# *Augmented Reality Technology on Chinese Vocabulary Teaching for International Undergraduate Students*

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**Abstract**
Studying basic Chinese as a foreigner poses challenges rooted in unfamiliarity with the language's characters and tones, compounded by cultural differences. These obstacles require state-of-the-art learning material which encourages participation, stimulates attention, and retains the learner's enthusiasm. This study deployed an active learning approach, examined the primary challenges faced by international students in Chinese character cognition, and proposed the utilization of Augmented Reality (AR) technology in teaching Chinese vocabulary to address these difficulties. The research employs various methods to collect data, such as tests, surveys, interviews, and classroom observation records. Through comprehensive analysis of these data, the effectiveness of AR technology in Chinese vocabulary teaching is thoroughly investigated. The purposes of this study were: 1) to compare the pre-test and post-test results of students' Chinese vocabulary learning when AR technology is employed and 2) to assess students' satisfaction with the application of AR technology in Chinese vocabulary teaching. The research focuses on 35 undergraduate international students at Sichuan University of Science and Engineering. The findings reveal: 1) the student's achievement based on the average score of the post-test was higher than the pre-test significantly, and 2) AR-enhanced vocabulary teaching enhances teaching effectiveness, stimulates students' learning interests and enthusiasm, fosters increased interaction and communication among students and between students and teachers, thus aiding students in mastering vocabulary more effectively.

Keywords: Augmented Reality Technology, Chinese Language Teaching, Vocabulary Teaching, Action Research

## 1. Introduction

With the burgeoning development of China's economy, an increasing number of foreigners are delving into learning Chinese. Within Chinese teaching, vocabulary and its instruction have garnered significant academic interest. The efficacy of vocabulary instruction directly impacts learners' proficiency in Chinese. Chinese harbours an extensive lexicon, necessitating an optimized design for vocabulary teaching to aid students in better word retention. It's imperative to synthesize experiences and refine vocabulary teaching methodologies continually.

Several innovative teaching methodologies have emerged amid the seamless integration of information technology, intelligent techniques, and pedagogy. Augmented Reality (AR) technology, capable of creating immersive virtual three-dimensional environments, seamlessly blends the virtual and tangible in education. Consequently, Bistaman et al. (2018) posit that AR substantially stimulates students' interest, bolsters enthusiasm, enhances learning efficiency, and catalyzes innovative teaching methodologies.

Presently, research on the application of AR technology in language instruction spans multiple languages, including Chinese, English, Thai, and others. In Chinese instruction, Prontip (2015) integrated AR technology for teaching Chinese vocabulary, yielding improved learning efficiency and heightened student motivation. Uiphanit et al. (2020) developed a mobile AR application for enhancing Chinese vocabulary learning for students who learn Chinese as a main subject, significantly improving their learning capabilities. Similarly, in Thai language instruction, Vongsripeng (2011) applied AR technology to teach Thai letters, enhancing learning efficiency and deepening students' comprehension and retention of Thai characters. In English instruction, Shaumiwaty et al. (2022) incorporated AR technology in primary school English classes, bolstering the teaching effectiveness of English literacy and pronunciation. Gawale et al. (2018) leveraged AR for English animal vocabulary instruction in Thai kindergartens, rendering abstract content vivid and comprehensible. Moreover, Meksamoot et al. (2017) designed electronic teaching materials for complex Thai consonants, improving learning efficiency and speaking prowess, thereby fostering student interest.

The exploration and evolution of AR technology in teaching diverse languages have spotlighted its potential in modern Chinese vocabulary instruction. While a few researchers have explored AR-based Chinese vocabulary teaching, complete teaching practices and detailed methodologies, models, and evaluation indicators remain scarce. Cai et al. (2022) pointed out that in language classes, AR applications should not be restricted to a specific instructional strategy only but be used diversely. Wen et al. (2021) highlighted that the research on integrating pedagogical designs with AR in language learning is less mature.

Hence, this study centers on Chinese vocabulary instruction for international students, undertaking action research by employing AR technology in Chinese vocabulary teaching. Devising a teaching blueprint leveraging AR technology alongside existing teaching materials, this study orchestrates AR Chinese vocabulary sessions for international students. A comprehensive survey and interviews evaluate the application's impact in Chinese vocabulary instruction.

The key contributions and significance of this research are outlined as follows:

(1) Exploring teaching strategies and models compatible with AR technology in vocabulary instruction, fostering diversified approaches to vocabulary teaching.

(2) Pioneering the application of AR technology to innovate Chinese vocabulary instruction, fostering the evolution of Chinese pedagogy, and enriching digital resources for Chinese instruction.
(3) Within the information education landscape, utilizing AR technology as a blueprint for the reform of Chinese instruction.

## 2. Research Methodology

The primary research methodologies employed in this study encompass action research, questionnaires, and interviews.

***(1) Action Research Method***
The action research process involves several stages: firstly, formulating an action plan; secondly, implementing practical research; thirdly, assessing the exercise impact; fourthly, reflecting upon and refining the action plan; fifthly, re-implementing the program; sixthly, observing the outcomes; and finally, reflecting on the entire process. Through these steps, we conduct action research into the application of AR technology in Chinese vocabulary teaching. We aim to summarize experiences and shortcomings, propose improvement measures and recommendations, and derive conclusive findings that can substantiate the utilization of AR technology in Chinese vocabulary teaching.

***(2) Questionnaire Survey Method***
Upon the completion of the teaching period, an electronic questionnaire will be distributed among the teaching subjects to evaluate the effectiveness of AR technology in Chinese vocabulary teaching. This survey aims to analyze the impact of AR technology on Chinese vocabulary teaching effectiveness and gather students' feedback.

***(3) Interview Method***
Throughout the teaching process, interviews were conducted to gather teachers' perspectives on the effectiveness of AR technology in vocabulary teaching. These interviews aimed to analyze the challenges and potentialities associated with integrating AR technology into vocabulary teaching. Additionally, interviews with students using AR technology for Chinese vocabulary learning aimed to discern genuine classroom experiences, learning conditions, emotional shifts, and altered learning attitudes facilitated by AR technology.

## 3. Research Subjects

The subjects of this research encompass international undergraduate students enrolled in Chinese studies at the Sichuan University of Science and Engineering in China. The class consists of 35 students, 17 boys and 18 girls, aged between 17 and 19, with an elementary-level Chinese proficiency. Among them, three have successfully passed the HSK Level 3 exam. Most students have pursued Chinese language studies for over three years, commencing during their first year of high school. Each year, students engage in two courses—basic Chinese and vocational Chinese—amounting to 240 learning hours annually. The study involved action research on Chinese vocabulary teaching utilizing AR technology, spanning 19 weeks with four classes per week, each session lasting 50 minutes.

## 4. Research Design

### *(1) Research Process*

This research focuses on Chinese vocabulary teaching and conducts action research on the application of AR technology in teaching Chinese vocabulary to international students. Initially, we used ZAPPAR software to design AR vocabulary teaching courseware. A targeted design for AR technology in Chinese vocabulary teaching was developed based on student materials, and teaching practices were implemented accordingly. The action research methodology was employed to continuously observe, reflect, and adjust teaching strategies throughout the process, providing a realistic record of the teaching practice. The actions in this study are divided into two rounds. The initial one spans the first ten weeks, encompassing 30 lessons. Pre-testing was conducted before its initiation. After completing AR-based Chinese vocabulary lessons, students underwent test assessments and post-testing to gather pertinent data. Synthesizing and reflecting on outcomes from the initial phase laid the groundwork for executing the second phase. According to the first-round results, the next one further adjusted and created AR-based vocabulary teaching materials. The second post-testing was conducted at the end of the second round. Subsequently, a combination of questionnaire surveys and interviews was employed to assess the impact of AR technology on vocabulary teaching. The primary research objectives of this article can be categorized into the following four aspects:

1) Designing a teaching plan for implementing AR technology in vocabulary teaching, grounded in the existing teaching materials.
2) Implementing action research methods to teach Chinese vocabulary using AR technology.
3) Gathering student feedback on the effectiveness of AR technology application in vocabulary teaching through questionnaires.
4) Conducting interviews with a Chinese teacher and students utilizing AR technology for learning Chinese vocabulary at school.

### *(2) Test Design*

This research incorporated three evaluations: a pre-testing administered before the teaching interventions, a post-testing after the initial teaching action round, and a subsequent post-testing following the completion of the second round. Table 1 provides comprehensive details regarding these evaluations. Employing a systematic sampling approach, we selected ten vocabulary words per lesson, amounting to 80 words in total. Across the three assessments, there were a combined 80 questions. The compilation of vocabulary test items primarily assessed three facets: pronunciation/intonation, word meanings, and word forms, aiming to gauge students' grasp of the vocabulary.

Table 1: The specific details of three consecutive tests

| Testing | Number of items |
|---|---|
| Pre-testing | A total of 40 questions |
| Post-testing after the first round of action | A total of 20 questions |
| Post-testing after the second round of action | A total of 20 questions |

### *(3) Questionnaire Survey*

After completing the second round of instructional interventions, a questionnaire survey is administered to students involved in AR-based Chinese vocabulary instruction. Structured on the Likert five-point scale, the questionnaire encompasses diverse aspects, including:

1) Basic personal information, such as ethnicity, gender, age, proficiency in the Chinese language, and duration of Chinese language learning.
2) Current utilization status of AR technology (1 item).
3) Students' experiences with AR usage (2 items).
4) Emotional attitudes of students (6 items).
5) Students' learning outcomes (7 items).

***(4) Interviews***

To further explore the implementation of AR in Chinese vocabulary instruction, students' experiences with AR, their attitudes, and detailed recommendations are investigated through post-teaching session interviews.

A total of 10 students were interviewed, comprising five males and five females. The interviews, lasting over 10 minutes each, were conducted face-to-face and over the telephone, encompassing two face-to-face sessions and eight telephone interviews.

These semi-structured interviews involved the author using prepared outlines before the sessions. The outlines were designed based on student's learning experiences and additional information needed from the questionnaire survey, encompassing a total of 6 questions. The interview outlines are provided in Appendix 5, featuring the following specific questions:

1) What vocabulary teaching methods are you familiar with?
2) What are your perspectives on using AR technology for vocabulary learning?
3) What are your most prevalent challenges when learning vocabulary using AR technology?
4) How do you address these challenges? Please share your insights.
5) What advantages have you encountered in learning vocabulary with AR technology?
6) Following the use of AR technology in vocabulary learning, what guidance and recommendations would you offer to the teacher?

## 5. Results and Discussion

***(1) Analysis of Pre- and Post-test Scores Before and After the First Round of Actions***

Figure 1 demonstrates a notable contrast between the pre- and post-testing overall scores among students following the initial round of action. The discernible increase in overall scores post the first round signifies the efficacy of AR in vocabulary instruction. Further scrutiny of student learning outcomes, specifically in word form, pronunciation, and meaning, unveils a significant enhancement in 'Form' and 'Meaning' scores between the pre and post-tests after the initial round of action. However, there's no marked improvement in 'Pronunciation' scores. This suggests that AR-based teaching in the initial round has had a restricted impact on students' proficiency in word pronunciation. Consequently, the focus will be on assessing the efficacy of AR in teaching Chinese word pronunciation during the second round of instructional actions.

***(2) Analysis Of Pre- and Post-Test Scores Before and After the Second Round of Actions***

Figure 2 illustrates a notable disparity between the pre- and post-testing overall scores among students after the second round of action. There's a marked enhancement in the overall scores of students before and after the second round of action, underscoring the efficacy of AR in vocabulary instruction. Further scrutiny of student learning outcomes concerning word form, pronunciation, and meaning unveils a noteworthy improvement in 'Form' and 'Pronunciation' scores in the pre and post-tests following the second round of action. However, there's no

substantial improvement in 'Meaning' scores. This indicates that AR-based teaching in the second round constrains students' command over word meanings. Thus, the author suggests that refining AR-based vocabulary instruction should prioritize enhancing the efficacy of AR in teaching Chinese word meanings.

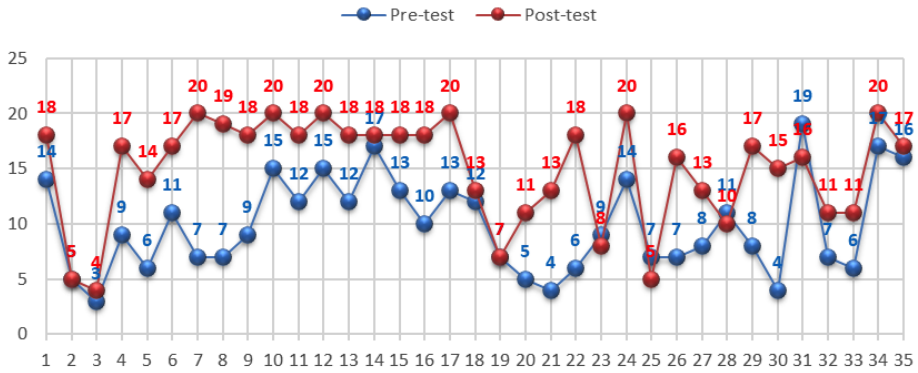


Figure 1: Analysis of pre- and post-test overall score differences in the first round

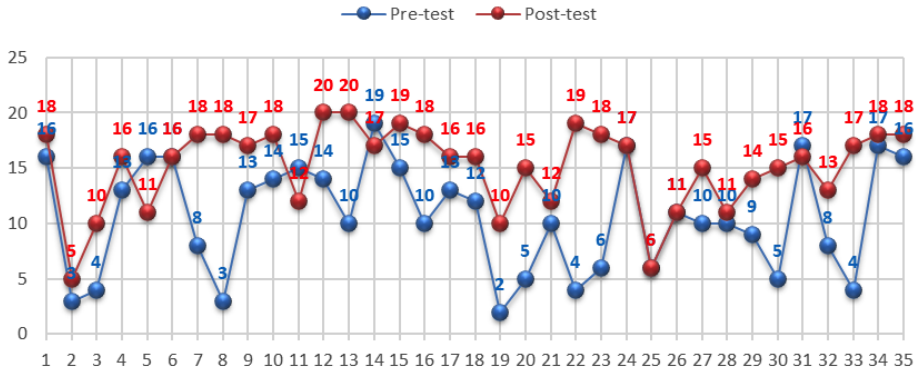


Figure 2: Analysis of pre- and post-test overall score differences in the second round

***(3) Analysis of Questionnaire Survey***

The questionnaire survey encompassed 35 students engaged in AR-based Chinese vocabulary teaching. All 35 questionnaires distributed were collected, resulting in a 100% response rate, with 35 questionnaires deemed valid, indicating a 100% validity rate. Regarding prior AR technology usage, survey results revealed that 97.1% of students hadn't previously utilized AR or similar technologies in their Chinese language learning endeavours. In comparison, only 2.9% had some exposure to similar tools. This implies a relatively limited integration of AR technology in current Chinese language teaching practices. Regarding students' experiences with AR, survey findings showed that 57.1% of students found AR technology easy to operate, with 31.4% strongly agreeing. Only 11.5% expressed some uncertainty about its usability, indicating that most students perceive AR technology as user-friendly. Additionally, 54.3% agreed that AR technology enhances students' engagement in classroom activities, with 40% strongly agreeing. Conversely, a minority (5.7%) were somewhat uncertain. Notably, a few students encountered network issues, limiting their participation in class activities and contributing to a perception of AR technology as cumbersome among some students.

Figure 3 illustrates the impact of AR technology on word form, meaning, and pronunciation connections among students. Concerning the relationship between word form and meaning

facilitated by AR, 51.4% of students acknowledge its assistance in establishing these connections. Among them, 28.6% strongly agree, while 17.1% remain uncertain, and 2.9% disagree. This highlights AR's role in deepening students' understanding of vocabulary by associating word form with richer semantic content. Regarding connecting word form with pronunciation through AR, 57.1% of students express that AR aids in this association, with 28.6% strongly agreeing and 14.3% remaining uncertain. This demonstrates AR's capacity to link word characteristics with correct pronunciation, thereby enhancing reading fluency. Regarding pronunciation and meaning connections through AR, 57.1% of students believe it facilitates this association, with 31.4% strongly agreeing and 11.5% expressing uncertainty. AR notably assists in comprehending diverse meanings of words or phrases within varying contexts, aiding students in learning polysemous words. Notably, AR is observed to be most effective in linking pronunciation with meaning, followed by word form and pronunciation, and finally, word form and meaning.

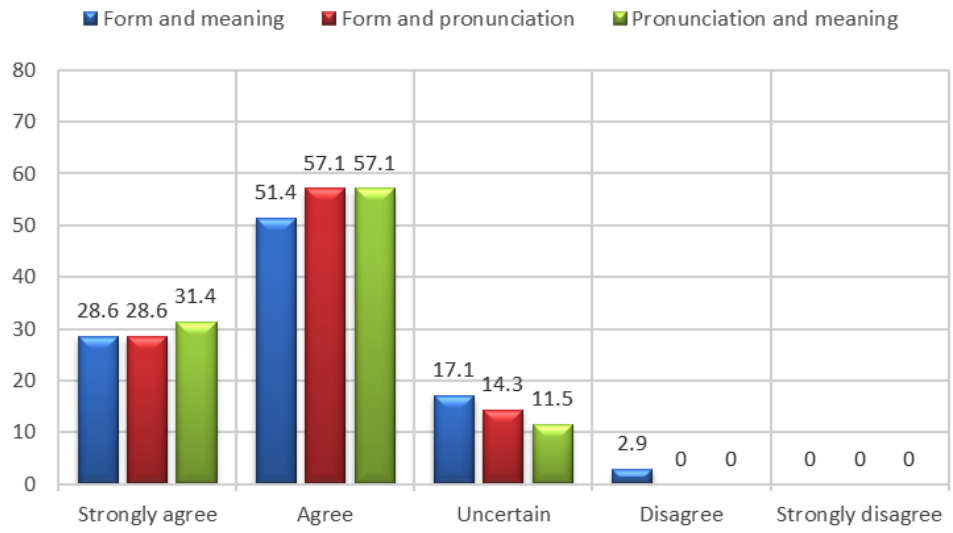


Figure 3: Analysis of using AR to help students establish connections between word form and meaning, word form and pronunciation, and pronunciation and meaning

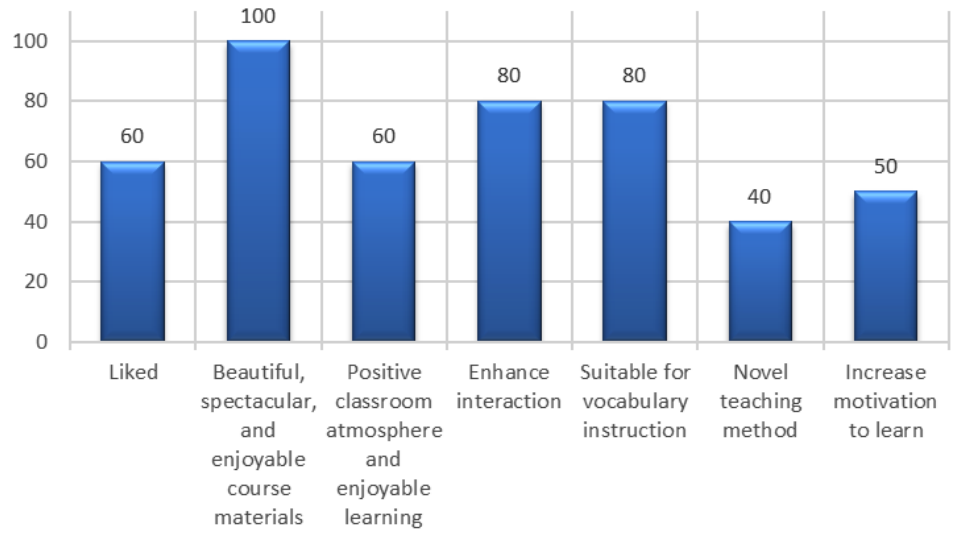


Figure 4: Students' perspectives on using AR for Chinese vocabulary learning

***(4) Analysis of Interview Findings***

Figure 4 portrays interview insights revealing unanimous student appreciation for AR course materials, with 100% of respondents describing them as visually appealing, remarkable, and enjoyable, offering a refreshing departure from conventional blackboard-based instruction. Moreover, 80% of students highlight AR's effectiveness in fostering student engagement, deeming it apt for vocabulary instruction. Additionally, 60% express a genuine fondness for AR-based learning, attributing it to creating a positive classroom ambience and enjoyable learning encounters. Half of the students (50%) perceive AR as a motivational tool for Chinese language acquisition, while 40% regard it as an innovative instructional approach. These findings collectively affirm that students universally recognize and appreciate AR-based instruction's engaging and enjoyable nature.

## 6. Conclusion

After conducting two teaching cycles and analyzing various materials and data collected during the instructional process, this study has yielded several conclusions regarding the implementation of AR in Chinese vocabulary education.

***(1) Boosting Student Motivation***

Through interviews, questionnaires, tests, and assessments of student assignments, it was evident that AR-based instruction effectively alleviates the monotony often associated with traditional teaching methods. AR engagement fosters a robust vocabulary foundation among students, heightens their classroom involvement, and cultivates positive interactions between teachers, students, and peers. Consequently, students exhibit increased enthusiasm and initiative in their learning endeavours. Notably, when encountering challenging tasks, students proactively seek solutions or guidance from teachers to stay on par with their classmates.

***(2) Sparking Students' Interest And Drive to Learn***

Action research, including student interviews and assignment evaluations, demonstrated a considerable surge in students' enthusiasm for learning Chinese vocabulary. The amalgamation of AR and real-world elements ignites students' interest and augments their intrinsic motivation, resulting in heightened attentiveness and engagement. In the classroom, students display diligence, active participation in class exercises, and completion of AR-related learning tasks, yielding commendable outcomes for AR-based instruction.

***(3) Improving Learning Outcomes and Academic Performance***

Two action research cycles revealed significant improvements in Chinese vocabulary acquisition in form, pronunciation, and meaning. This also suggests a positive correlation between AR instruction and enhanced Chinese language proficiency. AR-based vocabulary instruction solidifies students' vocabulary comprehension and bolsters their understanding of word forms, pronunciation, and meanings, enhancing overall Chinese language learning performance.

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