A Study on the Integration of Immersion in VR and Knowledge Instruction Based on the Semantic Wave Theory for the International Education of Chinese Culture

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Abstract. Virtual Reality technology can be used to create an immersive environment that transcends space and time to meet learners' requirements for cultural experiences, and can provide an aid to teaching international Chinese culture. Even so, existing pedagogical research has paid less attention to the integration of knowledge teaching and VR immersive experiences, which limits the dissemination of Chinese culture and the modernisation of international cultural education in China. In order to realise the effective integration of knowledge teaching and VR immersive experience, this study attempts to construct a teaching model of "knowledge teaching → VR immersive experience → knowledge teaching" based on semantic wave theory. The "Suzhou Garden" is chosen as a concrete case to illustrate the application of this teaching model. This paper verifies the effectiveness of this teaching model through experiments. The results show that it is conducive to improving teaching effectiveness, learning interest and cultural acceptance of Chinese culture, and that student satisfaction with it is high despite some modest recommendations. The study is useful in helping to address the disconnect between VR immersion experiences and knowledge teaching, and to deepen the integration and innovation of international Chinese culture teaching and VR technology. The combined study of virtual reality technology and learning international Chinese has broken new research ground in a new area.

Keywords: VR immersive experience, Knowledge instruction, Semantic wave theory, International Chinese cultural education.

1 Introduction

As for the application of VR in international Chinese cultural education, only Wu and Wang (2022) illustrated through an empirical study that VR immersive learning is beneficial in improving cultural learning interest [1].

The existing studies are introductory however offer scant empirical evidence, and their reliability is limited. They are primarily based on contextual cognitive theory and focus on the virtual context created by VR, with little consideration of the integration

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of classroom knowledge teaching and VR immersion. The design of the cultural teaching model is also lacking in substance [2].

In general, the previous results provide a certain theoretical and practical basis for this study while leaving sufficient research space [3]. It is necessary to further explore the effective integration of theoretical instruction and VR immersion in international Chinese education.

The strength of SG and SD are mostly negatively correlated, and the semantic wave shows an undulating change. As shown in Figure 1, the SG is weak, and the SD is strong at the wave's peak. At the wave's trough the SG is strong, and the SD is weak.

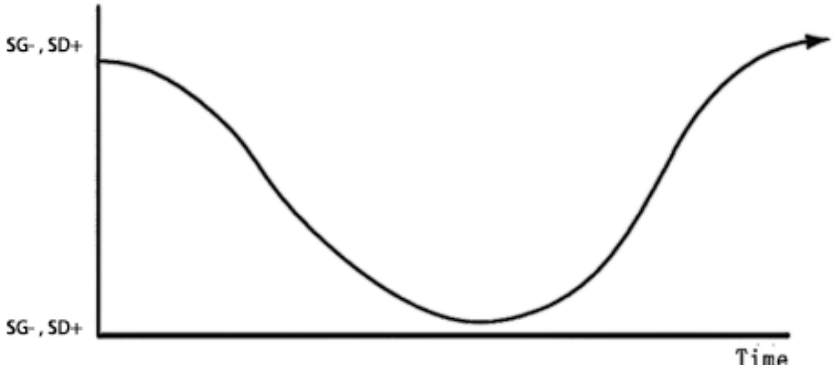

Fig. 1. Semantic profile of a single semantic wave

According to the semantic wave theory, the ideal knowledge acquisition should be a continuous cycle and progression of "abstract→ concrete→ abstract". As shown in Figure 2, the abstract concepts of SG-/SD+ are initially interpreted into concrete knowledge by using the context, and "semantic unpacking" is performed.

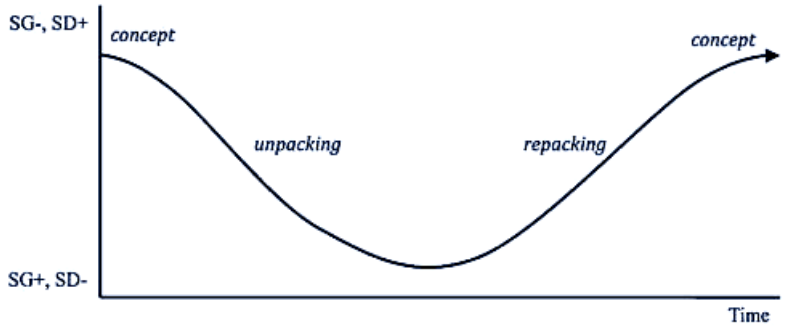

Fig. 2. Semantic profile of a single semantic wave

2 A VR Cultural Teaching Model

2.1 Design Concept

Figure 3 presents the concept of VR cultural education under the guidance of semantic wave theory. The wave peaks represent abstract cultural concepts, such as cultural terms and value concepts; the wave valleys represent concrete cultural scenes, such as garden scenery, activities, and festivals. The semantic waves are connected by curves, which represent the process of unpacking and repacking cultural knowledge. Initially, the concept is presented through theoretical explanation, then a VR immersive experience is conducted to unpack the concept, and finally, it is summarized again to pack the concept [4].

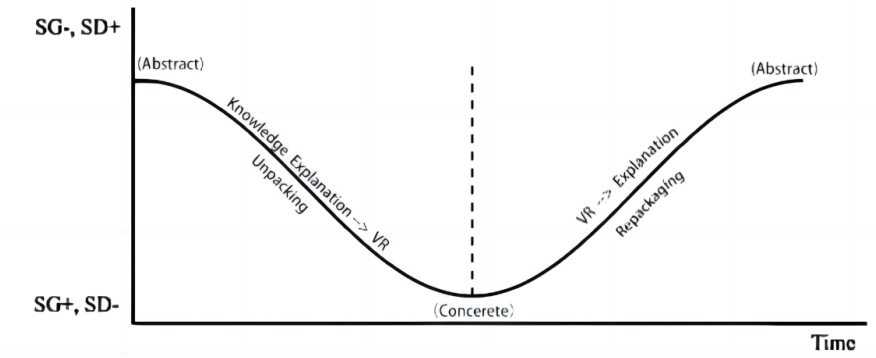

Fig. 3. Single semantic wave diagram of VR cultural education model

In actual cultural education, there may be multiple cultural knowledge points, forming multiple semantic waves and loops. This teaching model is shown in Figure 4.

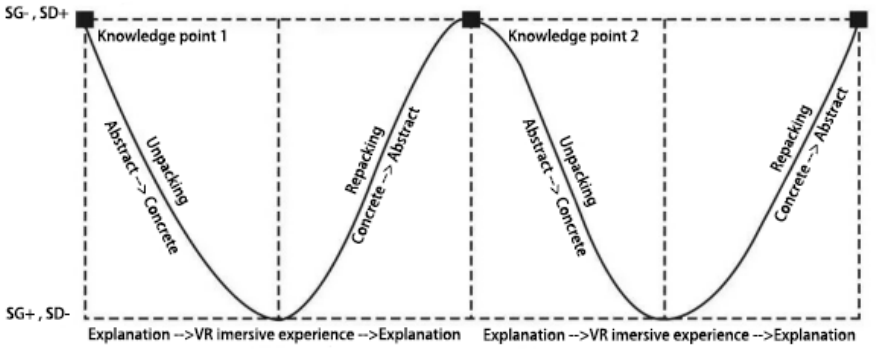

Fig. 4. Multiple semantic waves diagram of VR cultural education model

2.2 Teaching Model Design

The integration of virtual reality into cultural education necessitates the creation of a matching pedagogical model under the guidance of semantic wave theory [5]. It should set hierarchical teaching objectives, determine step-by-step content, employ complementary teaching resources, and organize diverse teaching activities in articulated teaching sessions.

This teaching model can be divided into three stages: knowledge presentation, immersive knowledge unpacking, and knowledge repackaging, as shown in Table 1. Among them, VR immersion includes a VR live tour, VR games, and other forms.

Table 1. Teaching model for VR international Chinese culture class based on semantic wave theory

Four Dimensions		Teaching Sessions and Processes	Three Major Teaching Stages	Teaching Technology Resources
Hierarchical teaching objectives		Introduction and presentation of learning objectives Warm-up activities and discussion Skimming the text Cultural explanation, initial perception	Knowledge presentation (theory instruction)	Traditional Multimedia
Articulated teaching sessions and diverse activities	Step-by-step Teaching Content	Immersion experience, deep perception VR cultural practice experience activities	Knowledge Unpacking (VR Immersive Experience)	VR equipment and resources
		Key summary, abstract overview Learning effectiveness testing and self-assessment	Knowledge repackaging (theory instruction)	Traditional Multimedia

In summary, under the guidance of this teaching model, cultural content can be taught in stages according to the hierarchical teaching objectives. Using traditional multimedia and virtual reality instructional resources, the three links of knowledge presentation, knowledge unpacking, and knowledge repackaging can be closely connected through the design of teaching activities.

3 Teaching Effectiveness Test Methods

3.1 Design

During the experiment, the teaching mode was utilized as the independent variable, and other variables were controlled, and the same teacher conducted all lessons [6]. At the finish of the experiment, students in both groups were requested to complete the cultural knowledge test and the cultural learning interest and Chinese cultural acceptance scale. The experimental group additionally completed the teaching mode evaluation questionnaire. The overall experimental process is shown in Figure 5.

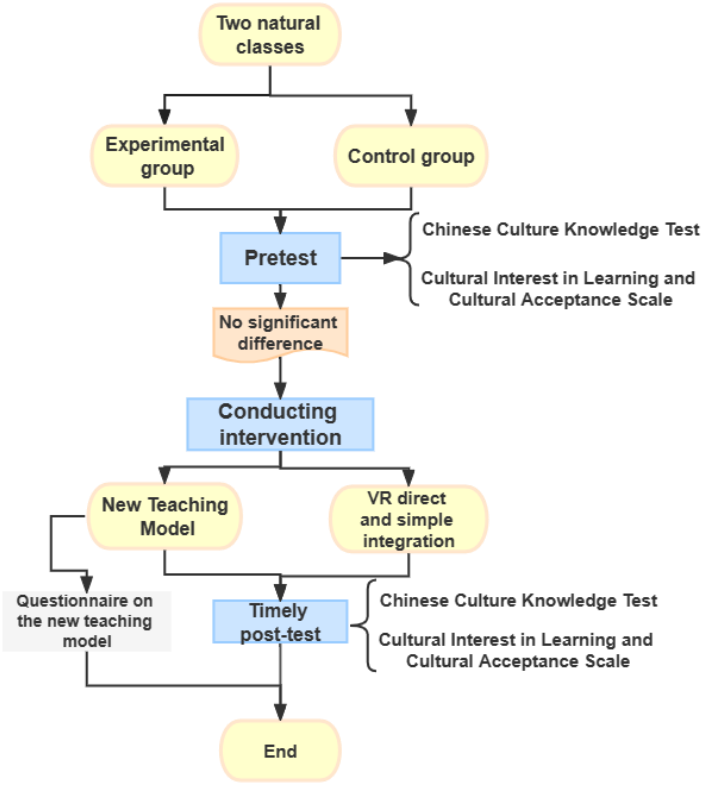

Fig. 5. Teaching experiment process design

4 Results

4.1 Cultural Knowledge Mastery Test

The two groups' pretest scores of students' cultural knowledge were 58.8 and 61.5, respectively. By independent sample T-test, the T for the experimental and control groups

was -0.696, and the P was 0.488, greater than the standardized alpha coefficient of 0.05, which indicated no significant difference. After the teaching experiment, the average score of the control group was 79.25, and the experimental group scored a substantially higher mark of 93.5. See Figure 6 for details.

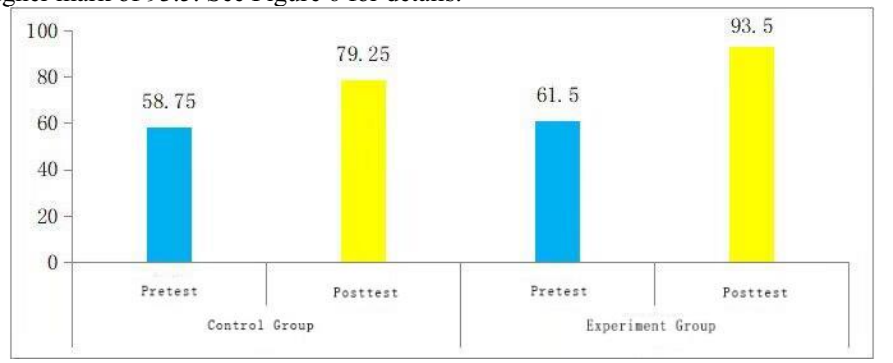

Fig. 6. The average score of cultural knowledge test

As seen in Table 2, there was a significant difference between the pre-test and post-test in the control group, with the post-test scores significantly higher than the pre-test. The T before and after the experiment was -7.724 with a P of 0.000, less than the standardized alpha coefficient of 0.05. Similarly, in the experimental group, there was a significant difference between the pre and post-tests, and the post-test scores were significantly higher than the pre-tests. Both the control group and the experimental group's post-test results considerably outperformed their pre-test scores, indicating that both the direct inclusion of VR in the cultural instruction and the instruction using the new teaching model helped the students to acquire more knowledge of Chinese culture[9].

Table 2. Analysis of the difference between pre and post-test scores of the cultural knowledge test

		N	Mean	Sd	T	P
Control Group	Pre-test	58.75	40	18.001	-7.724	0.000
	Post-test	79.25	40	12.888		
Experiment Group	Pre-test	61.50	40	17.328	-9.857	0.000
	Post-test	93.50	40	9.213		

Comparing the difference in post-test scores between the experimental and control groups is still necessary, nonetheless [7]. There is a significant difference between the two groups' post-test scores, as shown in Table 3, where the T is -5.689, and the P is less than 0.05. The experimental group's post-test results on the cultural knowledge test were noticeably better than those of the control group. It indicates that the VR cultural teaching mode based on semantic wave theory is more conducive to improving students' cultural learning effects and aiding them in mastering Chinese cultural knowledge [8].

Table 3. Analysis of post-test difference between the control group and experimental group

		N	Mean	Sd	T	P
Post-test	Control Group	40	79.25	12.888	-5.689	0.000
	Experiment Group	40	93.50	9.213		

4.2 Interest in Learning and Chinese Cultural Acceptance

In the pre-test, there was no significant difference between the two groups regarding students' interest in learning and acceptance of Chinese culture. As seen in Figure 7, after the experiment, the average scores of students' learning interest and Chinese culture acceptance in the experimental group were 4.39 and 4.53, respectively, and they both increased [10].

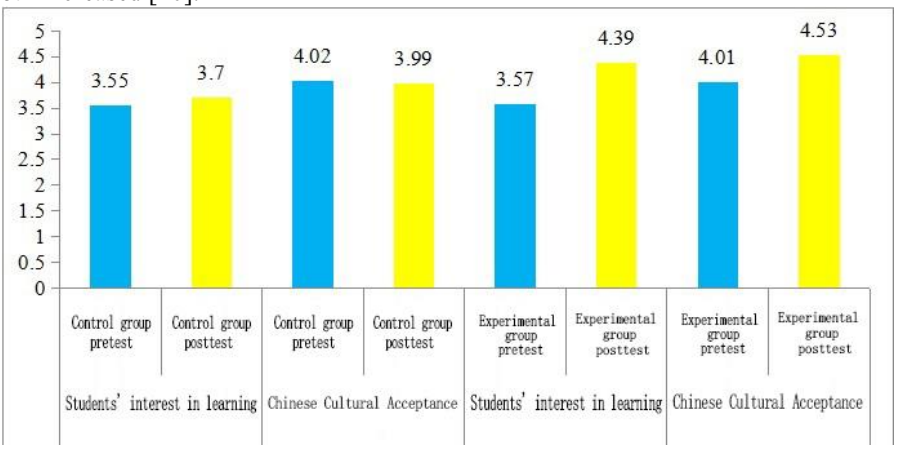

Fig. 7. Pre-test and post-test comparison of students' interest in learning and acceptance of Chinese culture

The changes in students' interest in learning and acceptance of Chinese culture in two groups were analyzed, and the results are shown in the table 3. There was no significant difference between the pre-test and post-test of the control group. In contrast, the experimental group had significantly higher scores on the post-test scale.

5 Conclusion

Chinese culture education is essential to international Chinese language education, and Virtual Reality technology may provide a spatially and temporally immersive environment, offering a new approach to cultural education. However, the current VR cultural education model needs to be more mature. There is a disconnection between VR immersive experiences and knowledge instruction, which hampers the acquisition of Chinese cultural knowledge to some level.

There is an urgent necessity for further studies into the practice of this teaching model based on semantic wave theory that integrates VR immersive experiences and traditional knowledge instruction in a complementary way. Furthermore, provided it is demonstrated to be beneficial in the extensive teaching practice, it is advised to apply this teaching model and adjust it flexibly according to the actual situation to improve international Chinese cultural education.

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