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Research Article

Immersive language learning: Students' perceptions of a virtual reality-embedded station rotation model for Chinese as a foreign language

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ABSTRACT

Virtual reality (VR) has become an increasingly valuable tool for learning because it can transform abstract ideas into concrete, meaningful concepts. However, students' perceptions of this emerging approach are crucial for developing an effective VR-based teaching model. This study aimed to explore the perceptions of intermediate-level Chinese as a foreign language (CFL) students toward a VR-embedded station rotation learning model. A qualitative case study design was employed, using focus group interviews and open-ended questionnaires with 30 intermediate-level CFL students from a college in China who participated in the VR-embedded station rotation model for one semester. Data were collected at mid-semester and at the end of the semester. The findings revealed seven themes: five positive—VR technology, vividness, practice, personalization, and receiving help—and two negative—challenging tasks and technology use. Students appreciated the immersive VR experiences, interactive activities, and personalized feedback, but also encountered difficulties with task complexity and technical issues.

Keywords: VR-embedded station rotation learning model, case study, Chinese as a foreign language, student perceptions

INTRODUCTION

Over the past decade, the rapid advancement of immersive technologies has fundamentally transformed the landscape and pedagogical practices of global education. As a flagship technology in the new wave of educational digital transformation, virtual reality (VR) has emerged as a critical enabler of instructional innovation across diverse academic fields, owing to its defining characteristics of immersion, interactivity, and situational authenticity (Cipresso et al., 2018). Distinct from conventional multimedia tools that primarily deliver passive content, VR translates abstract theoretical concepts into tangible, interactive real-world simulations, enabling learners to construct knowledge through experiential engagement. This unique technological advantage is especially pronounced in language education: it transcends the physical

boundaries of traditional classrooms, creating authentic communicative contexts for learners and effectively addressing the longstanding challenge of decontextualized language instruction.

Against the backdrop of China's growing global economic and cultural influence, the worldwide demand for Chinese as a foreign language (CFL) education has grown at an unprecedented rate over the past two decades (Gong et al., 2018). According to recent statistics, as of 2024, Chinese language instruction is now offered in over 190 countries and regions globally, with the total number of CFL learners surpassing 250 million. Nevertheless, a growing mismatch has emerged between this surging global demand and the inherent limitations of traditional CFL pedagogical models. Conventional CFL classrooms are predominantly teacher-centered, relying heavily on didactic lectures and rote memorization drills. This approach fails to provide learners with sufficient authentic communicative opportunities, resulting in a severe shortage of oral language practice. Furthermore, the psychological pressure associated with face-to-face public speaking often leads to significant foreign language anxiety among learners, which significantly impedes the development of their overall communicative competence (Gong et al., 2020). These interconnected challenges have become critical bottlenecks that limit improvements in the quality of CFL instruction worldwide.

To mitigate these longstanding pedagogical challenges, blended learning models have gained widespread adoption in higher education institutions worldwide. Among various blended learning frameworks, the station rotation model (SRM) has established itself as a highly effective and widely implemented approach, primarily because it balances online self-paced learning with offline face-to-face teacher-student interaction (Bernard et al., 2014). In the SRM framework, the classroom is organized into multiple specialized learning stations. Students rotate through these stations on a predetermined schedule, completing distinct tasks including teacher-led direct instruction, small-group collaborative activities, and independent online learning modules. This structured approach not only boosts student personalized learning, social interaction, and direct content learning in the classroom but also enables instructors to provide differentiated instruction and personalized learning pathways according to students' individual learning needs (Horn & Staker, 2014; Staker & Horn, 2012).

While both VR technology and SRM have demonstrated substantial pedagogical benefits, the existing body of research has largely investigated them separately. On the one hand, most existing VR language-learning studies focus on short-term learning outcomes of isolated VR applications, with little attention to the systematic integration of VR into formal, structured instructional frameworks (Radianti et al., 2020). Reliance on standalone VR tools without adequate instructional scaffolding often results in insufficient teacher guidance and limited peer interaction during learning, making it challenging to establish a coherent, effective learning cycle. On the other hand, most SRM-related research has focused on conventional digital learning platforms, and very few studies have explored feasible pathways to integrate immersive technologies, such as VR, into the station rotation framework (Parmaxi, 2023). Notably, in the context of CFL instruction, empirical evidence on the effectiveness and implementation of VR-embedded SRM remains extremely scarce. Furthermore, learners' firsthand experiences and subjective perceptions of this innovative instructional model have yet to be comprehensively explored.

Based on the above research gaps, this study aims to examine the effects of the application and students' perceptions of the VR-embedded SRM in intermediate CFL classrooms. Adopting a qualitative case study design, the research conducted a one-semester teaching experiment with 30 intermediate CFL learners at a vocational institute in eastern China. Data were collected through two rounds of focus group interviews and open-ended questionnaires at mid-semester and the end of the semester. This study attempts to answer two core research questions:

1. How to design a VR-embedded station rotation teaching model suitable for CFL classrooms?
2. What are the perceptions and evaluations of intermediate CFL learners towards this teaching model?

The findings of this study are expected to make two key contributions: theoretically, they will enrich the existing theoretical framework of immersive technology-enhanced language learning; practically, they will provide replicable and scalable instructional guidelines for frontline CFL educators, thereby facilitating the deeper integration of educational technology and Chinese language pedagogy.

LITERATURE REVIEW

Virtual Reality in Language Learning

As a transformative educational technology, VR constructs immersive, interactive, and contextually authentic virtual environments (Cipresso et al., 2018; Huang et al., 2010). In general education, VR enhances learner engagement, improves long-term memory retention, and deepens conceptual understanding by immersing students in hands-on scenarios that transcend physical classroom boundaries (Parong & Mayer, 2018).

In language education, VR solves a core problem. Second- or foreign-language learners lack authentic communication contexts (Parmaxi, 2023). Traditional teaching often uses decontextualized drills. VR simulates real-life interactions. It lets learners practice speaking, listening, and pragmatic competence in low-anxiety, safe environments (Gong et al., 2020). Kavanagh et al. (2017) noted VR has great potential for language teaching. However, its classroom adoption still faces persistent barriers, including hardware and software usability issues, technical instability, and inconsistent curriculum implementation.

Recent studies link VR to digital game-based language learning (DGBLL). This framework combines immersive technology with gamified tasks. It boosts motivation to learn and improves vocabulary retention (Kazu & Kuvvetli, 2023). Dhimolea et al. (2022) reviewed immersive language technologies. They found VR environments significantly enhance short-term and long-term vocabulary acquisition, as well as communicative competence. These findings are promising. Yet most current studies focus on standalone VR applications. Few explore integrating VR into structured blended learning frameworks (Radianti et al., 2020).

Station Rotation Model in Blended Learning

Blended learning has emerged as a core teaching model in higher education over the past two decades, integrating online flexibility with in-person guidance (Bernard et al., 2014). According to Horn and Staker (2014), the SRM is a subtype of the rotation model in blended learning, allowing students to rotate through teacher-led, collaborative, and online learning stations within a structured schedule.

The SRM divides classroom activities into different learning stations, as mentioned. Students rotate through tasks such as teacher-led lessons, group collaboration, and independent online work on a fixed schedule (Truitt & Ku, 2018). This model boosts student engagement and peer collaboration. It also helps teachers offer tailored support for individual learners (Staker & Horn, 2012). Truitt and Ku (2018) noted that technology integration is key to effective SRM use. Online platforms often deliver personalized learning content at digital stations.

Current SRM research has two main gaps. First, most studies focus on quantitative results. Few analyze students' perceptions and experiences qualitatively (Truitt & Ku, 2018). Second, few studies examine how immersive technologies such as VR integrate with SRM. This leaves questions about VR's role in station-based learning unanswered (Radianti et al., 2020).

Chinese as a Foreign Language Learning Challenges and Technological Solutions

Global demand for CFL education has risen sharply since 2004. This growth is driven by China's expanding global economic and cultural influence (Gong et al., 2018). Despite this trend, CFL learners still face persistent challenges. They have limited access to authentic Chinese communication situations, lack enough oral practice, and feel high speaking anxiety in traditional classrooms (Gong et al., 2020). These barriers slow the development of communicative competence, a core goal of CFL education.

Technology provides key solutions to these challenges. Kirkley and Kirkley (2005) first proposed that immersive technologies like VR, when integrated with blended learning, can create dynamic, authentic practice environments for language learners. Later studies support this view. VR gives CFL learners low-pressure speaking practice. It reduces anxiety and builds confidence in oral communication (Gong et al., 2020). However, most VR-based CFL research focuses on short-term skill gains. Few studies explore student perceptions of long-term, semester-long integration into structured blended learning models.

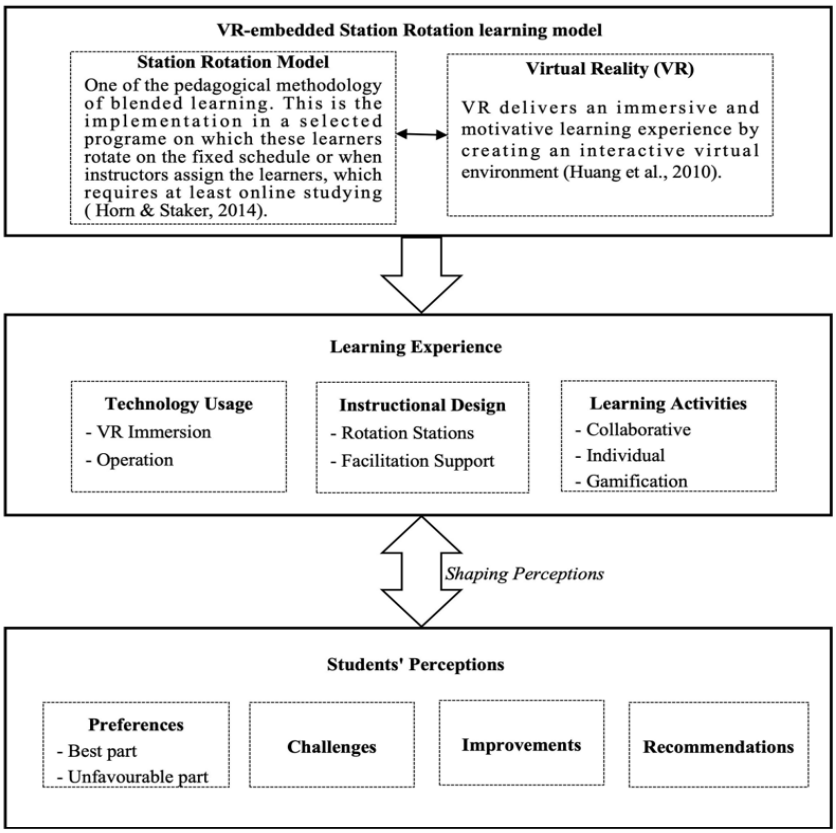

Figure 1. Conceptual framework of the study (created by the authors)

Research Questions

The research question addressed is as follows:

1. What is the effective pedagogy design of the VR-embedded station rotation learning model in a CFL classroom?
2. What are the students' perceptions of the VR-embedded station rotation learning model in a CFL classroom?

To address these research gaps, this study examines intermediate CFL students' views on a semester-long learning model integrating VR with the SRM. It provides qualitative evidence to guide the design and use of technology-enhanced CFL teaching.

Theoretical Framework

This study draws on two core theories of second language acquisition: Krashen's (1982) input hypothesis and Swain's (1985) output hypothesis. Krashen's (1982) theory emphasizes that comprehensible, context-rich input is essential for language learning. Swain's (1985) theory complements this view. It highlights that meaningful interactive output is critical for developing fluency and accuracy. The VR-embedded SRM aligns with both theories. VR provides authentic, immersive comprehensible input. Multi-station interaction and practice create opportunities for meaningful output. This addresses core challenges in CFL learning (Gong et al., 2020) (see **Figure 1**).

RESEARCH METHODS

Participants

30 CFL learners, 20 male and 10 female, from Jiaxing Nanyang Polytechnic Institute participated in this study to experience the VR-embedded station rotation learning model. They were all intermediate Chinese students, aged 18-26. The classroom had a diverse student population from around the world.

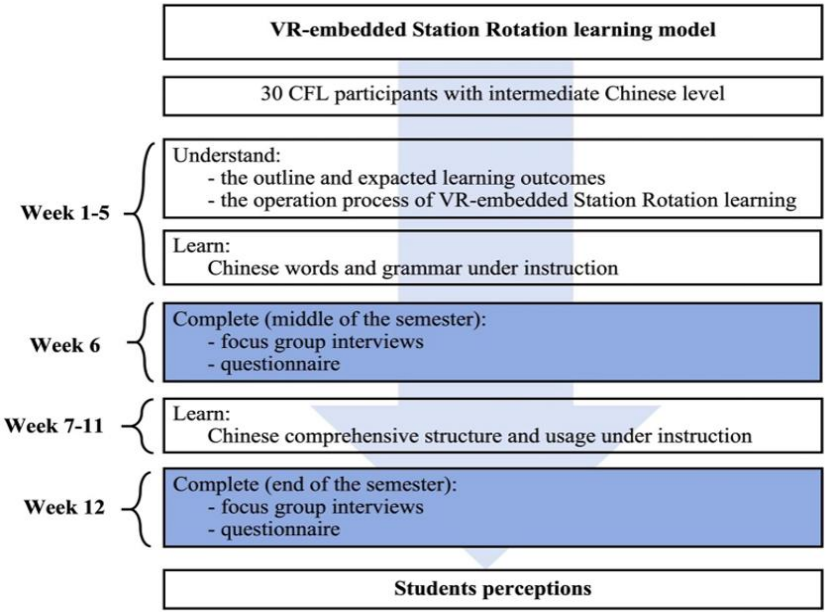

Figure 2. Diagram of the main experimental activities (created by the authors)

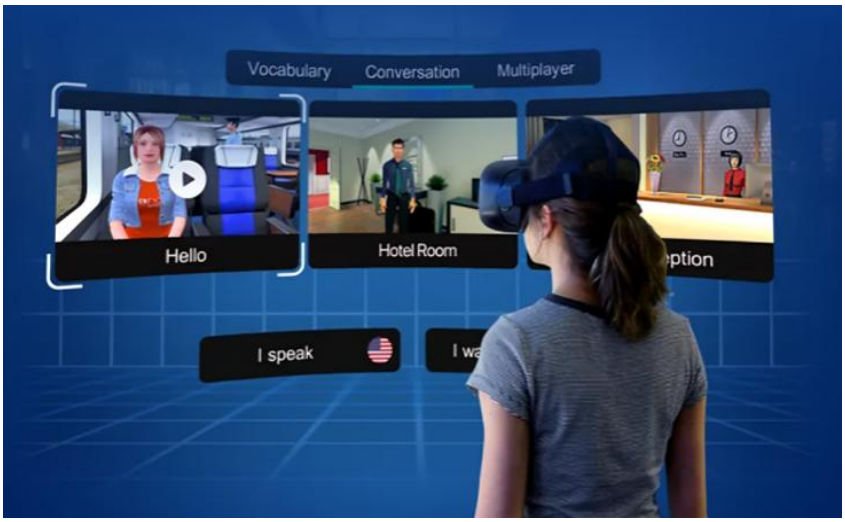

Figure 3. VR study in VR-embedded station rotation learning model (Mondly, 2024)

Research Design and Instruments

Research design and instruments were developed according to the research questions, and the experimental activities were explained in **Figure 2**.

Design of Learning Experience Based on Virtual Reality-Embedded Station Rotation

Virtual reality-embedded station rotation classroom setting

The classroom was arranged to facilitate smooth movement among the three learning stations during the implementation of the VR-embedded station rotation model. The layout was designed by researchers to minimize congestion, support collaborative interaction, and ensure safe use of VR equipment. There are three stations in this model: lecturing, online activities (the VR station), and group activities. Tables in the VR station were positioned at the back of the classroom for students to use while working on their VR devices. This location allowed VR devices to remain set up throughout entire classes without the need to move devices or furniture and helped avoid damage to these devices from frequent student rotation among stations (Huang et al., 2010; Peterson, 2016). Students had access to 10 VR devices, with a VR-to-student ratio of 1:3. Also, they had access to digital content on the VR system for learning Chinese (Mondly, 2024) (see **Figure 3**).

Table 1. Activity chart of VR-embedded station rotation learning model

Group	Round 1	Round 2	Round 3
1	*Lecturing* 	*Gourp activity* 	*VR study* 
2	*Gourp activity* 	*VR study* 	*Lecturing* 
3	*VR study* 	*Lecturing* 	*Gourp activity* 

Figure 4. Teacher orientation on the VR station (photo taken by the authors)

During each station of this model, students in the first station worked with the instructor. The instructor in the classroom either taught new content, retaught prior knowledge, extended learning for learners who were ready, or provided extra practice based on students' needs. In the next station, students studied collaboratively in small groups. At this station, students practiced their knowledge and concepts through a series of tasks to earn marks and rewards. Students at the third station (VR station) used VR devices to interact with VR content and learn and practice in various classroom scenarios. During class, the learners rotated through these three stations. See **Table 1** for the VR-embedded station rotation pedagogy model.

See **Figure 4** and **Figure 5** for the learning activities in the VR station.

Focus group interviews

The first data collection method was group interviews with students. The decision to use a focus group interview was based on the idea that participants would generate more discussion about the topic (Remler & Ryzin, 2021). In addition, the focus group interview approach made students feel more comfortable than just attending a one-on-one interview with a teacher (Creswell & Poth, 2016).

Figure 5. Students experienced in the VR station (photo taken by the authors)

There were four questions included in the students' focus group interviews:

1. What is the best part of the VR-embedded station rotation learning model?
2. What is the unfavorable part of the VR-embedded station rotation learning model?
3. Did you encounter any challenges during the VR-embedded station rotation learning?
4. What recommendations would you offer to a student who is new to VR-embedded station rotation learning?

These interview questions were based on and developed from the Truitt and Ku (2018) study, the Andrew et al. (2020) study, and the Blended Learning Toolkit (2011).

Open-ended questionnaires

The second method of data collection was student questionnaires. Student questionnaires were used to help learners communicate how they felt and to eliminate the influence of peer pressure, fear of speaking in front of teachers, and fear of being judged by teachers.

There were four questions included in the student questionnaires:

1. What is the part that you like most about the VR-embedded station rotation learning model?
2. What is the part that you like least about the VR-embedded station rotation learning model?
3. If you could improve the VR-embedded station rotation learning model, what changes would you make?
4. What recommendations would you offer to a student who is new to VR-embedded station rotation learning?

These questions were also based on and revised from the Truitt and Ku (2018) study, Andrew et al.'s (2020) study, and Blended Learning Toolkit (2011).

Data Collection

The study was conducted in an intermediate-level CFL classroom at a college in East China. Before data collection, the teacher arranged the classroom to support VR-embedded station rotation learning. This included the teacher introducing VR-embedded station rotation learning to the students, teaching them how to access learning resources using technology, use VR devices, and respond to questions in VR scenarios.

In this study, there were two phases of data collection during the semester. Each phase was designed to last for one week. The first phase took place in the middle of the semester, and the second phase occurred near the end. During the first data collection period, students participated in the focus group interview. Six

focus group interviews were conducted each week of data collection, with each group consisting of five students. The moderator started by explaining to students how a focus group interview would work. The students were then asked to discuss their experiences and feelings through VR-embedded station rotation learning by answering four interview questions. Each interview lasted 10 to 15 minutes. Each focus group interview was recorded using a desktop microphone and Ding Talk software. The recordings were transcribed during the final data collection phase. After completing the focus group interview, students were given a paper-based, open-ended questionnaire with four questions. This process was repeated in the second data collection phase at the end of the semester.

As there was less than a two-month gap between the two data collection sessions and the students' responses did not differ markedly, the data were analyzed together rather than separately. The data collection process continued until theoretical saturation was reached, a methodological benchmark indicating that further interviews and questionnaires would not yield any previously unidentified themes or analytical perspectives.

Ethical Considerations

Participation in the study was voluntary, and collaboration depended on participants' availability. This complied with the ethical requirements. Ethical approval for this study was granted by the Institutional Review Board of Jiaxing Nanyang Polytechnic Institute (approval no. JNPI-20240120). All participants provided written informed consent prior to participation, having been fully informed of the purpose of the study, their right to withdraw at any time without penalty, and data confidentiality measures. Separate written consent was obtained for audio recording of focus group interviews. Recordings were transcribed verbatim, with all identifying information removed to ensure anonymity. Data were stored securely on a password-protected computer and will be deleted after two years.

Data Analysis

According to Remler and Ryzin (2021), coding is the process of tagging qualitative text data using a system of categories. In this study, coding of interviews and questionnaires facilitated data analysis and the identification of common themes. For coding and data identification, NVIVO was used during the initial processing stage. To interpret the data, thematic content analysis was used to identify patterns and themes in the qualitative data (Braun & Clarke, 2006). The data were coded, and Microsoft Excel was used to organize and summarize the identified themes. The complementary nature of the methods was achieved by combining focus group interviews (which enabled in-depth discussion and interaction) and open-ended questionnaires (which enabled anonymous, individual reflection). This method provided a more complete picture of students' perceptions than either method used alone. Future research could extend the triangulation to include classroom observation data and measures of student learning outcomes.

Trustworthiness

To enhance the credibility of this qualitative study, the following strategies were used (Guba & Lincoln, 1985):

Credibility: It was established by spending a semester with participants, member-checking initial findings with a subset of participants, and triangulating data from focus groups and questionnaires.

Dependability: Detailed documentation of the research process, such as interview protocols, coding procedures, and decision-making trail, was maintained to ensure replicability.

Confirmability: A second researcher independently coded 20 percent of the data, and discrepancies were resolved through discussion.

Transferability: More description of the research setting, participants, and procedures so that readers can assess the applicability of the findings to other contexts

Reflexivity and Researcher Positionality

As the lead investigator, the author brings extensive experience as a CFL instructor, complemented by specialized training in educational technology. While this dual expertise offered nuanced perspectives on both

the research setting and participants' real experiences, it also carried inherent risks of researcher bias. To mitigate potential biases, the researcher maintained a detailed reflexive journal throughout the investigation, systematically documenting personal preconceptions, emotional responses, and evolving interpretations. Furthermore, interrater reliability was established through independent coding of a 20% random sample of the dataset by a second trained researcher, which cross-verified coding decisions and enhanced analytical objectivity. Crucially, all analytical interpretations remained strictly data-driven, with alternative theoretical explanations and contradictory findings actively explored and addressed throughout the iterative analysis phase.

FINDINGS

Focus Group Interviews

Best part of virtual reality-embedded station rotation learning

The main themes identified regarding the best aspects of VR-embedded station rotation learning were VR technology, vividness, practice, and personalization.

Virtual reality technology: The best part of this model, according to the students, is VR technology. VR differs fundamentally from traditional classroom instruction by offering CFL learners low-stakes opportunities for real-world speaking practice. This unique advantage helps alleviate the pervasive speaking anxiety that hinders many students, while simultaneously building their confidence in oral communication (Gong et al., 2020). In their interviews, students mentioned that using VR technology to simulate real-world language environments allows them to gain immersive learning experiences, such as ordering food and traveling. The students also reported that, when practicing Chinese in the VR setting, they experience a safer, more comfortable learning environment, free of the shyness and awkwardness that come with face-to-face learning. Some students stated that

> "we felt very excited to use VR devices and to access the popular technology, and even just being equipped with the VR technology helps us learn more." [student 01, male, 22 years old, from Kyrgyzstan, intermediate CFL level]

Vividness: The vividness was considered one of the model's best features. When learning about different topics, students reported that VR-based learning was refreshing and fun; they could see vivid, intuitive simulations of real-life scenarios. Some students also mentioned that rotating among the different stations was novel and interactive; they explored and collaborated on various learning tasks at each new station and practiced their communication and social skills.

Practice: Students also mentioned that practice was the best part of this model. The students stated that this learning approach not only provided an immersive technology experience but also enabled them to share and communicate their learning experiences with their teachers and classmates across different learning stations in a timely manner. It gave them more motivation to use technology next time to learn Chinese better. In addition, one student noted that practicing Chinese in a virtual environment is impressive, as they were able to understand how to apply different knowledge, such as words, grammar, and structures, more accurately.

Personalization: The final theme that emerged from the question was personalization. One student expressed that

> "VR station gave us instant feedback on pronunciation and language usage based on the content of the answer, which helped us to correct errors and improve Chinese in a timely manner." [student 02, female, 20 years old, from Tajikistan, intermediate CFL level]

Another student stated that this model provided personalized learning paths based on students' learning progress and needs, allowing them to pursue more flexible learning arrangements at their own pace rather than following a unified instructional approach.

Unfavorable part of virtual reality-embedded station rotation learning

The students were then asked to identify the unfavorable aspect of VR-embedded station rotation learning. The students identified two main parts where this model was unfavorable: difficulty and technology.

Difficulty: The students shared one theme of difficulty. Common concerns were that they frequently had to raise their hands to get the teacher to come over and help them, as they were often confronted with content that could not be agreed upon with their peers and needed to be confirmed by the teacher in an authoritative role.

Technology: The other theme identified by the students was technology. Problems such as learning to use digital devices properly, accurately manipulating VR technology independently, and handling frozen applications made it difficult for students. One student indicated that this added to the problem they felt was unrelated to learning about Chinese itself.

Challenging part of virtual reality-embedded station rotation learning

The students were asked to identify challenges they encountered while participating in the VR-embedded SRM. In their responses, there are two categories: Chinese course and technology-related challenges.

Chinese course: The students expressed that learning Chinese is inherently challenging, and sometimes, when tasks listed in Chinese were distributed, they had to look up some Chinese characters to answer these questions before moving on to understanding and completing the tasks at different stations.

Technology: Learning to use technological devices and content was another challenge. Some students reported that the software and application would sometimes freeze while they were responding to their digital content (see student's quote below).

> "Sometimes the internet was unstable while completing online tasks. I had to spend extra time waiting for the internet to stabilize before I could proceed to the next task, which slowed my learning. " [student 03, male, 24 years old, from Russia, intermediate CFL level]

Recommendations for students who are new to the model

During data collection, students were asked for advice they would give to learners new to this learning model. Much of the advice focused on asking for help during VR-embedded station rotations and staying highly focused on learning across stations.

Asking for help from both teachers and classmates: The most common suggestion was to ask for help when students complete tasks at different stations (see the students' quote below).

> "It is normal that you have to get used to the fact that you need to seek guidance from your teacher often, such as making sure that you understand the requirements of the task correctly before completing the various learning tasks and operating the VR devices in the right way. " [Student 04, female, 21 years old, from Kazakhstan, intermediate CFL level]

> "There is usually only one teacher in the classroom; however, you often encounter situations where students at different stations all need help from this teacher at the same time, so you could ask your peers for help first. This could save you a lot of time." [student 05, male, 23 years old, from Nigeria, intermediate CFL level]

Stay focused: The students also commonly advise new learners to maintain a high level of focus when learning and completing tasks at different stations. Some students reported that each station had a set time limit, requiring them to complete their learning and transition promptly to the next station. This required them to consistently maintain a high level of attention to complete tasks at each station on time.

Open-Ended Questionnaires

Like the most

The most common themes included VR technology, vividness, practice, and personalization.

Virtual reality technology: One of the most important things the students mentioned they liked about this learning model is its use of VR technology (see student quote below).

> "When I mention to my other friends that I use VR to study Chinese in my school, they envy me and think that it is a popular technological tool that they only see on TV or the news." [student 06, female, 19 years old, from Congo, intermediate CFL level]

> "I was able to clearly list almost every topic we learned with VR. Learning with VR in the classroom allows me to memorize this point or this language usage technique for a long time, instead of the rote memorization that is traditionally associated with theoretical instruction." [student 07, male, 25 years old, from Russia, intermediate CFL level]

Vividness: Vivid learning was the second-most-liked aspect of this learning model among students. The students commented that the learning process was interesting. The VR scenarios made them feel as if they were in a real-life environment, and after giving their answers, they all looked forward to the other characters' responses. In addition, one student shared,

> "The learning design was interesting, and the learning activities were different at each station, and I was looking forward to and curious about each learning station." [student 08, female, 22 years old, from Kyrgyzstan, intermediate CFL level]

Practice: One of the prominent themes was useful practice, experiencing a variety of interactive activities (see students' quote below).

> "Because we have little exposure to learning Chinese with VR in our normal lives, we always cherish this learning way even more and make full use of the VR technology to complete more learning tasks and gain more learning experiences." [student 09, male, 21 years old, from Kyrgyzstan, intermediate CFL level]

> "I enjoy completing word puzzles and role-playing activities in small groups, and when I work with my peers, I subconsciously want to compare myself to them, which makes me want to be the outstanding one within the group by completing tasks better and faster." [student 10, female, 23 years old, from Kazakhstan, intermediate CFL level]

Personalization: Personalized learning was also a key theme. The students felt that the VR learning station provided targeted, real-time feedback to correct their Chinese expression based on their response to each question. A couple of students also shared that at different stations, the teacher provided specific answers to questions students raised. Additionally, they gained inspiration by communicating with their peers. This was a benefit they could not get from the uniform arrangement of learning and task completion.

Like the least

The prominent theme to this question was about the difficulty of understanding tasks presented in Chinese and of manipulating digital devices.

Difficulty: One student noted that because the task activities were in Chinese, it took longer to understand the task itself. Sometimes they had to move to the next station when time was up, but the task had not been completed. In addition, other students mentioned that they encountered some problems when they first started learning Chinese using digital devices, such as operating and smoothly switching between different VR learning modules independently at the VR station. This situation becomes more difficult for those students who are not very good at using technical equipment.

Improvement: Another question in the student questionnaires asked what improvements students would make to the VR-embedded station rotation learning model if they could change anything. The two prominent themes were the duration at each station and the classroom network environment.

Duration for each station: Several students suggested that the duration of each station could be extended, as they needed time to understand the requirements of the different tasks listed in Chinese each

time. If more time were allocated to this process, they believed they could complete all tasks more thoroughly at each station. Additionally, some students stated that they were looking forward to the extended learning time, especially at the VR learning station, where they felt they could memorize more words and practice speaking more effectively.

Network environment in the classroom: Most of the students suggested that the campus network, or the network in this building where the classroom was located, needed to be improved; they experienced lag when using VR to complete tasks, and sometimes other electronic devices, such as the multi-functional teaching machine and their own mobile phones, also disconnected from the network. They felt their learning experience with this learning model was disrupted by the unstable network environment.

Recommendations

The final question was: what advice would the students give to learners new to the learning model? The two most common pieces of advice were to ask for help and to stay energetic.

Asking for help

Some students stated that it is necessary for new students to learn by asking for help in the classroom. Students were the masters of their own learning in this model, and they needed to learn to seek help from various sources to complete their tasks within the limited time allotted at each station. One student shared,

> "If you have problems, especially the first time you are exposed to a VR station that uses electronic devices, you need to ask the teacher and your classmates around you to get help, which makes your learning smooth and easy." [student 11, male, 24 years old, from Kyrgyzstan, intermediate CFL level]

Keep energetic

Students confirmed that maintaining an energetic mindset helps them absorb more knowledge and adapt quickly to this model (see the student quote below).

> "It is normal for students to feel unfamiliar with this type of learning at first, and they need to undergo a process of acclimatization to each station. However, it is important not to give up or lose patience. Once you are familiar with the learning schedule and techniques of each station, you will be immersed in each learning station and will be able to subconsciously remember and apply more knowledge. " [student 12, female, 20 years old, from Uzbekistan, intermediate CFL level].

> "If possible, you can learn how to use the VR device before the course begins. When this learning model begins, you will be immersed in learning with a digital device much more quickly. " [student 13, male, 26 years old, from Kyrgyzstan, intermediate CFL level]

After coding and analyzing the data, common themes emerged across the focus group interviews and open-ended questionnaires. Five themes were identified as positive aspects of the VR-embedded station rotation learning model, in order of perceived importance: immersive VR technology, vivid and engaging learning experiences, abundant opportunities for practical application, personalized learning and timely feedback, and accessible peer and teacher support. Two major challenges were identified: technical instability and usability issues, and task complexity under time constraints. The core connotations of each theme and representative student quotations for results are presented in **Table 2**.

DISCUSSION

The research question was addressed using two data sources: students' focus group interviews and student questionnaires. Across the two data sources, seven themes were identified in this innovative learning model: five positives and two negatives. Specifically, the five positive aspects include VR technology, vividness, practice, personalization, and getting help, whereas the two negative aspects are challenging tasks and technology use.

Table 2. Students' perceptions of the VR-embedded station rotation learning model

Theme category	Core connotation	RSQID
Positive perceptions (strengths)		
1. Immersive VR technology	VR technology simulates authentic real-world language scenarios (e.g., restaurant ordering, travel communication) that provide low-stakes practice environments. It reduces speaking anxiety associated with face-to-face interaction and enhances long-term knowledge retention compared to traditional rote learning.	[01, 06, 07]
2. Vivid and engaging learning experience	The multi-station rotation design and interactive VR content make learning novels interesting. Students reported increased motivation and engagement, with many expressing a desire to extend learning time at the VR station.	[08]
3. Abundant practical application opportunities	The model combines teacher-led instruction, collaborative group practice, and immersive VR practice, providing multiple channels for students to apply linguistic knowledge. Peer interaction during group activities also fosters healthy competition and communication skills.	[09, 10]
4. Personalized learning and timely feedback	The VR system provides instant, targeted feedback on pronunciation and language usage. Teachers can also offer differentiated instruction based on individual student needs, allowing learners to progress at their own pace.	[02]
5. Accessible peer and teacher support	The small-group station format facilitates peer assistance, which helps resolve technical and learning issues quickly when teacher support is limited. Teachers also provide targeted guidance rather than uniform instruction.	[04, 05]
Negative perceptions (challenges)		
1. Technical instability and usability issues	Unstable campus network, occasional VR system freezes, and the learning curve for operating VR devices disrupted the learning flow and consumed valuable class time. These issues were particularly challenging for students with limited digital literacy.	[03]
2. Task complexity and time pressure	Task instructions presented entirely in Chinese created comprehension barriers for intermediate-level learners. The fixed time allocation for each station often left students unable to complete tasks thoroughly, especially at the VR station where deeper engagement was desired.	[03, 11]
Student-proposed improvements		
1. Optimize technical infrastructure	Upgrade classroom network speed and stability; provide pre-class training on VR device operation to reduce in-class technical delays.	[03, 13]
2. Adjust station duration and task design	Extend the time allocated to each station, particularly the VR station; provide bilingual task instructions and pre-teach key vocabulary related to task requirements.	[11, 12]
Recommendations for new learners		
1. Proactively seek assistance	Ask peers and teachers for help promptly when encountering technical or learning difficulties, rather than struggling alone.	[04, 05, 11]
2. Maintain focus and prepare in advance	Stay focused during station rotations to complete tasks within the allotted time; familiarize yourself with basic VR device operations before the course begins.	[12, 13]

Note. RSQID: Representative student quotation IDs

Positive Themes

Learners' positive attitudes toward VR stem from its ability to deliver comprehensible, context-rich input (aligning with Krashen's, 1982 input hypothesis) and enable interactive output with instant feedback (supporting Swain's, 1985 output hypothesis). Notably, VR reduced speaking anxiety, echoing Gong et al. (2020), who found that limited low-pressure practice hinders CFL oral development. By offering a safe, immersive environment for unpressured speaking practice, the VR-enhanced SRM effectively overcomes this longstanding challenge in language education.

Most students reported enjoying learning with VR technology in this model. For today's digital natives, technology is a tool they are bound to encounter in their daily lives (Gu et al., 2013). Students grow up with access to and use various electronic devices at home, so extending technology into the classroom simply offers another way to help them actively embrace learning at school. However, Radianti et al. (2020) noted that VR, as a relatively new technology, is still not fully implemented in classrooms. For learners who are caught in the digital divide (Mossberger et al., 2008), as well as those who do not have access to new technology in their lives, the VR-embedded station rotation learning model provided an opportunity for them to experience learning with VR technology, thus allowing these learners to be more equitable or competitive in the age of digital learning.

Another positive aspect is that learning with the VR-embedded station rotation learning model was vivid and fun. During rotation among different stations, students are exposed to various learning atmospheres (Truitt & Ku, 2018). Students emphasized that the VR station allowed them to memorize more words, grammar, and structures than they normally would, and to speak Chinese with more confidence. This is beneficial for both students and teachers. If students find their learning interesting, they may have more motivation and energy to complete more learning tasks (Keller, 2009). As a result, teachers would not need to rack their brains to devise ways to engage all students in learning. In this study, this effectiveness was reflected in the students' key theme of wanting to extend the class duration to complete more learning tasks.

The VR-embedded station rotation learning model also provided students with more memorable and practical learning experiences. The multi-station design offers multiple opportunities to practice producing output, which is necessary for developing fluency and accuracy, as stated in Swain's (1985) output hypothesis. The model not only allowed students to practice with technology in an immersive way but, more importantly, facilitated real-time communication and collaboration among the teacher, students, and peers. Hrastinski (2019) emphasized that learning through varied practices encourages students to use a mix of learning elements to acquire more knowledge. This view was reflected in the feedback from most students in this study, who enjoyed the variety of practical activities offered by this learning model. This implication was also supported by Hrastinski (2019), who stated that the technology-assisted SRM enables students to remain engagement and utilize their learning content for a longer period.

Personalization is another positive theme reported from this study. Personalization is regarded as a vital element of an effective teaching method (Walkington, 2013). The VR system provides learners with instant feedback, enabling them to modify their output in real time and improving the effectiveness of comprehensible output. The students in this study felt that this learning model helped them receive timely feedback and promptly correct their learning outputs. In addition, the students perceived themselves as the masters of learning in the classroom, working with peers and pacing their learning at the VR station based on their receptiveness to knowledge. This effect was confirmed by Zheng et al. (2022). The researchers stated that the combination of technology and differentiated activities provides students with a more personalized learning experience, thereby improving their sense of engagement and belonging and helping them achieve, or even exceed, expected learning goals.

Being able to get more help with this model is a final positive theme. According to Lin et al. (2012), students tend to help their peers and share their learning experiences when they need to use technology to complete a learning task, and they find that helping each other allows them to identify and solve more technology-related problems that commonly arise in the classroom more quickly. In this study, the predominant theme among students was that when they were unable to understand how to use the VR device or a particular grammar, they could discuss it with peers to get an answer. In addition, the students in this study noted that the teacher provided targeted guidance tailored to each student, rather than simply delivering a uniform lecture and assigning tasks. At the university level, Tsinidou et al. (2010) found that the teacher's role is a crucial factor in students' perceptions of a course.

Negative Themes

Challenging tasks and the usage of technology are perceived as the two negative themes of this learning model. They serve as a reminder to aspiring educators that further research in this field is needed, as certain areas still require support, even when employing the VR-embedded station rotation learning model, which is commonly perceived as a positive experience for students.

One negative aspect concerns challenging tasks. In this learning model, the task activities were listed in Chinese, and students had to look up the meanings of the words to understand the task before they could begin learning. The limited time allotted at each learning station left some students unable to complete the tasks. In addition, students who were less adept at using technological devices might have more difficulty completing the learning tasks and ensuring consistent operation of the VR device (Makransky & Petersen, 2021). The study finds that although the VR-embedded station rotation learning model is strict about students' learning activities and time schedules, it is still important to provide students with sufficient explanations and guidance throughout the process to support their learning.

The use of VR technology is another negative theme. Despite the study's positive theme on technology, students were unable to complete the learning tasks fluently within the time-limited stations due to a lag in the VR system. Most students also mentioned that the network speed could not keep up with their planned learning pace. When the network dropped or was unstable, students had to wait or leave learning tasks at the station. The awareness raised by this negative theme is that while learning with VR can play a positive role in students' learning (Radianti et al., 2020), it can also lead to negative outcomes. There are still some aspects of the performance that may not meet the students' learning needs.

CONCLUSION

This qualitative case study explored the perceptions of 30 intermediate-level CFL students regarding a VR-embedded station rotation learning model implemented over one semester at a Chinese vocational college. Data collected from two rounds of focus group interviews and open-ended questionnaires identified five positive themes and two key challenges. Students particularly valued the immersive authentic contexts provided by VR technology, the engaging multi-station learning design, and the personalized feedback and peer support available in the model. The main challenges identified were technical instability and time pressure associated with task complexity.

The study makes significant contributions to both theory and practice in technology-enhanced language learning. Theoretically, it proposes and validates a new blended learning framework that addresses critical limitations of standalone VR applications. By integrating immersive technology with structured station rotation, the model balances experiential learning benefits with teacher guidance and peer collaboration, offering a theoretically grounded approach to integrating VR into language education.

Practically, this study offers a concrete, replicable model for CFL instructors seeking to incorporate VR into their teaching. The three-station design is easy to implement in standard classrooms and can be adapted to different proficiency levels and subject areas. The findings also provide actionable recommendations for educational administrators to support technology integration and for developers to improve VR-based language-learning tools.

While this study provides valuable insights, it has several limitations that point to important future research directions:

1. **Cultural and demographic diversity:** Future research should examine how students from different cultural backgrounds and with varying levels of digital literacy perceive and interact with the model.
2. **Long-term learning outcomes:** This study focused on student perceptions; future research should include quantitative measures of language proficiency to assess long-term effects on vocabulary retention, speaking fluency, and overall competence.
3. **Proficiency-level differences:** The study included only intermediate learners; future research should investigate the effectiveness for beginner and advanced CFL learners.
4. **Comparative studies:** Future research could compare this model with other blended learning approaches to identify the most effective strategies for technology integration.

Overall, this study demonstrates that the VR-embedded SRM has the potential to transform CFL teaching and learning by creating immersive, engaging, student-centered environments. As immersive technologies evolve, this model can serve as a foundation for developing innovative language teaching practices that meet the needs of 21st century global learners.

Implications

Theoretical implications

This study makes a unique theoretical contribution by proposing and empirically testing the VR-embedded SRM, which combines immersive technology with structured blended learning. This model addresses key limitations of standalone VR applications identified in previous research, including insufficient teacher support, unstructured learning progression, and limited peer interaction (Radianti et al., 2020). By integrating VR immersive practice with teacher-led instruction and collaborative group work, the model provides a

balanced framework that is consistent with core second-language acquisition theories, such as Krashen's (1982) input hypothesis and Swain's (1985) output hypothesis.

Furthermore, this study extends the literature on DGBLL (Kazu & Kuvvetli, 2023) by showing that structured blended learning models can enhance the effectiveness of immersive technologies. Unlike previous studies that focused mainly on standalone VR applications, this research demonstrates that integrating VR into a well-designed station rotation framework maximizes the benefits of immersive learning while minimizing its challenges. This offers a new theoretical lens for understanding effective technology integration in language classrooms and provides a foundation for future research on technology-enhanced language learning.

Practical implications

For CFL instructors, this study provides a practical, replicable model for integrating VR into the classroom. The three-station design (lecturing, group activity, and VR study) allows for a balanced approach to language instruction, combining teacher input, collaborative output practice, and immersive VR experiences. This model is particularly suitable for intermediate-level CFL learners, who often struggle with limited opportunities for authentic practice and speaking anxiety (Gong et al., 2020). The findings also highlight the importance of providing adequate technical support and scaffolding to help students overcome challenges with technology and task complexity. Instructors should consider pre-class training on VR device operation and pre-teaching key task vocabulary to reduce cognitive load.

For educational administrators and policymakers, this study demonstrates the value of investing in immersive technologies for language education. Positive student perceptions and engagement outcomes suggest that VR can effectively enhance international students' learning experiences and improve the quality of CFL instruction. Administrators should provide teachers with the necessary hardware, software, and professional development support to successfully implement technology-enhanced teaching models.

For technology developers, the research identifies key areas for improving VR-based language-learning systems. Students value real-time feedback on pronunciation and language use; however, they often encounter technical issues such as network instability and system freezes. Developers should prioritize optimizing VR system stability and usability and designing more adaptive learning features that provide personalized support for students with diverse learning needs and digital literacy levels.

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Ethics declaration: This study was approved by the Institutional Review Board at Jiaxing Nanyang Polytechnic Institute on 3 February 2024 with approval number JNPI-20240120. All participants provided written informed consent prior to participation, after being fully informed of the study purpose, procedures, potential risks and benefits, and their right to withdraw from the study at any time without penalty. Separate written informed consent was obtained for audio recording of focus group interviews and for the publication of photographs taken during the study. All data were anonymized during transcription, with all identifying information removed to ensure participant privacy. Data are stored securely on a password-protected encrypted computer, and will be retained for 2 years after publication, after which all identifiable data will be permanently deleted. No personal identifiable information is included in this manuscript.

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