasional Riksa Bahasa XIV*, 9.
- [13] Xiao Renfei, A. A. (2020). Studi Pengajaran Mandarin di Indonesia . *Unesa University Press*.
- [14] Nahid Dehghan Nayer, F. A.-N. (2023). Statistical Procedures Used in Pretest-Posttest Control Group Design: A Review. *Acta Medica Iranica*, 8.
- [15] Hasny Delaila Siregar, M. W. (2024). Analisis Uji Hipotesis Penelitian Perbandingan. *Al Itihadu Jurnal Pendidikan*, 3, 12.