Chinese Language Learning Sciences

Yu-Ju Lan
Scott Grant *Editors*

Contextual Language Learning

Real Language Learning on the Continuum from Virtuality to Reality

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Chinese Language Learning Sciences

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Preface

The year 2020 presentesd the world with incredible challenges brought about by the advent of the COVID-19 pandemic. These challenges have impacted on all aspects of our lives regardless of where we live. Our societies have been forced to look at new ways of doing some things for the first time. At the same time, the pandemic has brought into even sharper focus issues that have existed for a long time, many of which have been subject to ongoing research, reflection, experimentation, and change, albeit it often at a relatively slow pace. The pandemic has provided a new momentum to help overcome the inertia that has held back innovation in many fields as we cling to familiar ways of conducting our business, whatever that may be.

Education is no exception. Lockdowns implemented by governments around the world to slow down the spread of the COVID virus have seen educational institutions everywhere scramble to provide students with high-quality learning experiences in a fully online environment. As many have found, simply moving the classroom-based curriculum online rarely works well, and potentially leaves students feeling disengaged, demotivated, and isolated. Many educators and educational institutions have responded to this challenge with innovative approaches that have helped, at least in part, to address these and the many other issues in education highlighted by the pandemic.

Some of these issues are in fact not new and have been the subject of much thought, research, and experimentation over a period of decades. Technology has also played a role in this thinking about new approaches to education, the Internet being one of the more obvious examples of how technology can bring radical new opportunities to teaching and learning. This book is timely in that the research described in its chapters, while carried out mostly before the onset of the pandemic, has a poignant relevance in terms of addressing some of the new challenges spawned by the pandemic while at the same time being driven by the desire to address issues that existed pre-pandemic. Even as we move into a new era of education that may well be a hybrid model of online and face-to-face learning, technologies like virtual reality (VR) and augmented reality (AR) provide educators with a means of exploring new and innovative ways of value-adding to educational experiences and outcomes. The following chapters describe in detail a range of research carried out using VR and AR technology and the pedagogical approaches facilitated by these technologies.

In her chapter entitled "Language Learning in Virtual Reality: Theoretical Foundations and Empirical Practices," Yu-Ju Lan lays the theoretical groundwork for the role in language learning and teaching of the various types of VR and AR discussed in the other chapters. Lan argues that in recent decades the increasing influence of the global market and global competition has correspondingly increased recognition of the importance of learning foreign languages. Driven by socioeconomic factors and technological development, the focus of foreign language education has shifted from pure linguistic knowledge accumulation to the building of pragmatic competence. She argues that learners need to be engaged in meaningful and social interactions in authentic contexts for successful language acquisition to occur, key elements that are embodied in sociocultural theory and embodied cognition. In the modern age of rapidly developing digital technology, the ability and opportunities to create authentic learning contexts in which pragmatic competence can be developed have increased dramatically. Restrictions imposed by governments around the world on freedom of movement during the height of the COVID pandemic have brought into even sharper focus the need to be able to create authentic learning contexts and opportunities for social interaction that are not confined by physical boundaries (e.g., travel to places where the language being learned is the mainstream language), a need that existed even before the pandemic occurred (e.g., expanding beyond the boundaries of the physical classroom). Having identified solid theoretical foundations and a number of practical implementation principles, the real value of Lan's study to foreign language educators is in the five categories of empirical practice and the insightful reminders and suggestions she offers the reader.

Hybrid approaches to language learning are a common theme throughout the chapters. Hsu and Chan's study involved an innovative use of interdisciplinary learning and technologically enhanced language learning (TELL). At the pedagogical design level, a hybrid approach was adopted which involved focused investigations carried out in the real world outside the classroom where data was collected using mobile digital technology, which was then followed by the use of that data to create a virtual reality representation of the real-world environment and to produce 5 descriptive writing compositions in the classroom. A second level of hybridization involved an interdisciplinary approach that saw the integration of courses from three different disciplinary areas to provide a focus and scaffolding for the hybrid activity: Chinese language learning, geography, and information technology. The ultimate focus of the study was to see what impact this hybrid approach would have on the Chinese language students' learning achievements. The study confirmed that the combination of interdisciplinary learning with real-world investigation and VR recreation had a significant positive impact on Chinese language learning outcomes. Moreover, their study found that the better students performed in the creation of their VR environment, the better their Chinese language achievements were.

In her chapter entitled "Design of a Distributed Language Learning Environment" (DLLE), Dongping Zheng and her colleagues continue the theme of hybrid approaches to language learning with a reconceptualization of language learning as being a "coordination of events with both aesthetic and ethical values and intention"

where the events are "distributed across the physical, virtual and artificial environments" in the traditional language learning context. Starting from an SLA perspective, they argue that while communicative instruction, with its focus on interaction, briefly usurped the dominance of structuralism and universal grammar approaches in the 60s and 70s, the pressure of language policies to realign language instruction with traditional assessment frameworks has once again moved the focus back to an emphasis on lexicogrammar at the expense of other vital acquisition processes. Zheng et al. argue that instructional practices need to draw on "formal and informal learning spaces" in order to provide learners with authentic language experiences that facilitate meaning-making and sense-making that is "subject to social influences," where learners are "doing something" with the language while drawing on lexicogrammar as needed. Acknowledging that the traditional classroom (formal learning spaces) "are authentic in their own right," they argue that learners need a space (informal learning spaces) in which to immerse themselves in playing and experimenting with language and experience being with the target language "inter-bodily" and "intra-bodily" over an extended period of time. Zheng and her colleagues see immersive VR environments as providing this kind of "space." Arguing for a "holistic system" of learning, they see the VR and non-VR learning spaces (the classroom) that make up a distributed language learning environment (DLLE) as "merely different places that provide unique ecological niches for players to deploy their affordances for certain actions." For Zheng et al., the combination of the DLLE approach, the virtual environment used in the study Bizhuwanshang (On Green Bamboo Hills—a virtual panda reserve) and radical ecolinguistics has the added benefit of exploring ways to create a sense of urgency for learners to care about the earth that we all share in common.

Immersion and interactivity are two important threads that weave their way through the fabric of all of the chapters in this book. Hayes, Kucher, Meng, and Tesh take a deep dive into the different levels of immersion and interactivity that various media educational tools provide. Their study 6 levels of immersion currently available for immersive language learning experiences: 2.5D flat screen, 360-degree video, mixed reality, augmented reality (AR), 360-degree interactive video, and Highly Immersive Interactive (HII). In their chapter, Hayes et al. present an extremely useful section on how the different levels of immersion map on to the development of a range of different language skills. They also offer sage advice on considerations around which kind of virtual reality application/level of immersion is suitable/adequate for particular types of learning outcome. While they acknowledge that the different levels of immersion that different implementations of immersive media afford can impact on learners' experiences and learning outcomes, other considerations such as cost versus effectiveness are important. Not all learning objectives need the highest, and therefore the most expensive, level of immersion to be met. However, they are also quick to point out that more research needs to be done to determine which skills are better taught using which VR applications (though this in itself could be a complex and costly exercise).

As Lan in her chapter "Language Learning in Virtual Reality: Theoretical Foundations and Empirical Practices" forcefully points out, while some foreign language

educators believe that that merely placing students in a highly immersive virtual reality environment without a specific focus or goals is enough, this in itself will not produce desired learning outcomes. In the context of the Chinese language classroom, Tseng and Geng explore the importance of tasks in designing VR learning experiences and the impact that task design has on the learning experience, particularly on learner motivation, engagement, and confidence. In line with Zheng's call for providing language learners with authentic experiences that create opportunities for meaning making in a socially influenced context, Tseng and Geng created a combination of tasks and virtual environments designed to promote students' communication proficiency in Chinese. The environments were immersive, authentic, and information-rich in the target language. Tasks were designed with a multi-layered approach that included specific instructional topics, specific linguistic features and functions (e.g., requiring the use of the Chinese particle 把 ba3), task type (e.g., information gap), and scenarios. Subsequent analysis of questionnaires completed by participants affirmed the key role of task design, with the majority of students agreeing that the combination of the immersive VR environments and focused tasks "effectively helped their learning of the language functions." Moreover, "all students believed that they could better communicate for the specific purposes at which the tasks aimed."

As Tseng and Geng found in their study, well-designed VR/AR environments and tasks can have a positive effect on learner motivation. Wang, Grist, and Grant report on their findings of a study into ways of promoting out-of-class autonomous Chinese language learning using an established virtual world 3D simulation of a Chinese township that has a range of language and culture learning activities and interactive virtual characters to stimulate learner motivation. The aim was to provide students with additional learning opportunities to practice and reinforce their communicative language skills autonomously outside of regular classroom-based and online classes. A key goal of the study was to investigate learner perceptions of this kind of learning resource and particularly if this kind of integrated approach would in fact foster autonomous learning outside of the classroom. While the study found that this approach was beneficial for learning outside the classroom, it also highlighted that appropriate scaffolding (technical and task related) before the commencement of and during the activities in the virtual township is a key element to achieving better learner engagement and outcomes. As part of this scaffolding, learners expect their instructors to play a significant role in supporting their out-of-classroom learning. Clarity of task instructions, particularly where access to such information is on a self-service basis, was also found to be a critical factor in this approach.

The findings of Wang, Grist, and Grant serve to highlight the importance of the participation and enthusiasm of the instructors in the implementation of new approaches to learning and teaching. Cheng conducted a longitudinal study looking at the participation of intern Chinese language teachers in a training course aimed at preparing instructors for the implementation of Chinese language VR/AR courses. In addition to increasing the awareness of the intern teachers about the affordances of VR/AR technology for language teaching, the training course and associated study also brought to light a number of challenges they faced. Through analysis of a rich

variety of data collected during the study Cheng concluded that while VR/AR can indeed be beneficial for the achievement of a range of learning objectives (vocab and grammar learning, cultural understanding, Chinese character recognition, and the four language skills), most of the learning activities were only able to promote cognitive learning at the lower end of Bloom's taxonomy, e.g., remembering and understanding. This was in part as a result of insufficient learning resources made available by commercial providers, which in turn highlights the need for educators to specifically design VR/AR lessons focusing on how the technology can enhance higher-level cognitive learning skills, e.g., analyzing, evaluating, and creating. Cheng argues that in order to achieve this, teachers themselves must gain greater familiarity with the affordances of VR/AR technology, while at the same time training courses for teachers planning to use VR/AR technology in their teaching practice need to also place a greater focus on high-level cognitive learning activities. As part of this approach to training, Cheng advocates a 5-phase training model for intern teachers which is made up of discussion, hands-on activities, lesson planning, experimentation, and reflections. The study found that this approach was successful in pushing the intern teachers to create more examples of VR/AR technology lessons and raising their awareness of how to execute an innovative lesson.

For Lau and Wen, the affordances of particularly AR technology to support learning through simulation activities are still poorly understood, particularly in comparison with other immersive technologies. In the area of foreign language learning, previous research seems to have somewhat overlooked ways of enhancing the interaction between language learners and the contextual information provided via AR in comparison with other subject areas. Cheng's study highlighted the importance of raising the awareness of VR/AR affordances among trainee teachers and finding ways to address challenges and limitations faced by these teachers when learning to design and implement higher-level cognitive learning in VR/AR. Lau and Wen's analysis of 17 published studies specifically focused on better understanding these two aspects in relation to language learning, i.e., the learning and teaching affordances of AR and enactment constraints on educators seeking to incorporate AR into their teaching practice. Indeed, the result of their analysis is that they strongly back (albeit indirectly) Cheng's call for increasing teachers' awareness of and knowledge about AR technology. Lau and Wen suggest that this can be achieved by having designers, teachers, and stakeholders working together right from the start which would help boost teachers' confidence and eliminate misconceptions about things like technical complexity. To further boost teachers' ability to enact AR-assisted learning, Lau and Wen also suggest the embedding of learning analytic tools in AR learning systems, a move that would improve teachers' ability to work more independently with AR through monitoring student progress and interpreting the results of student learning.

While the other chapters investigated the application of immersive technologies to language learning through studies involving multiple participants in one-off experiments or longitudinal studies, or through meta-analysis of existing studies, Kaplan-Rakowski and Gruber's study entitled "One-on-one Foreign Language Speaking

Practice in High-Immersion Virtual Reality" focuses on the experiences of one-one-one tutoring sessions. The sessions were carried out using a VR application that sits at the high immersion end of the spectrum detailed in Hayes et al.'s study. The lessons were held in a variety of realistic VR locations which provided authentic contexts for situated learning. Interactivity in the lessons mainly took the form of conversational interaction and the design and analysis of the lessons and learning effectiveness was done in light of the Interaction Hypothesis. The authentic VR settings were found to foster relevant and personalized conversations and to also enable role play and task-based learning. Greater learner agency was an additional benefit found as the highly immersive and realistic environments helped spark learner creativity. In addition to taking a close look at the pedagogical affordances of highly immersive social VR applications for language learning, Kaplan-Rakowski and Gruber also explore the limitations and technical impediments of using such applications, including the lack of facial expression and other nonvocal paralinguistic signals that are an integral part of human communication.

Among the various advanced technologies which are emerging and influencing the practice of language education in the real world, without doubt virtual reality has successfully grabbed the attention of language educators and researchers and inspired their research and development efforts. The nine chapters included in this book shed a light on the path leading to a new chapter of research on VR for language teaching and learning. Thus, the chapters included in this book will likely provide readers with a deep and extensive understanding of the potential the smart combination of VR and language learning. More issues for future research are undoubted to be inspired by reading the articles of this book.

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Chapter 1
Language Learning in Virtual Reality: Theoretical Foundations and EmpIrical Practices

Yu-Ju Lan

Abstract This chapter focuses on the theoretical foundations of virtual reality (VR) for language learning and their empirical practices. Two main theory umbrellas, sociocultural theory and embodied cognition, form the trunk of the theoretical foundations of this chapter. The former emphasizes the importance of social interaction in the development of cognition, while the latter argues that the representation of knowledge is grounded in a person's experiences of interacting with and perceiving the environment, which involves bodily sensation, perceptions, and actions. Although there are plenty of theories supporting foreign language learning, the abovementioned theories are chosen because they give prominence to experience-oriented learning and support kinesthetic learning. Experience-oriented learning refers to situated cognition and benefits learners' pragmatic linguistic skills. By involving foreign language learners in VR, the three features of VR (immersive, interactive, and imaginary) match the essential components of successful language learning, i.e., learners' active involvement in an authentically meaningful and social interaction. Therefore, the two theories mentioned above, sociocultural theory and embodied cognition, well bridge the features of virtual reality and the essential components of successful language learning. Following the description of the theoretical foundations, the essential components of implementing the abovementioned theories in empirical practices are elaborated. Based on the theoretical foundations and the implementation principles, five categories of empirical practices are introduced, including social connection, game-based learning, self-exploration, cooperative task-based learning, and learning by creation. Finally, some reminders and suggestions are given to conclude the chapter.

Keywords Constructivism · Contextualized learning · Embodied cognition · Foreign language learning · Sociocultural theory · Virtual reality

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1.1 Introduction

Learning a foreign language (FL) or more in addition to one's native language is always an import educational issue, especially in the age of globalization. Most of the countries view the capabilities of using multiple languages by their citizens as one of the critical ways to increase their competitiveness. Regarding the instruction of an FL, how to help learners acquire linguistic knowledge is the most prominent concern in the early days. However, pragmatic competence has become the core of FL education in recent years (Council of Europe, 2001; Lan et al., 2016) due to the influence of socioeconomic factors of the global market and technological development (Warschauer, 2000).

As mentioned above, the improvement of modern technologies plays an important role in the transition of human-to-human interaction; consequently, there has been a huge revolution in reading and writing (Eshet-Alkalai, 2004). The traditional paper-based reading and writing are also gradually replaced by diverse digital editing tools. For example, emails, social network, and other networks seem to be the most popular approaches to connecting people in the twenty-first century. As a result, the approach to learning or teaching an FL is also changing due to the advantage and usage of technologies (Arnó, 2012; Lan, 2020).

The changes in the approaches to FL learning and teaching mentioned above are also influenced by the transition of learning theories. A look back at the development of FL teaching and learning shows that the research focuses have been changing (Grosse & Voght, 2012), from de-contextualization to contextualization; from behaviorism to social constructivism; from linguistic skill-centered to pragmatic orientation. As a result, researchers, when investigating the process of second language acquisition, do not only focus on the linguistic skills any longer but also consider the factors in the real contexts that have the potential for influencing the FL learning outcome (Godwin-Jones, 2018).

As mentioned above, language learning and teaching nowadays are contextualization oriented. Furthermore, according to Lan (2014), the essential components of successful FL learning are (1) learner's active involvement, (2) authentic contexts, and (3) meaningful and social interaction. In other words, only if a learner actively involves in meaningful and social interactions in authentic contexts will successful language acquisition happen (Lan, 2020). However, creating the authentic contexts and social occasions needed in an FL educational setting to encourage learners to actively get involved in meaningful interactions is always a challenge to FL teachers and researchers (Lan, 2015). Given the specific features of virtual reality (VR)—creation, immersion, and interaction—with a platform to create authentic contexts and the capabilities to support social interaction, VR is a potential solution to the abovementioned obstacles in FL settings (Lan, 2020). However, without support and guidance from solid theoretical foundations, VR could be only a fancy "toy" for FL learners for a short period, and it could fail to enhance FL learning.

This chapter, therefore, focuses on bridging the theoretical foundations of FL learning in VR and their empirical practices. The following sections describe the

theoretical foundations of FL learning, especially focusing on the perspectives of contextualized learning, the bridge between theories and practices of FL in VR, theory-driven studies of VR for FL learning, and conclusions.

1.2 Contextualized Foreign Language Learning

Contextualized learning is rooted in Vygotsky's (1978) sociocultural theory. Sociocultural theory emphasizes the effect of the interaction of interpersonal, cultural-historical, and individual factors on learning and development (Tudge & Scrimsher, 2003). The cultural-historical factor mentioned above further reveals that learning and development cannot be isolated from the contexts. Therefore, a context should include the environment, the objects, and the individuals, and the interaction among the three elements is the essential part of the theory. Although sociocultural theory is also a kind of constructivism, it is different from Piaget's theory. It emphasizes the interaction between persons and their environment through cultural objects, languages, and social contexts.

Briefly, the Vygotskian sociocultural theory includes three key themes: (1) cultural-psychological tools, especially language, mediate human actions, including thinking and speaking; (2) learning is a process of internalization, especially through communicative interaction; and (3) the development is a dynamic and historical process in which the nature (settings) and human have a mutual influence. Sociocultural theory emphasizes not only the importance of a learner's perception but also the internal dialogue and interpersonal interaction in the process of knowledge development.

The argument of sociocultural theory views the social interactions among individuals in their environments beneficial to transforming learning experiences. As one of the remarkable applications of sociocultural theory to education, "scaffolding" provided by a more capable interlocutor or a peer plays an essential role in the development process and helps the individual reach a higher development level, i.e., zone of proximal development (ZDP). According to the perspective of sociocultural theory, ZPD stands for "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). Following the concept of ZPD, in addition to scaffolding, reciprocal teaching, peer collaboration, and apprenticeships are also widely adopted in educational research and settings.

In addition to sociocultural theory, embodied cognition is another theory that supports contextualized learning. It emphasizes the formative role of the environment (context) that plays in the development of the cognitive process (Cowart, 2005). It also argues that the representation of knowledge is grounded in a person's experiences of interacting with and perceiving the environment, which involves whole-body involvement, including sensation, perceptions, and actions. That is, it considers the interactions among perceptions, the body, and the environment (Barsalou, 2008).

Following the perspective of contextualized learning described above, FL researchers and educators also believe that contexts provide FL learners with a direct link between the FL materials that they had learned and stored in their brains (Legaulta et al., 2019; Prince, 1996) and the underlying concepts or clues, thereby enhancing their FL learning (Lan et al., 2015; Snow, 2005). Under the belief in contextualized learning, FL learning is hence both social and mental, in which the person and the environment are necessarily connected in an inseparably dialectic relationship (Lantolf, 2005; Swain, 2000). Additionally, based on embodied language processing, a person's certain way of moving his/her body impact how he/she comprehends a language (Havas et al., 2007; Lan, Hsiao, Fang et al., 2018). In recent years, the evidence obtained from brain research also approves the belief that language processing is an embodied process (Hertrich et al., 2016; Willems & Casasanto, 2011). Mahon and Caramazza (2008) further argued that the motor system is automatically activated when a person (a) observes manipulable objects; (b) processes action verbs; and (c) observes the actions of another individual.

In brief, contextualized FL learning is an experience-oriented and dynamic process which highlights situated learning with FL learners' active involvement in the interaction among individuals, objects, and the environment. Under the belief in contextualized FL learning, creating authentic contexts for FL learning is strongly suggested by several commonly referred foreign language teaching/learning guidelines, such as The Common European Framework of Reference for Languages (Council of Europe, 2001) and the proficiency guidelines developed by the American Council on the Teaching of Foreign Languages (American Council on the Teaching of Foreign Languages, 2012).

1.3 From Theory to Practice: VR for FL Learning

To integrate the theoretical themes described in the previous section into daily FL teaching and learning, using technology is never absent. Technology has been subtly and profoundly changing the language educational landscape (Arnold & Ducate, 2015). As described in Lan's (2015) article, it is always a challenge for FL teachers to create the authentic contexts and social occasions which are needed in traditional FL educational settings and are able to encourage FL learners' active involvement in meaningful interactions. By adopting advanced and appropriate technologies, the barriers caused by space or time can be easily conquered.

However, what are the essential features of technologies to successfully implement contextualized FL learning? Technology that supports the following three essential components of successful language learning should be concerned, i.e., learner's active involvement, authentic contexts, and meaningful and social interaction (Lan, 2014). Among numerous potential technologies, VR is one of the most prominent

options in contemporary technologies due to its capability of supporting social interaction by immersing language learners in authentic contexts (Lan, 2020). Consequently, VR has been widely adopted in research related to foreign language learning and teaching (Wang et al., 2020).

VR is a set of images and sounds, produced by a computer, and seems to represent a place or a situation that a person can take part in. According to Robertson et al. (1993), VR can be classified into two categories: immersive VR and non-immersive VR. The first kind of VR emphasizes spatial immersion (Howard-Jones et al., 2014) from the first-person view with a restricted meaning of "being there." In contrast, the second kind of VR allows users to experience immersion from the third-person view by using a mouse, a keyboard, or a monitor to control their avatars. In addition to the abovementioned definition given by Howard-Jones et al. (2014), Papagiannidis et al. (2008) defined VR according to its function as either the game-based VR or the society-based VR. Entertaining is the main purpose of the game-based VR, whereas providing users with a platform to perform social connections is the design focus of the society-based VR. In this chapter, the society-based VR will be the focus, and there will be no restrict classification between immersive and non-immersive VR when bridging foreign language learning in VR and the related theoretical foundations.

As described above, VR is a world rich in imagination produced by a computer. Any contexts existing in the real world or only in humans' imagination can be created with the VR technique. The world can be as large as a universe or as tiny as a cell. It can be a very common location in daily life like a supermarket (Lan et al., 2015) or a highly professional room like an operating room (Mohsen, 2016). In this environment, both images and sounds are authentic. By using their avatars, users have the perception of "being there," regardless of which VR categories are used (Lan, 2020). Additionally, after logging in the virtual world, a user can interact with the objects. They can observe, manipulate, or operate the objects. They can also interact with other users in the world, via text or voice, just like what they do in the real world (Lan, 2015; Yeh et al., 2018). Interestingly, this kind of avatar-based and social immersion can be viewed as a kind of virtual "whole body" interaction with the environment (Lan, Hsiao, Fang et al., 2018). With the specific features of VR, by immersing themselves in such an authentic world, FL learners can also collaborate with others to accomplish language tasks (Lan et al., 2016; Yeh & Lan, 2018).

Based on what is described above, the specific feature of VR seems to perfectly meet the requirement for contextualized FL learning. Therefore, some FL researchers or educators might think that the only thing they need to do is to have FL learners log in VR, then the expected learning goals would be reached. Is that correct? Definitely not! A careful and meaningful theory-driven activity design is a necessary catalyst to make successful FL learning happen in VR (Lan,). As described in Lan's (2016) article, although the features of VR match the essential components of successful language (Lan, 2014), it is not guaranteed that the expected learning goals would be reached if no appropriate learning activities as mediators are adopted during the learning process.

A learner-centered activity that inspires and motivates FL learners to interact with other learners in the VR world autonomously is the solution to the problems mentioned above. Numerous approaches are viewed as learner-centered activities, such as task-based learning, problem-solving, inquiry-based learning, discovery learning, and project-based learning. However, when the sociocultural perspective is considered, a combination of cooperative/collaborative activity and those approaches mentioned above should be adopted. During such learning processes, an FL teacher's role is not a knowledge provider but a learning facilitator by organizing the learner-centered activities and providing FL learners with supports when necessary (Bhattacharjee, 2015; Lan et al., 2016). While working with and co-pursuing the learning goals with peers, FL learners are encouraged not only to develop new insights and to connect them with their previous learning experience but also to subconsciously use what they have learned. Such a learning state helps lower learners' anxiety in using an FL, and consequently enhance their performance in FL learning (MacIntyre, 2017). Additionally, throughout the process of learner-centered learning, FL learners need to identify the authentic situations, raise their own hypotheses and plan their problem-solving actions, collect useful information, and refine their problem-solving plans according to the experience obtained from the learning process or the feedback provided by the teachers, peers, or environment. Obviously, interpersonal or person-environment interaction is necessary during this process. Finally, they will be highly motivated in reaching the learning goals through the learning process by collaborating with others. Moreover, what they have learned during the process will cultivate their new skills which can be applied in real life.

In sum, simply logging in VR without the integration of learner-centered activities that are following the perspectives of contextualized learning would show that VR is just another fancy technology for FL learners and their learning motivation will fade predictably.

1.4 Theory-Driven Studies of VR for FL Learning

The studies included in this section will be briefly introduced in five categories of practice: social connection, game-based learning, self-exploration, cooperative task-based learning, and learning by creation. They are chosen because their theoretical foundations were rooted in the perspectives of contextualized learning and they give good examples of bridging the theoretical foundations and empirical practices; therefore, they maximize the effects of learning in VR on learners' language acquisition (Lan, 2020).

1.4.1 Social Connection in VR

Building a successful social connection provides opportunities for FL learners to engage in social interaction and therefore enhances FL learning, especially when such a connection involves native speakers and non-native speakers. Additionally, VR's feature that supports social interaction among global learners in immersing themselves in the contexts is naturally becoming one of the preferable methods for FL teachers or researchers. As VR becomes more affordable, commercially available and accessible, it has attracted more attention of researchers and educators (Lan, 2020; Pan & de C. Hamilton, 2018).

Liaw (2019) used *vTime*, a VR social networking site, and *VR Box*, a headgear similar to Google Cardboard, in a two-phase study focusing on EFL Intercultural Communication. The participants of Liaw's study were college students taking a required year-long EFL course targeting at enhancing oral communication skills. At phase 1, with clear task goals, the participants carried out various cooperative language tasks in VR with their classmates, including giving information, carrying out small talks, and engaging in group discussions. After the participants were familiar with carrying out those tasks with their Taiwanese classmates in VR, at phase 2, they were asked to carry out intercultural communication tasks with English speakers around the world who also used the open social VR software. They were encouraged to interact with as many interlocutors as they could find online. They also needed to upload a YouTube video of their process of one online interaction. At the end of phase 2, each participant was asked to briefly report their learning experience gained during the study. The results reveal that the participants' positive perception of the social and physical presences afforded by the VR environment. Additionally, interacting with international interlocutors in VR not only provided the participants with a joyful learning experience but also expanded their learning from a classroom setting to an unlimited digital wild context.

Tang and her colleagues' studies are another example of investigating how VR can be used as a catalyst for learners of Chinese as a foreign language (CFL)'s social connection. They observed how CFL learners transferred their role in a VR community from a peripheral participant to a more active and central one (Tang et al., 2012). During the transformation process, they also tried to determine if the acquisition of CFL can occur in a virtual situation without explicit instruction (Tang et al., 2016). During the study, they observed and analyzed interpersonal interactions, the development of CFL communication competence by the participating learners, their communication models, and the interaction frequency. The results show that the immersion in a friendly VR environment enhanced interpersonal interactions. Additionally, CFL learners demonstrated their communication competence during a natural process of social interaction, including receiving information from others, exploring the virtual world, dialogue, assimilation, adaptation, asking questions, problem-solving, etc. Based on the findings obtained from their study, Tang and her colleagues claimed that language acquisition could be improved autonomously in such a virtual situation.

1.4.2 Game-based Language Learning in VR

Learning a language in addition to one's native language takes time and constant engagement. But it is challenging for most of the learners. How to transform FL learning into a joyful and gamified process for motivating learners' involvement, therefore, becomes one of the highlights of FL research. According to Kapp (2012), gamification is a strategy that can engage people, motivate action, promote learning, and solve problems. Numerous studies on game-based learning reported the effective effects of gamification on learners' motivation and engagement in learning activities, and consequently, their learning performance (Kotob & Ibrahim, 2019).

In the game-based learning VR, the learning materials are embedded in the interactable objects, such as a car or a non-player character (NPC), in the environment. Learners can log in the VR repeatedly and learn the embedded materials whenever they are available. Usually, there are learning goals set beforehand, but learners can make their own learning plans and take corresponding actions. Additionally, to prevent learners' extreme excitement in playing from distracting them from accomplishing the learning mission, common approaches, such as providing hint prompts, leveled challenges, rewards, or competition, are adopted to reaching the abovementioned goal, i.e., to promote and maintain learners' motivation and autonomy during the learning process, as well as encourage them to log in it and keep learning again and again (Lan, 2016).

Lan's (2015) study about contextual EFL learning includes an example of game-based VR learning. In her study, several contexts were constructed in Second Life (SL), such as restaurants, a night market, an airport, a clinic, a playground, several kinds of shops, and a station. All the learning materials were embedded in the abovementioned contexts. EFL learners can log in and learn the embedded materials anytime, anywhere. Take the night market as an example, EFL learners learned the English vocabulary words by clicking the objects, such as the teddy bear or a lightsaber. They can also practice English conversation with the NPC boss at the ring toss booth. Figure 1.1 shows the context of the ring toss booth. The EFL learner first clicked the objects on the shelf on the left-hand side to learn the vocabulary, then practiced the conversation with the NPC boss on the right-hand side. After they finished all the learning tasks, they can play the ring toss game, and finally, they can choose a reward from those on the shelf on the left-hand side. All the learners' scores received in the ring toss game were recorded and shown on the screen. Besides playing the ring toss game and obtaining a reward after accomplishing the learning task, this competition approach was also found to have motivated EFL learners to repeatedly log in the VR environment and learn the materials by playing.

It is worthy of notice that the learning activities reported in Lan (2015) were conducted after school. EFL learners logged in during their free time and before they took their EFL classes. Therefore, it is also a kind of flipped learning application. The learning outcome was promising. The participating EFL learners made a significant improvement in their EFL learning performance.

Fig. 1.1 A night market in SL

The study of Lan and her colleagues in 2018 (Lan, Hsiao, Shih et al., 2018) is another example of game-based language learning in VR. Still, the participants of this study were special education students, rather than regular participants like those in the studies described in the previous sections. Additionally, the target language was Mandarin Chinese, the students' first language. Four special education students with a language delay participated in this study. A total of eight lessons and the corresponding contexts were developed with the embedded materials which matched the four students' learning needs, especially for the design of the human–computer interface. Besides, additional scaffolding was designed to serve as learning guides to help the four students individually learn the materials by playing in and conquering the graded challenges of each lesson.

The four special education students of that study came to the resource center in their school twice a week for eight weeks. They logged in the VR contexts together but carried out learning by playing individually. Although they learned individually, they could share their playing experience and findings with the others or the teacher during or after playing via their avatars in the VR contexts. And they loved to do so. Moreover, they even loved to share their VR experience with their families. The special education teacher and one researcher stood by to provide them with support if necessary, usually regarding technical support. Figure 1.2 shows that they logged in a health center to learn the materials embedded beforehand.

The results were very promising. The learning outcomes of the eight-week learning sessions were comparable to those of one-year traditional learning lessons. In addition to the gains of Chinese Mandarin ability, all the four participants enjoyed the learning process very much. For example, one student answered the teacher's one question about how he thought about the learning experience after the eight-week

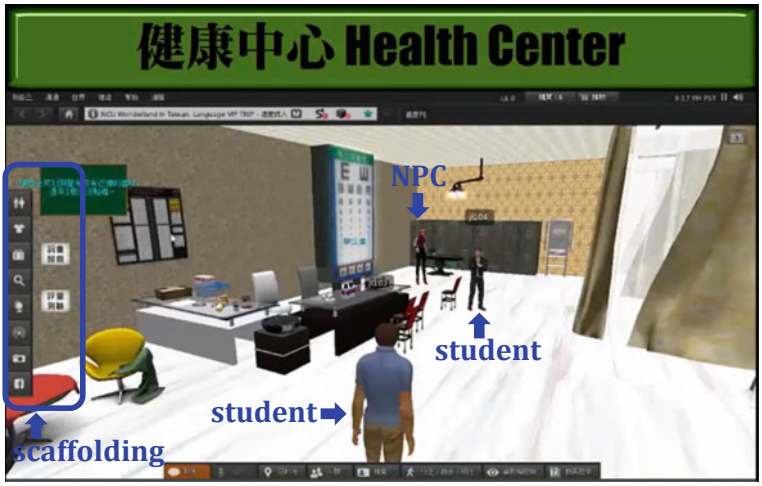

Fig. 1.2 A health center in VR

learning. "How much do you like it? Very much or just a bit?" His answer was "I super love it."

1.4.3 Self-exploration in VR

When engaging in self-exploration VR in language learning, users should be explained and provided with precise learning guides or learning goals, or they will easily lose the learning focus in the splendid and colorful world, and consequently obtain unsatisfactory learning results (Lan, 2016; Mayrath et al., 2011). With a precise learning guide, an authentic VR environment allows learners to expand their experiences by visiting places, such as the Arctic or the outer space, which they cannot visit physically in the real world. For example, a virtual field trip is a common activity carried out in VR to have learners explore a target spot without the barriers caused by the limitations of time or space (Blyth, 2018; Pilgrim & Pilgrim, 2016). As reported in Mark (2016)'s study, which integrated Google Cardboard and Google Expeditions Pioneer Program in students learning, the outcome of a virtual trip was positive. Students instantly engaged in real contexts with immersive expeditions. With the tour guide embedded in the expeditions, students' curiosity was inspired, and it helped them keep observing and exploring the visited contexts. It did not only excite the participating students as they "traveled" to Machu Picchu or the moon but also helped them better to understand the places they "visited" and to strengthen their learning.

The study of Lan et al. (2019) is another example of using VR as a self-exploration tool to enhance Chinese as a second language (CSL) essay writing by students from

Singapore. In their study, the VR contexts were constructed in Second Life (SL), including a hotel, two restaurants, and a zoo. The VR exploration was integrated into the pre-writing stage. Take the topic of "comparing the two restaurants" as an example, the CSL students logged in SL to explore and figure out the differences between the Western- and the Chinese-restaurant (see Fig. 1.3). They wrote down what they found and then used the collected information to complete the latter essay writing activity. It was found that with the very clear requirement of the essay writing activities, the CSL students used the time well in exploring the VR environments and collecting information needed for essay writing. Students' learning motivation was high, and consequently, the learning outcome was positive and satisfactory without a doubt.

Similar to the study of Lan et al. (2019), that of Lan and Van (2020) investigated the impact of 360-degree VR videos on basic Chinese writing by CSL students from Vietnam. All the participants were CSL beginners, learning Chinese in Taiwan. After receiving the instruction on the vocabulary and sentence patterns, the participants used Google Cardboard and 360-degree VR videos in their smartphones to take a VR field trip and visit several famous landscapes in Taiwan, such as Mountain Ali and the Taiwan International Balloon Festival (https://youtu.be/47Gm2Lwp4LA) (see the screenshots shown in Fig. 1.4).

After the VR field trip had finished, the CSL students wrote down what they saw in the 360-degree VR videos. By using Google Cardboard and the VR videos, all the students expressed a strong feeling of "being there." Additionally, immersing themselves in the videos with the rich information in the scenes inspired them to

Fig. 1.3 Left: The Chinese restaurant; right: The Western restaurant

Fig. 1.4 Two screenshots: left, Mountain Ali; right, the Taiwan International Balloon festival

write an essay with better quality and quantity, compared with those written without such the immersive experience. Interestingly, they became more willing to write a Chinese essay than they were before having an immersive experience.

1.4.4 Cooperative Task-based Learning in VR

Cooperative learning is an effective method and is commonly adopted in FL learning (Lan et al., 2009). Rooted in the constructivist theory, cooperative learning is a form of socially mediated learning that emphasizes the interactions between individuals. However, without a proper activity design or well-shared accountability among individuals, there could be conflicts, leading to a poor learning outcome (Lan et al., 2007).

In FL learning settings, cooperative learning is usually integrated with task-based learning (TBL), forming cooperative task-based learning. A task, from the perspective of FL learning, can be any daily activity that results in processing or understanding a language (Lan et al., 2016). Additionally, a language task comprises two essential elements: the settings and the conditions under which the task takes place (Nunam, 1989). While carrying out a language task, FL learners perform social interaction and meaningful negotiation to reach the task goals. Successful TBL requires learners' active participation. Based on the description above, a cooperative language task should include four essentials: actual events in daily life, authentic contexts, a precise task goal, and cooperation among a group of accountable members.

The matching specific features of VR with the abovementioned goals of cooperative TBL makes VR an ideal platform to implement cooperative TBL for language learning (Lan, 2020). Based on the results obtained from numerous empirical studies, many language tasks can be easily designed and carried out better in VR than in traditional classrooms (Lan et al., 2016). Take the commonly adopted information-gap task as an example, FL teachers split the information into several parts, at least two, and distribute each part to an individual student. Then they are paired or grouped to exchange what information they have in hand without peeking at the others'. However, it is commonly found that the paired students put their information on the desk, and then look at two pieces of information together to figure out the answer (Lan & Lin, 2016). But the situation cannot be seen in VR because of the hindrance between the learners' avatars.

Lin and her colleagues' (Lin et al., 2014) study demonstrates a good example of implementing cooperative information-gap tasks in VR. Three units and the corresponding contexts were created: "Unit 1: Pair the Friends," "Unit 2: Family Day," and "Unit 3: Clues in the Maze." The participants in this study were 144 CFL learners from Monash University, Australia. They were divided into small groups. Then each group was further divided into two small teams. When carrying out the task in each unit, the information was divided into two halves; each small team had one half of the information. The two teams in the same group had to exchange their information via oral interaction with their partner team. Failing to successfully exchange complete

information in a small group could not bring out the answer, and consequently, the group would fail in reaching the task goal.

For example, in the third unit "Clues in the Maze," the participants were either inside or outside the maze (see Fig. 1.5). The participants who were inside the maze did not receive any notes from the teacher, but they could see the stuff in each shop and could share the information with their peers who were outside.

In contrast, those participants who were outside the maze did not know what was inside the maze, though they were given a map of the maze. On the map marked the shops' numbers, as well as their locations. The shop numbers were in random order. Additionally, the hint for the answers, such as "when," "where," "who," etc., was also added into some shops, as shown in Fig. 1.6. It should be noted that the map with the hints was a digital note in Second Life, rather than a paper-based hard copy.

Fig. 1.5 Left: Inside the maze; right: outside the maze

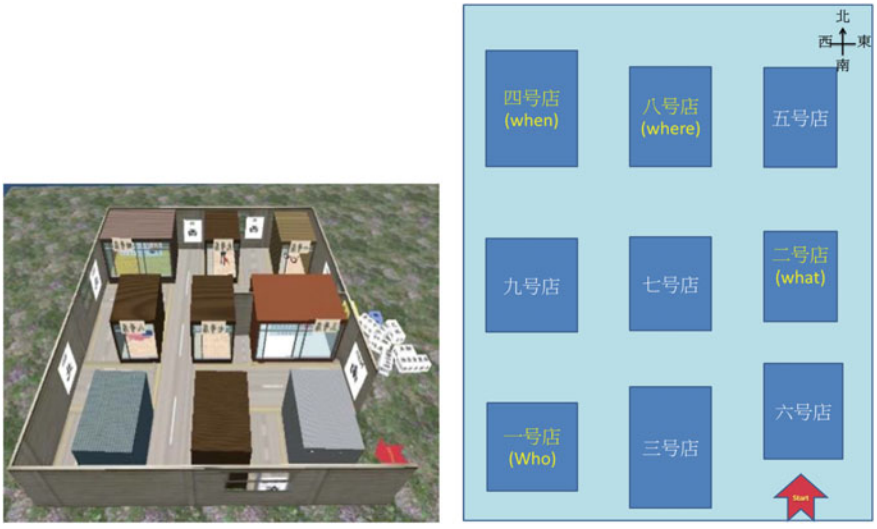

Fig. 1.6 Left: The maze used in Unit 3, "Clues in the Maze;" right: the map of the maze with hints

Moreover, the attribute of the digital note was neither duplicable nor sharable. That is, it was only owned by one avatar in the context. The unshareable characteristic of the digital note gave the participants who owned the map a push to use Chinese to communicate with their team members who were inside the maze while leading them to the correct shops and to collect the information needed for reaching the goal. Figure 1.6 shows the maze and the map with hints. The results showed that carrying out cooperative language tasks in VR helps CFL learners set clear goals and enrich their oral output.

Lan and her colleagues (2016) investigated the effects of language tasks on CSL students' oral communication performance, which is another example of implementing cooperative task-based learning in VR. In the abovementioned study, the participants were 30 CSL beginners from 4 countries, learning Chinese in Taiwan. The participants were divided into several small teams and were assigned language tasks. They had to work with their team members to collect, share, and exchange information, and finally reach the task goal, i.e., solve the problem in the scenario. For example, one of the tasks was a detective-like one. The scenario was about four people sharing an apartment. One person's cookie was eaten by someone else without permission. The cookie owner was furious and wanted to find out the "criminal." There were four rooms in the apartment. Each room was embedded with some clues, some of which were interference not contributing to solving the problem. Therefore, the team members had to discuss how to distinguish the useful information from the interference. At the end of the task, all the teams told the teacher their answers and provided as many reasons as possible. The team who had the correct answer and provided the most reasons won the competition. Additionally, each member of the winning team was rewarded with a motorcycle to freely explore the VR environment.

Figure 1.7 shows the students entering the shared living room, "the crime scene," to see what the "criminal" left there. Figure 1.8 shows the end of the activity when all

Fig. 1.7 Students entering the shared living room to see what the "criminal" left

Fig. 1.8 Students getting together to share their answers and reasons

the students gathered to tell the teacher their answers and reasons. The motorcycle on the right of Fig. 1.8 was the reward for the winning team. The results of the study show that the CSL students made a significant improvement in their oral communication performance. Additionally, they behaved with high motivation. They expressed that they loved to learn Chinese in VR, and it was much fun to cooperate with peers to solve the problems given by the teacher. In brief, their Chinese oral performance and learning motivation and attitudes were enhanced by doing cooperative task-based learning in VR.

1.4.5 Learning by Creation in VR

Creation means the act of creating something, based on the Cambridge online dictionary. Usually, the process of creation involves learners' ability to produce or use original and unusual ideas. Similar to problem-solving, creation deals with generating solutions. According to Hennessey and Amabile (2010), creativity can occur in daily life. It involves problem-solving and pragmatic skills. With creation, learners construct knowledge by linking what is known to create the solutions to new problems in the situations faced. Through creation, learning can be deepened. It also improves learning transformations by enhancing students' ability to bridge what they learned in the classroom settings and the real world. Given the benefits to students' learning by creation, learning by creation has been attracting researchers' and educators' attention (New Media Consortium, 2015).

Some VR tools, such as Tilt Brush, Google Blocks, Tinkercad, Omni-Immersion Vision (OIV), and Minecraft Realms, not only provide learners with an immersive

environment but also support hands-on creation activity. With such an authoring tool, users can create their own VR objects or contexts without a high technical threshold. After the completion of construction, the creators can share their creations with others by uploading them to the cloud. Moreover, some authoring tools, such as OIV, even allow users to experience social interaction with others from around the globe in the virtual contexts they have created. Additionally, when language learners are involved in the collaborative VR creation process, it becomes a critical thinking process in which they proceed with collaboration, problem-solving, and self-directed learning, and consequently their learning outcome, learning ownership, and autonomy are enhanced (Grover et al., 2015; Yeh & Lan, 2018).

Wu et al. (2019) adopted OIV in an EFL class with a focus on enhancing the communication skills of college students. The participants were Taiwanese EFL learners from the College of Medicine at a university in northern Taiwan. The students created their stories and then created the corresponding contexts in OIV. Then, they acted out their stories via their avatars in the VR environment. Their role-play in VR was recorded and shared with their classmates. Figure 1.9 is a screenshot of one video created by one OIV team. It is found that in the video one student chose a modern avatar, the man in a suit, while the other a historical one, a female emperor from Chinese history. Additionally, the house and all the objects in the scene were created by the students using OIV. The screenshot showed a couple discussing the husband's health problem before they decided to go to the doctor. The husband told his wife that he felt dizzy all day. His wife found that he ate too many hamburgers

Fig. 1.9 A screenshot of a student's video

Fig. 1.10 Students used a 3D authoring tool, Build & Show, to create VR contexts needed in their English lessons: left, a playground; right, a living room

and was also overweight. She doubted that he might be suffering from diabetes and then suggested that he go to the doctor.

It was found that the students in VR performed well in creations and role-plays with detailed descriptions of the scenarios and plots. Cooperative learning by creation in VR benefited EFL students' English language skills, healthcare professional-patient communication skills, and in enhancing empathy and understanding toward patients. The participating students also expressed very positive attitudes toward the use of VR creation in their English learning.

Yeh and Lan (2018) collaborated with an EFL teacher in an elementary school in the rural area in northern Taiwan. They conducted a one-semester study by integrating a 3D authoring tool, called Build & Show, into daily English classes. In the study, a class of 15 fifth graders were taught to use Build & Show in their computer lessons. Then, they helped the English teacher by collaboratively constructing the contexts they later needed in their English lessons. Figure 1.10 shows the students cooperatively created the contexts needed for their English learning. The screenshots in Fig. 10 show that more than two students' avatars were at the same location in the virtual environment. On the left of Fig. 1.8, students were constructing a playground, while on the right students were working together to arrange the furniture in a living room.

Later, during the English lessons, the teacher logged in her avatar in the VR environments created by her students and started teaching the materials in the VR environment. It was found that the students paid their most attention to what the teacher was teaching with pride shown on their faces. They also showed high ownership of their English learning. It is worthy of notice that the participants' learning strategies, planning, self-evaluation, peer-discussion, and problem-solving skills improved as well.

1.5 Conclusion and Suggestions

As VR technology and the devices become more accessible, researchers and educators are more interested in understanding the potential of emerging technology. Moreover, when low-priced VR devices, such as Google Cardboard, become popular, integrating VR technology into daily learning seems to be an inevitable result in the digital age. In Castaneda et al. (2017) report of a large-scale study, more than 1300 students across six grade levels participated in the study of using VR for daily learning during the 2016–2017 school year. Additionally, a report about Google's ongoing investment in the UK says that Google is going to bring VR to one million UK school children (Heathman, 2016, November 15).

VR has been used for enhancing FL learners' intercultural awareness, oral communication skills, pragmatic competence, social connection, learning motivation and autonomy, creativity, etc. Although most of the existing literature reports positive and promising results, some essential components must be considered when adopting VR in FL research or empirical practices. Lan (2016) mentioned in her article about the design principles of 3D VR games for language learning, indicating that learners, linguistic knowledge and pragmatic competence, and the process of acquiring the language are important elements for the successful implementation of using VR for FL learning. Individual differences, one of the learner variables, are an important factor that researchers and educators must pay attention to. Learners' learning styles are different. The learning difficulties encountered by individuals are different. Learners' motivation differs from that of other persons. All the individual differences mentioned above should be considered when considering VR as a learning platform or a tool for FL learning. It is also worthy of notice that whichever kind of VR devices is adopted, the immersive- or non-immersive VR, situated tasks and appropriate learning scaffolding are also one of the major influences on students' learning outcomes (Castaneda et al., 2017; Lan, 2016, 2020).

In sum, VR, as an emerging technology, advances markedly in the digital age. It can be a facilitator or a barrier in the FL learning process. The learners' needs and the theoretical foundations are the keys to a sound and successful usage of VR for language learning; therefore, they should always be emphasized.

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Chapter 2
The Effects of Applying Virtual Reality Implementation on Chinese Writing Skill of Description

Ting-Chia Hsu and Chuan-Yi Chan

Abstract This chapter reports on the integrations of Chinese, geography, and information technology courses, with teachers from each discipline collaborating to prepare their courses, as an example of Content and Language Integrated Learning (CLIL). This empirical study employed mobile devices in the learning activities, used the situated learning strategy, and involved the students in real-life investigation in the interdisciplinary literacy curriculum. The students observed and learned in the real-life environment, and utilized mobile technologies to support their data collection and information searching. They made connections between the knowledge in the textbook and the real-life situation in the literacy-based learning activities. After they came back to the classroom, they used the data and photos they had collected to design the virtual reality of the environment they had visited in order to recall and reflect on the descriptive writing activity. This chapter primarily explored the learning effectiveness of Chinese, and found that the students made significant progress. The higher performance of the students' VR creation, the better the outcome of their descriptive essays. It was confirmed that creating a VR project in the information technology course according to the resources collected from the actual investigation in the geography course played a role in deepening effective reflection in the pre-writing stage so that the students could perform better in the descriptive writing in the Chinese course.

Keywords Interdisciplinary curriculum · Descriptive writing · Virtual reality · Content and Language Integrated Learning

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2.1 Introduction

This chapter reports a study that aimed at using a learner-centered interdisciplinary integrated curriculum to support senior high school students' practice of Chinese descriptive writing. The interdisciplinary activities are currently putting into practice, because students have to apply the appropriate knowledge, skills, and attitudes to solve complex situations in their real life (Mansilla et al., 2009). Interdisciplinary integrated courses can not only teach students knowledge, but can also help them to use the subject knowledge in their lives and writing (Dunn, 1994). Scholars have indicated that students have to show their critical awareness and understanding in interdisciplinary work (Mansilla et al., 2009). Therefore, many teachers are attempting to link the relevance of the knowledge content of various disciplines to guide students to cultivate their cognition, affect, and skills in their life. This chapter focuses on the performance of Chinese learning and descriptive writing from the integration of three different subjects. Writing is a means of extending and deepening students' knowledge (Huy, 2015).

The study reported in this chapter combined the 10th-grade Chinese language, geography, and information technology courses to help students learn descriptive writing in their Chinese course, to apply the knowledge of volcanic terrain in their geography course, and to implement a virtual reality (VR) project in their information technology course. The real-life investigation aimed to increase the students' actual experience in the pre-writing stage, as scholars have pointed out that writing activities should focus on developing strategies to involve experiential learning in the writing (Johannessen, 1995). The interdisciplinary curriculum is based on volcanic topography in a geography course. This interdisciplinary study linked the Yuwen River history of sulfur mining mentioned in Chinese language poems and the knowledge of volcanic topography to guide students to discover the relevance of the subject knowledge and enhance the richness of their descriptive essays. In the information technology course, the students were asked to survey and collect data about Taiwan's Beitou Volcano in order to create their VR project. They could take photos, notes, and voice recordings using mobile devices and were then asked to create a personal VR project to recall and reflect what they had experienced in the real-life investigation, as VR has been seen as a reflective tool in a recent study (Stavroulia & Lanitis, 2019).

2.2 Literature Review

2.2.1 Content and Language Integrated Learning

Content and Language Integrated Learning (CLIL) is a dual-focused approach which gives equal attention to language and content so that students can participate in some curriculum content integrated with language learning (Dalton-Puffer, 2011). This is

a popular approach in Europe (Bower, 2021; Merino, & Lasagabaster, 2018) and in Asia (Yang, 2015). Language learning consists of listening, speaking, reading, writing, and culture (Chien et al., 2020). CLIL in this study is about using a lingua franca correlated with the learning activities of another subject. Scholars have noted that CLIL lessons are usually timetabled as content lessons (e.g., biology, geography, engineering), while the target language normally continues as a subject in its own right as language lessons taught by language teachers (Lasagabaster & Sierra, 2009).

In language learning in a CLIL context, writing is a relatively difficult skill as the students need to output authentic and logical descriptions. As for the learning content, narrating contexts is a detailed description of "who, what, when, where, and which." Moreover, writing tutorials should guide students to read, observe things and activities around them, collect writing materials, and then cultivate basic writing skills such as imagination, thought, memory, sensibility to express their experience and feelings. Accordingly, descriptive essays should be written with concrete understanding and perceptions of space, time, and contexts (Huang et al., 2019). In this study, the CLIL teachers created specific learning activities involving information technology, geography, and Chinese writing, so that the natural science and social science teachers could complement each other (Mahan, 2020).

2.2.2 Descriptive Writing

Scholars have revealed that it is easy to assess the quality of descriptive writing according to its sensory presentation, fluency, syntactic complexity, and accuracy (Way et al., 2000). Other scholars explored 45 English education sophomore students' performance in descriptive writing with a 5-Likert scale which measured the components of grammar, punctuation, coherence, cohesion, and content (Sumekto & Setyawati, 2018). In Chinese writing, in addition to literary style, there are four scoring standards, namely intention, material, structure, and wording. Wording includes picture shaping, detail depicting, and level making. Among them, picture shaping refers to how much information is contained in a single screen, while detail depicting indicates to describe the focus of a close-up picture. This writing technique, which involves carefully observing one's surroundings and truthfully presenting them via detailed descriptions, is called "Descriptive Writing Skills" in Chinese writing teaching.

Descriptive writing refers to one of four rhetorical modes, known as modes of discourse. It is also the fiction writing mode for transmitting a mental image or the particulars of a story (Huy, 2015). Therefore, the writing skill of description refers to the actual and practical description of the various situations and things one faces, especially the sound, color, shape, smell, touch, and so on, including vision, hearing, smell, taste, and touch. In class, teachers mostly guide students by teaching articles from textbooks, and integrate descriptive writing skills into writing tutorials, so that students can observe and experience life, and then collect and enrich their personal writing resources. Through selecting appropriate materials from personal writing

resources, students can compose a compelling article using the detailed description. Accordingly, the purposes of description are to re-create or visually present a person, place, event, or action so that the reader may picture that which is being described (Huy, 2015).

According to writing-related studies, it could be found that students who master cognitive strategies can also perform better in writing. For example, deliberate practice and cognitive apprenticeship can serve as writing techniques that help effectively apply knowledge during writing (Kellogg, 2008). Besides, a study by Escorcia et al. (2017) pointed out that writing performance is positively related to writing strategies such as note-taking and draft reading. Also, based on previous studies, Balderas and Cuamatzi (2018) stated that the process whereby teachers lead students to practice self-correction strategies can not only help improve their metacognitive ability, but can also sharpen their writing skills. These studies all inferred that understanding relevant cognitive strategies and skills does indeed benefit writing performance. There is a growing number of studies which are using technology to enhance students' writing practice. Additionally, more and more studies have shown that the application of VR does improve writing skills, especially the writers' descriptive skills, and that VR boosts the acquisition of writing skills (Chen et al., 2020). Therefore, the study reported in this chapter applied VR to writing tutorials to cultivate students' observation of details through the construction work of VR practice. It was assumed that if the students could make the most of the five senses of sight, hearing, smell, taste, and touch to observe, recognize, and understand things, they could strengthen their observation ability, which in turn would lead to improvement in their descriptive writing ability.

2.2.3 Technology-Enhanced Language Learning

With the rapid progress of technology, most people have their own cell phone in this era of global digitalization. Many scholars have attempted to apply different learning activities in education through the convenience of mobile learning (Kumar & Chand, 2019). Therefore, the convenience of mobile learning can be used to design student learning situations and allow students to share content without the limitations of time and environment (Sung et al., 2016). Moreover, past studies have pointed out that mobile learning can not only attract students to engage in the learning activities, but can also allow them to switch from passive learning to becoming active learners (Hsieh & Tsai, 2017). Scholars have also combined the advantages of mobile learning and augmented reality (AR) to conduct situated language learning in a real environment (Hsu, 2017), and the integration of mobile learning and virtual reality to conduct environmental learning in the virtual world (Chang, Hsu, Kuo et al., 2020). Therefore, it can be seen that the application of mobile learning combined with AR or VR in education is becoming a trend.

From reviewing the mobile learning research for K-12 from 2010 to 2016, and using Bloom's taxonomy as a theoretical framework for classifying students' cognitive level of activity, it was found that 40% of students remained in the first and second level, namely memory and understanding, while 60% were in the third to sixth level, meaning that they could apply, analyze, evaluate, and create (Crompton et al., 2019). According to this result, mobile learning has the potential to change teaching and learning methods, and it can also be applied to higher level thinking. It was confirmed that students used mobile learning to analyze and create higher cognitive abilities. As for the subject fields, subjects that apply mobile devices include science, mathematics, social studies, language, art, and special education (Crompton et al., 2019). In fact, the use of mobile devices in language teaching is already prevalent. Because of their easy operation, mobile devices help to stimulate learning motivation and interest. However, designing appropriate teaching content plays a key role in the use of mobile devices to provide brand new learning experiences. On the other hand, we should also pay attention to the operational difficulties occurring when using mobile devices (Andujar et al., 2020). A study of mobile-assisted language learning (MALL) also pointed out that intrinsic motivation has no direct influence on students' behavioral intentions, while the perceived usefulness and perceived ease of use have a positive effect (Sun & Gao, 2019). Also, learning languages with mobile devices is effective for improving the performance of college students. Nonetheless, the learning content must be designed based on students' needs, and be continuously promoted by the teacher to achieve its objectives (Klimova, 2019). Additionally, some studies have indicated that middle school students' participation in immersive learning through mobile devices does not necessarily have a positive correlation with their interest and achievement of the subject, but the design of field visit activities in games is positively related to their performance (Huizenga et al., 2019). The research has pointed out that these teaching methods do benefit learning, but there are still some disadvantages.

2.2.4 Virtual Reality

In VR environments, students have an immersive virtual environment that can enhance their interactions with the learning environment (Olmos-Raya et al., 2018). Moreover, experimental results have found that it is possible to use VR to further develop students' imagination and possibility of learning (Hu et al., 2016). In addition to the actual operation of the VR system, it was expected that the students would be able to use it to construct VR content based on their knowledge. In this learning approach, it is expected that students who learn with practice will perform better than those who learn with passive learning methods (Chang, Hsu, & Jong et al., 2020). Scholars have also presented that the majority of students have enjoyed using VR learning environments for learning writing (Pack et al., 2020). VR-assisted learning in K-12 has mainly been carried out based on constructivism (Tilhou et al., 2020). Scholars have noted that the virtual worlds are not a finished product made

available to the user, but rather platforms which allow the user to create the world needed for goal attainment (Garrido-Iñigo & Rodríguez-Moreno, 2015). According to a constructivist paradigm, the VR technology promotes the learners to actively interact with the learning processes and aims at reducing the gap between the learners' knowledge and their real-life experience (Huang & Liaw, 2018).

The reason why VR can propel the revolution of education is that it offers a better immersive learning environment (Chang, Hsu, Chen et al., 2020), allowing students to focus on the learning materials. If students are guided more engagingly and clearly, their learning performance can be boosted via VR (Gadelha, 2018). Besides, the use of VR in teaching can indeed improve students' learning motivation and ability, including increasing the effectiveness and reducing the anxiety of cooperative learning. A previous study found that the participants who used the mobile VR tool were able to transfer the presented safety knowledge to the real world, and don an aviation life preserver significantly faster and with fewer errors than participants who used the traditional briefing card when they learned the safety instruction in the aircraft (Chittaro et al., 2018). Scholars have indicated that the educational environmental narrative games in VR provide rich, high-fidelity environments so that students have higher retention of the story content (Ferguson et al., 2020). Scholars have also revealed that many language educators in higher education are now widely expected to deliver their language instruction with the aid of VR technologies (Lin & Lan, 2015).

The previous research found that participants in the VR condition showed better performance of "remembering," and reported higher engagement than those in the traditional and the video conditions (Allcoat & von Mühlenen, 2018). In addition, scholars have revealed that participants in the immersive VR condition had higher quality creative products than those only in the paper-and-pencil condition (Yang et al., 2018). VR technologies have been confirmed to be useful in language teaching and learning (Morrison, 2017). As scholars have reviewed the VR studies and concluded that integrating VR technologies leads to enhanced learning experiences, as well as increased achievement and motivation (Tilhou et al., 2020), the current study attempted to employ the creation of VR in the pre-writing stage so that the performance of descriptive writing could be further explored. In particular, the recent studies also emphasized that there is usually no chance for students to have in-depth feelings about the contexts of a descriptive writing topic in the traditional language teaching activities (Huang et al., 2019). Therefore, the students were asked to collect data from an actual geography investigation related to the scenario in one unit of a Chinese course, and to create a VR project in their information technology course to enhance their in-depth experience and reflection, so as to facilitate the Chinese learning effectiveness of Chinese learning and the performance of descriptive writing. An innovative CLIL practice feasible for VR contextualized language learning was implemented to enhance the students' descriptive writing performance.

Table 2.1 The performance of VR projects in the subject of information technology

VR project scores	1	2	3	4	7	8	13
Scale 1-Pictures	1	1	3	2	3	4	5
Scale 2-Details	0	0	0	0	1	1	4
Scale 3-Text	0	1	0	2	3	3	4
Number of students	4	8	11	11	11	6	5

2.3 Experimental Design

2.3.1 Participants

A total of 56 students from a senior high school in Taipei City participated in this activity. All of the students were taught by experienced Chinese, geography, and information technology teachers. The Chinese learning unit was literature landscape—Beitou sulfur, and the geography learning unit was volcanic terrain. None of the students had used the VR system before. The information course teacher was responsible for teaching the students to make the VR project. If the VR project contained an authentic spherical (i.e., 360 degree) photo, the student would gain one point. If the student wrote some descriptive text for one photo, he/she would also get one additional point. If the VR project contained more detail such as a link for the spherical video-based virtual reality, the student gained one more point. The participants' VR project outcomes are shown in Table 2.1.

Based on the participants' VR project outcomes shown in Table 2.1, the students were divided into a low-performance VR project group and a high-performance VR project group. As a result, there were 34 students in the low-performance VR project group, and 22 in the high-performance VR project group. The two groups had similar learning effectiveness in the Chinese pre-test ($t = 0.53$; $p > 0.05$).

2.3.2 Experimental Procedure

Before the learning activity, the Chinese and geography teachers planned the interdisciplinary curriculum content, and designed the activity plan and learning site investigation. At the beginning, all the students were asked to take a pre-test of Chinese and geography. The Chinese language and geography teachers then taught the basic pre-class knowledge together to help the students enter the learning situation and have the concept of outdoor data collection. The students conducted 50 min of VR production teaching and 100 min of VR production time in their information technology class. After the course discussion and feedback time, the students were asked to take the Chinese and geography post-tests and to complete the writing motivation questionnaire. This chapter implemented an interdisciplinary integrated

curriculum to explore the effects of a virtual reality geography project on Chinese descriptive writing skills.

2.3.3 Measuring Tools

The writing motivation questionnaire was modified from Wang (2017) to measure the students' writing motivation (Wang, 2017). The current study applied a total of 10 items which were revised from AR to VR with a Likert 5-point scale. For example, one item was, "*I like to use the VR creation for outdoor exploration and to help me write.*" The Cronbach's alpha value was 0.88, indicating that the scale has good reliability. The VR projects which the students created were also assessed based on the rubrics shown in Table 2.2.

The Chinese language pre- and post-tests were designed by two experienced teachers. In both the pre- and post-test of Chinese proficiency, there were 30 multiple-choice questions with a total score of 60, and 10 multiple-choice items with a total score 40. The total score of the pre- and post-test of Chinese proficiency was 100. In the post-test of descriptive writing, the students had to write five compositions with a perfect score of 100. Two Chinese teachers reviewed their compositions and scored their descriptive writing according to the completeness of the description from five sensory perspectives, including pictorial description, detailed description, and structure. The average of the assessment scored by the two teachers was awarded to the students as their final points for writing.

Table 2.2 Rubrics for the VR creation used as a reflective tool for descriptive writing

Scales	5 Points	4 Points	3 Points	2 Points	1 Point	0 Points
Picture Diversity	Five or more pictures for description	Four pictures for description	Three pictures for description	Two pictures for description	One picture for description	Objects marked but none for description
Picture Details	Five or more close-up pictures for detailed description	Four close-up pictures for detailed description	Three close-up pictures for detailed description	Two close-up pictures for detailed description	One close-up picture for detailed description	No close-up pictures for detailed description
Vision, hearing, smelling, taste, touch, etc., are included in the verbal explanations	Five or more	Four	Three	Two	One	None

2.4 Results

In terms of the performance of the VR projects in the subject of information technology, there were four students who gained only 1 point, eight who gained 2 points, 11 with 3 points, and 11 with 4 points; these 34 students were named the low-performance VR project group. There were 11 students who gained 7 points, six who gained 8 points, and five who gained 13 points; these 22 students comprised the high-performance VR project group. The following section will explore the effectiveness of the interdisciplinary approach on the Chinese concepts assessed by the multiple-choice questions and descriptive writing performance.

2.4.1 The Performance of Chinese Concepts

From the analysis results of the multiple-choice test for this Beitou sulfur unit, the means of the pre- and post-test were 64.64 and 78.82, respectively. The VR combined with the interdisciplinary integration was significantly helpful for Chinese Language learning performance ($t = -10.72^{***}$, $p < 0.001$), as shown in Table 2.3. That is, the students improved their learning effectiveness of Chinese language from the interdisciplinary activities.

Accordingly, all the students made remarkable progress after the interdisciplinary activities. The students with both low and high performance in the VR projects in the information technology subject all made significant progress, as shown in Table 2.4.

There was no significant difference between the Chinese pre-test of the two groups ($t = -0.53$; $p > 0.05$), and neither was there a significant difference between the Chinese post-test of the two groups ($t = -1.57$, $p > 0.05$).

Table 2.3 The paired sample t-test results of Chinese language performance

Variable	Groups	*N*	Mean	SD	*t*
Chinese language	Pre-test	56	64.64	8.66	-10.72^{***}
	Post-test	56	78.82	9.83	

$^{***}p < .001$

Table 2.4 The paired sample *t* test on the pre- and post-test for each group

		Pre-test		Post-test		
VR Groups	*N*	Mean	SD	Mean	SD	*t*
Low-Level	34	64.15	7.88	77.18	10.49	-7.27^{***}
High-Level	22	65.41	9.90	81.35	8.32	-8.38^{***}

$^{***}p < .001$

Table 2.5 The Independent *t* test on the two groups' writing performance

VR Groups	*N*	Mean	SD	*t*
Low-Level	34	66.62	15.14	−2.69**
High-Level	22	76.93	12.03	

** $p < ..01$

2.4.2 Performance of the Descriptive Essays

From the results of the writing post-test, the better scores the students gained in the VR creation, the higher scores they were awarded for their descriptive essays. There is a significant difference between the performances of the descriptive essays written by the students with low- and high-level performance of the VR creation in the course of information technology after the actual investigation, as shown in Table 2.5.

2.4.3 Results of the Writing Motivation Questionnaire

As shown in Table 2.6, most students maintained a certain degree of writing motivation for the interdisciplinary activities including the making of the VR project based on the real scene they visited. In other words, the students believed that this learning activity could improve their willingness to write. Among the items of the questionnaire, the highest score is for the item: "*I prefer to create VR from outdoor investigation for supporting writing*."

However, there was no significant difference between the writing motivation of the low- and high-performance VR project groups ($t = 0.06$; $p > 0.05$), as shown in Table 2.7.

Table 2.6 Descriptive statistics results of the writing motivation questionnaire ($N = 56$)

Items	Mean	SD
1. I am pleased to use the VR creation for writing	3.36	1.14
2. The VR creation is helpful for my writing	3.59	1.07
3. I like to use the VR creation for outdoor exploration and to help me write	3.64	1.07
4. I prefer to create VR from outdoor investigation for supporting writing	**3.77**	1.11
5. The use of the VR creation helps me to start writing more easily	3.39	1.12
6. The VR creation enriches my writing ideas	3.41	1.17
7. The VR creation can enhance my writing motivation	3.20	1.12
8. The VR creation can enhance my creative writing	3.43	1.02
9. I usually like to use the VR creation to help my writing	2.73	1.18
10. I think using the VR creation can help my writing	3.48	1.18

Table 2.7 The Independent *t* test on the two groups' writing motivations

VR Groups	*N*	Mean	SD	*t*
Low-Level	34	3.41	1.02	0.06
High-Level	22	3.39	0.71	

2.5 Discussion and Conclusion

This chapter introduces the interdisciplinary integration of VR creation in an information technology course to help students improve their learning outcomes for Chinese language concepts for the learning unit, and their descriptive writing performance. This chapter presents an innovative CLIL practice feasible for VR contextualized language learning, which is consistent with the conclusion that mobile-assisted language learning (MALL) is widely used and able to support CLIL (Kamasak et al., 2021). Previous studies stated that the use of VR technologies in education can promote emotional induction from high immersion so as to have a positive effect on the interest subscale of motivation and knowledge acquisition (Olmos-Raya et al., 2018), and supported language learning as well (Lin & Lan, 2015).

Because learning motivation is one of the important factors affecting learners' intention to use VR technology in learning (Huang & Liaw, 2018), this chapter also confirms that the students' writing motivation was enhanced when they made the VR creation for preparing their descriptive writing material from sensory inputs. According to the research results, the students improved their Chinese language learning achievements as well. They had similar writing motivation regardless of high or low performance on the creation of the VR project. However, the students achieved higher performance of Chinese language learning when they created high-level performance on the VR project. Previous scholars indicated that appropriate learning strategies should be introduced in learning activities to guide students to improve their learning effectiveness and motivation (Huang et al., 2016). Integrating VR with language learning reduced students' learning anxiety (Chien et al., 2020), and the process of language acquisition was also performed positively in the virtual world (Garrido-Iñigo & Rodríguez-Moreno, 2015). This chapter has confirmed that the linkage of VR making and descriptive writing is an innovative and useful application of CLIL which combines the content and linguistic skills in parallel (Kamasak et al., 2021).

VR displayed an improved learning experience and increasingly positive emotion when compared to traditional and video learning methods (Allcoat & von Mühlenen, 2018). A shown in this chapter, VR creation is an important reflective process in the pre-writing stage, rather than a learning system, as in a previous study (Huang et al., 2019). Other scholars have presented the pedagogical meaning of VR for supporting situated and experiential education (Schott & Marshall, 2018). Scholars have displayed that VR provided students with a fully immersive and interactive storytelling experience so that the story content could be better retained (Ferguson et al., 2020). Another case study has explored college students' use of interactive VR

tools with Google Cardboard and Expeditions for learning Chinese as a foreign language (Xie et al., 2019), while Virtual Reality-Assisted Language Learning (VRALL) has opened a new research field in the area of MALL. Although the authors did not integrate Chinese learning with the content of other subjects, they concluded that the real-life view VR tools provided college students with an authentic context for learning Chinese (Xie et al., 2019).

Although a previous study has explored the positive effects of immersive VR on an individual's creativity, flow, and attention (Yang et al., 2018), future studies need to consider the students' cognitive load when they are unfamiliar with creating the VR system through learning by doing. Although a VRALL study found that middle school students were engaged in a virtual-assisted writing environment and showed positive attitudes toward Google Earth VR, some concerns about using Google Earth VR in writing, including the fact that it is time-consuming, distracting and that it poses integration difficulties, were addressed (Chen, et al., 2020). In particular, a previous study has mentioned that students are likely to encounter technical difficulties, so more teaching related to the technical aspects must be offered to ensure that students receive sufficient technical supports and master the operation of the equipment and technology (Domingo & Bradley, 2018). Researchers can also include a control group for more in-depth statistical analysis in the future.

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Chapter 3
Design of a Distributed Language Learning Environment

Contextualizing Chinese Language Learning in a Panda Reserve Virtual Reality

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3.1 Introduction

For several decades, language learning and teaching practices have been following the trend within second language acquisition (SLA) to place learners at the center of activity in the classroom. Drawing on normative and prescriptive theories of language like structuralism and universal grammar, teaching, learning, and assessment have focused on forms and symbols, especially grammar, to the detriment of other acquisition-vital processes (Han, 2008; van Lier, 2004). This attitude of

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language as subject matter was only briefly derailed during the 1960s and 1970s with the introduction of communicative instruction, before it too succumbed to the pressure of language policies seeking to realign language instruction with traditional assessment frameworks (Passey et al., 2004; VanPatten, 1998). However, a recent grassroots movement of Distributed Language (DL) theory seeks to remedy the static views of the past by reasserting the role of language as ecological, dialogical, and non-local (Cowley, 2012). In doing so, DL promotes instructional practices that leverage formal and informal spaces to provide learners with opportunities for languaging experiences, meaning-making events, and sensemaking susceptible to social influences (van Lier, 2004). For in language, we are always *doing* something—often with others (i.e., first-order languaging experience)—while we are constrained by and able to use skilled linguistic action (Newgarden, et al., 2015) to do things with (second-order) lexicogrammar (Thibault, 2011). By teaching language like we do math, science, or history, we restrict language to second-order processes (VanPatten, 2017).Relationally, her service to the local and international communities is informed by her philosophy of intentional cultivation of linguistic and cultural diversity of all ages.

For most students, the classroom is their primary learning resource and likely the most influential. Outside of that, there is little to no exposure to immersive environments, save for what technology-mediated spaces can provide. Oddly enough, despite the rapid evolution of technology and near-infinite availability of materials and opportunities for learning, the formal language classroom has remained, for the most part, untransformed.

In this chapter, informed by a Distributed Language perspective, we leverage the use of virtual reality (VR) technology and classroom space in the context of learning Chinese as a foreign language (CFL). Through the design of this Distributed Language Learning Environment (DLLE), we aim to provide (1) a Distributed Language-informed pedagogical model of language instruction and learning as well as (2) practical solutions to the lack of immersive environments in foreign language learning by design. Furthermore, we (3) address the ethical responsibility of language education for cultivating pluralistic perspective taking and values realizing with regard to individual, linguistic, cultural, and ecological diversity.

The project presented in this chapter is one element of a broader CFL initiative: A holistic narrative-driven learning environment cutting across spaces enabled both by VR technology and classroom space; virtual materials artifacts, e.g., non-player characters (NPC), objects and physical materials, e.g., reading texts and printouts. The project seeks to complement classroom language teaching practices by offering embodiment opportunities and situating language learners in predicaments that reflect real-world ecological problems (climate change, resource depletion, scarcity of water and food, threats to wildlife). It also intends to further language learners' well-being and becoming in their linguistic, sociotechnical, and intercultural capacities. Our overarching design aims to enable language learners to transform themselves into several predetermined roles, including a business administrator, a forest manager, an herbalist, and a mental health practitioner. While coordinating with someone from a different discipline, players learn perspective taking and values

realizing. Such actions are actualized in event-driven activities that require careful thinking and mindful action in how to make use of environmental and semiotic resources embedded in the VR and classroom spaces (in contrast to prescribed activities where learners follow step by step). Language learners in DLLEs are working out solutions to gain resolution by engaging in critical/harmonious discourse about the environment and ecological issues as well as connecting with experts (e.g., from forestry, wetlands, and conservation) and current research. Through coordinating multi-scalar events, such as identifying problems, experiencing a virtual panda reserve, and participating in proactive conversations, learners will embody unified speech and action (知行合一, *zhixing heyi*) while sustaining harmonious intra- and inter-bodily relationships with themselves and the environment around them.

Given a project as expansive as this, it is important to lay out the foundational frameworks that will serve as the guide for future research, instruction, and learning. To that end, in this chapter, we focus on providing an overview of the Distributed Language Learning Environment model, exemplified as the multilayered player character (PC) portfolio, which, in addition to providing vital player character backgrounds and readings, will also include a virtual reality component in the form of a village in China called *bizhu wanshang* (碧竹塢上 "on Blue Bamboo Hills").

In *bizhu wanshang*, players will embody the roles of four professionals: a business administrator, a forest manager, an herbalist, and a mental health practitioner. Together they will encounter a variety of environmental predicaments. Throughout their participation, Chinese language learners in groups of three will engage with both first-order experiences in languaging and second-order linguistic and environmental resources, such as real-world artifacts and multimodal reading corpora for each of the professions mentioned above. As a player, the learner's experience will also be multi-scalar. Thus, their learning experiences are rhythmic as they move in and out of the virtual environment. Sometimes they will engage with the readings on their own for individual meaning-making, and other times, they will coordinate perspectives with other player experts in their group. Zheng et al. (2019) and Zheng et al. (2009a) studied the virtual world and classroom space by comparing them when students were doing comparable activities. Zheng et al. (2019) took a distributed view and found ecological niches of both environments and thus called forth harmonizing languaging styles across the classroom and virtual environment ecosystem. Continuing with this line of work, our project in this chapter is forming a model of an optimal environment design for learners to experience the advantages of both spaces as a unified coherent whole. The model is heuristic and can be tailored to other languages. It can encourage cultural bridging between English and Mandarin Chinese speakers in ways that can be readily extended to other bilingual and multilingual contexts.

3.2 Literature Review

3.2.1 Common Practices of Teaching Chinese as a Foreign Language (CFL)

From 2004 to 2008, the number of Chinese learners in elementary schools and high schools had increased by 195% in the United States (Beckett & Zhao, 2014). Chinese has become the third most commonly used family language in the United States, only an inch behind English and Spanish (Beckett & Zhao, 2014). Despite this prevalence, the pedagogy of teaching CFL has not changed much since the 1940s. These unchanging conditions can be found in a plethora of instructional practices such as Qi and Li's (2010) advocacy of the traditional initiation-response-feedback/evaluation cycle (Lemke, 1989, 1990), in which instructors ask questions about a language point and students answer them. Qi and Li's data comes primarily from an intermediate Chinese classroom in a higher education study abroad program called Princeton in Beijing. Princeton's CFL pedagogy mainly focuses on using drills of vocabulary and grammar to practice and does not include any situated application of Chinese in context. Several other studies (e.g., Duff & Li, 2004; Lantolf & Genung, 2002; Yang, 2008) also examined discourse in higher education classrooms and found that besides teachers' explicit presentation and students' practice of language in the form of symbols, student performance time in class within an immersive environment was limited because class time was primarily dedicated to drill-oriented practice.

Research on teachers' perceptions of pedagogical practices reinforces this preference for mechanical learning. Among instructors, it is believed that communicative instruction is incompatible with learning Chinese, because Chinese is assumed to require more mechanical training than many other languages due to its special tones and characters (Lantolf & Genung, 2002). Such perceptions may be rooted in instructors' past experiences learning Chinese as their mother tongue from L1 instructors. The common practices of learning to read and write in Chinese as a first language setting are reading, remembering, and copying (Rao, 1996). As reported in Lantolf and Genung (2000), this insistence on mechanical drilling robs learners of their agency and opportunity to shine, ultimately leading to students' decreased motivation of learning a language. However, Lantolf and Genung's interpretation is merely based on learners' perceptions in a classroom ecology. We suggest that further research and discussion is needed, the kind that takes into account (1) instructors' perspectives, (2) the relational dynamics of in-class and out-of-class engagement, (3) the cross-cultural differences on perception of homework, and (4) the teacher's role, as well as (5) the lack of informal languaging experiences. Here, we seek only to provide an explanation, not judgment, of the original analysis.

We assume that the strong tradition of mechanical training in classrooms works well in L1 settings in China due to the fact that memorization of classical texts is highly valued (Cooper, 2004; Li & Cutting, 2011; Littlewood, 2000; Marton et al., 1993, 1996) and in Chinese culture, text memorization often leads to a deeper understanding than rote memorization (Lee, 1996; Li & Cutting, 2011). At a macro level,

Chinese society is a high-context culture, meaning "information is communicated through indirect and non-verbal means with a reliance upon mutually shared knowledge" (Hall, 1983, 1989; Jackson, 2014, p. 94), and Confucian parental and societal values promote the benefit of informal learning opportunities. However, in a CFL setting, this informal space with a rich semiotic budget (van Lier, 2004) is missing, as are the Confucian values of interdependent relationships across generations and clanship.

3.2.2 Second Language Acquisition

In recent years, communicative approaches and task-based learning (Bao & Du, 2015; Du & Kirkebæk, 2012; Winke & Teng, 2010; Wright, 2019; Yuan, 2015) have been picked up and practiced in CFL. For instance, Yuan (2012) designs CFL writing tasks to investigate the impact of two different task types (narrative and argumentative) to assess the quality and quantity of students' written output. The assessment focuses on fluency, complexity, and accuracy by analyzing the correctness rate of the words, sentences the participants used, and the typing speed of the participants, which makes evident the researcher's assumption that language is normative and consists of different components referred to as "building blocks."

Also following the task-based tradition, Winke and Teng's (2010) research analyzed learners' pragmatic abilities, thus considering aspects beyond language forms. The researchers developed a task-based CFL tutorial program to examine the development of students' pragmatic abilities when given explicit instructions. Instructors taught language forms in class, whereas an after-class tutorial program offered practice opportunities along with explicit instruction about pragmatics. The tasks used involved structured output activities with tutors and reflections about similar situations in real life. The output activities prompted learners to use new language forms in appropriate social situations with the tutor and were included to "promote hypothesis testing and automaticity in terms of pragmatic forms" (p. 368). Although this study's focus surpasses mere linguistic forms, it still teaches forms and uses as separate features, not as an integrated system.

Bao and Du (2015) also studied the benefits and challenges of TBLT in CFL and tested three types of tasks: An information-gap task in which each learner held part of the information and exchanged it in order to create a complete whole; a dictogloss task in which learners first took notes about what they heard on tapes, then constructed a text together, followed by a retelling of it; and role-play tasks in which learners in pairs presented dialogues according to the written instructions. It was a class experiment, rather than a lab experiment, thus the task content here was related to the lessons from the textbook the students should learn that day. Tasks were operationalized in three stages: Pre-task (i.e., the teacher prepared learners with the L2 knowledge needed for the task), during task, and post-task (i.e., the teacher invited some pairs for presentation and provided subsequent feedback). Here, even though

vocabulary and grammar were acquired in localized tasks or settings, non-classroom immersion opportunities were limited.

In addition to instructional practices that focus on teaching about linguistic characteristics, pedagogical research often divides learners and teachers into separate units. Learning processes and achievement are looked at with either teacher-centered or student-centered conceptual divisions. For example, the same studies often arrange teacher-fronted expository instruction for practicing vocabulary and forms (Bao & Du, 2015; Winke & Teng, 2010). Such centeredness isolates learning from teaching and learners from teachers. It fixates roles and identities based on boundaries of named languages (Li, 2018) and classroom as the only space for learning (RIDLLE, in press). In our Distributed Language Learning Environment model, linguistic knowledge and experiences of other domain developments are equally distributed. The saliency of learners' action over teachers is dependent upon multiple factors, for example, time, space, content, and activity types.

3.2.3 Distributed Language and Its Applied Research

Examining the current instructional practices, we see that common instructional approaches—whether teacher-fronted, expository teaching, or student-centered, task-based teaching—share the assumption that language is considered a network of symbols. Drilling and memorizing, writing tasks, communicatively oriented tutoring, and role-play tasks all extract vocabulary and grammar from their environments to teach about language rules, assuming that meaning is placed entirely in words and grammatical structures. That way, extracting single words and abstract grammar rules seem to have universal meanings that can be taught in isolation and then transferred to specific situations. While many teaching approaches experiment with different ways to do this (e.g., audiolingual, communicative, and task-based methods), the limitation of such assumptions is addressed by multiple undertakings, such as the social turn (Larsen-Freeman, 2002; Wagner, 2015), the ecological and sociocultural turn (Lantolf, 2012; Lantolf & Thorne, 2006; van Lier, 2004), and the ethnomethodology of learning in the wild (Piirainen-Marsh & Tainio, 2009; Sundqvist, 2009). Among these, the Distributed Language movement (e.g., Cowley, 2011a) is the most recent and radical. Instead of polarizing an opposite alternative, DL grounds symbols in language while coordinating. Distributed Language rethinks language in two orders: First-order languaging and second-order language. The theoretical significance of DL is that languaging activities as a meshwork may embody second-order lexicogrammar, but the embodied, embedded, extended enacted, ecological nature of experiencing cannot be replaced by written language (Linell, 2005) and lexicogrammar (Thibault, 2011). The collateral practical implications can be that new lexicogrammatical symbols, in a reversed order from language classes taught in the old-fashioned ways (Zheng et al., 2015), can be extended immediately to related actions in realistic situations (Zheng et al., 2019). This is not new, and most language

classes do this. However, what differentiates DL-informed practices is the dynamicity between *experiencing* and *learning about*, which belong to different consensual domains (Kravchenko, 2007; Maturana, 1978). Articulation of these time–space arrangements, such as time spent on each domain in relation to each other, the interval between the two domains, and the sequence of activities taking place, can render significant results in interpreting DL and actual practices (Zheng et al., 2019). The review of studies below demonstrates applications of DL in the design, analysis, and implications for learning.

Multiple research strands, among them place-based learning research enabled by mobile technology (Godwin-Jones, 2017; Hellermann et al., 2017; Zheng et al., 2018), provide insights to re-consider the relationship between content and place. In classroom settings, learning and teaching often focus on declarative knowledge, following a "learning about" model and pedagogies, with content and teachers' roles focused more on "teaching to" than "teaching with," whereas in virtual environments, diverse types of learning and languaging styles occur (Zheng et al., 2019). In comparing three learning environments—(1) expository teaching based on textbooks in classrooms, (2) working on a scenario with rich descriptions of a story and comprehension and reflection questions using handouts in group learning format, and (3) the same scenario of the story embedded in a multiuser virtual environment—(Zheng et al., 2019) found that in the classical teaching mode, teachers mainly taught the lexicogrammar by *answering questions, correcting,* and *inquiring*, while students followed the teacher by *repeating* and *note-taking*. In scenario two, the handout group, students gained more agency in their languaging style, by *answering questions*, *self-expressing*, and *reflection.* However, in the virtual space, students' activities were more salient and included complex learning that involved *individuating multiscalar coordination* between *reading* and *writing*. *Individual meaning-making* involved *clicking links, reading, translating,* and *writing*. *Distributed meaning-making* was dominated by *collectivized interaction, confirming, and directing*. Zheng and her colleagues showed a visualization of the process of learning in three different settings, and they used a harmonizing language to demonstrate the ecological niches each setting provided.

Thus, the assumed effects of DL application in understanding learning and language development are holistic and also, based on Zheng's design-based research on virtual world technology such as Second Life (Zheng, 2012) and Atlantis Remixed (Zheng, Young, Brewer et al., 2009a; Zheng, Young, Wagner et al., 2009b; Zheng et al., 2018, 2019) present in the affective, cognitive, and social domains. These studies mainly investigate language learners' doing, being, and becoming together in problem-solving of pre-designed and emerging problems while taking both verbal and locomotive actions. It was in the coordination of the collaborative resolution of "way seeking" that language learning occurred. Other observed outcomes were socio-technological literacy development; the students' increased attention to the relationship between their agency and the environment, material artifacts, and people they encountered (Zheng et al., 2018), translanguaging to identify themselves with cultural artifacts (Zheng, 2012); and languaging to regulate action between reading, learning to read, and writing (Zheng et al., 2019).

Informed by these reported findings, the DLLE model optimizes the ecological niches of both the VR and traditional classroom learning spaces. In doing so, this project will address the observed problems of previous language learning practices to provide a learning environment, in which learners draw on semiotic resources, contribute to the world with their own perspectives, and learn from experts embodied in the roles they select. As previously stated, language learning occurs through meaningful work. In this project, learners will engage with predicaments surrounding the very real environmental dangers facing the world today. Not only is the model intended to integrate the cognitive and social domains but it also embraces aspects of communicative instruction, such as Lee and VanPatten's definition of communication: "the expression, interpretation, and sometimes negotiation of meaning within a given context for a specific purpose" (Lee & VanPatten, 2003, p. 72). Certainly, this understanding of communication can be embedded into our design in service of working toward a clear resolution of the predicaments; however, this is only one of the avenues learners may choose to achieve collaboration. Such pathways include negotiation for action (NfA) (Zheng, Young, Wagner et al., 2009b) and co-action (Newgarden et al., 2015; Zheng & Newgarden, 2012). Co-action indicates that two persons' verbal and non-verbal actions are well understood by each other. Movements by each party are coordinated without a high need of negotiation as they take what they say and act upon it (see Zheng et al., 2017). Co-action pre-assumes NfA, which often leads to new ways of languaging and co-action, which then leads to new cycles of solo knowledge, action, and co-action. Theoretically, DL itself provides a perspective allowing a language learning model that leverages features of both VR technology, classroom-like resources, and linguistic communication, which we will use to help learners of Chinese engage in languaging.

In an effort to overcome the problems identified in traditional CFL, the conceptual framework chosen for this game includes the environment around the learner. It does not abstract language from its environment. As humans, our environment is meaningfully structured with a high potential for action for each individual. Still, the DL defines language as ecological, dialogical, and non-local (Cowley, 2011a) stressing that meaning is not merely situated in the environment but also *ecological* "coupling" of the individual and its environment (Barab & Roth, 2006, p. 4). Similarly, knowing, from an ecological view, can be defined as being able to deal meaningfully with situations, to notice their characteristics and tools, and to meaningfully make use of them (Barab & Roth, 2006). Lastly, language learning is to be regarded as developing "skilled linguistic action", not as internalization (Cowley, 2012; Dufva, 2013; Newgarden et al., 2015), but rather *dialogical* when taking a language stance (Cowley, 2011b). Here we are able to project language as an object that may be skillfully altered for our individual purposes, i.e., projecting language as an object to be skillfully altered for individual purposes. In general, acknowledging cognition as emerging in the interaction between an individual and the other necessarily strengthens the importance of procedural knowledge and over declarative knowledge (Dufva, 2013). This DL view calls for the adaptation of selected concepts and the introduction of new notions in order to refer to the processes happening in the interactivity between individuals, materials, and the environment (Steffensen, 2013), as well

as with individuals and their collective history. Steffensen and Cowley (2010) call such phenomena non-locality, as "language is both measurable first-order activity and organization that sustains traditions" (p. 6; Cowley, 2011a).

3.2.3.1 Embodiment

An important element since the rise of cognitive sciences is embodiment as it also plays a significant role in a distributed ecological view of cognition. Embodiment language learning characterizes language as the outcome of human interaction with the physical world. Research focusing on language acquisition of young children, for example, found a high significance of human embodied experiences with the surrounding world in cognitive development (e.g., Mandler, 2007). Embodiment, in this sense, refers to the fact that our experience is linked to and cannot exist without our bodily functions and behavior. Johnson (2017) supports this idea by saying that our language and mind cannot exist independently of our bodily experiences. This can be seen in our everyday life, where conceptual metaphors are prevalent. For instance, when speakers of English say, "The gas price is up", they use "up" to refer to an increase in amount because of the previous bodily experience they had with the concept of "up" (Tyler, 2008). Another one of the most important implications of embodied cognitive science is the assumption that, in relation to their own body, every animate being unconsciously categorizes their environment. We can even go so far as to say that the world only exists in our categories of it: We cut our experiences of the world into meaningful categories, which is how we create meaning (Lakoff & Johnson, 1999).

3.2.3.2 Values Realizing

The ecological view of language learning argues that languaging is a *values realizing* activity (Zheng & Newgarden, 2017). Values realizing involves participants evaluating their surrounding materials and artifacts and correspondingly making decisions and acting based on what they want to achieve and for what they care (van Lier, 2004). In detail, values-realizing theory defines values in terms of heterarchical, dynamic, and reciprocal relationships rather than characteristics assigned (as they often are) to persons, cultures, objects, or biological entities (Hodges et al., 2012). When driving a vehicle, drivers must constantly modify their driving styles or risk injury to react to the ever-changing demands of the road (Hodges, 2007). Driving fast might be most important at one point such as passing on a highway, but safety might come in at another, such as slowing down and stopping for a school bus (Hodges & Rączaszek-Leonardi, 2019).

For language, this means that people's choices are always influenced by values at play, some of them even handed down from generation to generation (Cowley, 2012), as they are "real goods that actions must realize sufficiently for an ecosystem to exist" (Hodges, 2009, p. 631). While it might be unconscious, linguistic values

realizing means caring about those values as well as ourselves, each other, and our surroundings by constantly evaluating how to act and what to say next (Hodges et al., 2012; Zheng et al., 2012). It is contributing to and making use of coordinated actions and goals, and it is sharing and utilizing culturally established knowledge for the sake of ours', each other's, and the environment's well-being (Cowley, 2012; Zheng et al., 2017).

3.2.3.3 Affordances

Originally coined by James Gibson (1979), affordance is successively used by scholars like Varela et al. (2016, p. 272), Forrester (1999, p. 88), and van Lier (2004, p. 91). Affordances can be defined as opportunities for interactivity in the environment available and relative to the learner. When a person perceives the affordance that any artifact offers in the physical and social world, action and meaning-making occur. In this sense, affordance is "action potential" (van Lier, 2004, p. 92), and only when action emerges, can we call it affordance. If we expand the notion of affordance to language learning, we can say that language learners perceive and pick up semiotic resources relevant to them in the learning environment, which create a potential for action and participation. Depending on individual interests, previous experiences, and current intentions, each individual will perceive different phenomena as salient, i.e., will make something different in an action. These affordances take the initial state of resources. It is after the individuating of these resources that they change and become an affordance (Zheng, 2012).

3.2.3.4 Scaffolding

One of the most important considerations when referring to affordances in an individual's environment is that the salience of a phenomenon is closely linked to someone's previous experiences. Scaffolding has been a concept central to the theory of Zone of Proximal Development (ZPD) put forward by Vygotsky (1978). The ZPD, originally coined by Wood, Bruner and Ross (1976), is defined as the distance between a student's actual developmental level and the level of potential development. The actual developmental level can be determined by a student's independent problem-solving performance, whereas the level of potential development is determined by the problem-solving skills attainable under adult guidance or in co-laboring with more capable peers (Vygotsky, 1978, p. 86).

The definition suggests that the purpose of scaffolding is to assist learners in developing their skills until they can eventually take the action themselves. In the process, the initial support from agents (or supporters) will continually become less, and the knowledge and skills of recipients (or learners) will increase. In the end, when the support from the agents is fully withdrawn, the learners will be able to independently solve problems.

3.2.4 Technology, Virtual Reality, and Language Learning in the CFL Context

3.2.4.1 Technology Use in the CFL Context

In many cases, technology helps to extend learning from the classroom to informal environments such as museums, zoos, libraries, wildlife centers, community institutions, playgrounds, think tanks, cafes, and homes in order to offer a wider range of natural interactions (Sunal et al., 2008; US Department of Education, 2017). However, the classroom has been the primary resource for learners in CFL contexts. Outside of classroom contexts, technology has opened up additional opportunities for self-study (Chai et al., 2016; Lin & Lan, 2015) and participation in simulated environments (Wong et al., 2010; Xie, Chen et al., 2019). In addition, technology adds to the potential of breaking up the seriousness of some educational spaces (Bhagat & Huang, 2018; US Department of Education, 2017; Ying et al., 2016).

Although technology has brought numerous possibilities to access the massive learning resources inside and outside of the classroom, and thereby serves as a bridge between traditional classroom teaching and learning in the wild, there are still many researchers and educators who perceive technology as an independent feature rather than a necessary component of a distributed learning environment. Quantitative research methods commonly used to measure and compare the effectiveness of classroom vs. technology-mediated learning (Zheng & Tian, 2020) have reinforced the idea of technology somehow being in conflict and competition with traditional classroom learning. Rather than focusing on how technology can be integrated into the learning ecosystem, researchers have frequently tried to prove that technology can act as a more effective alternative to traditional classroom teaching (Lin & Lan, 2015; Wang, 2016; Xie, Ryder et al., 2019), the key to cognition. It is this attitude we seek to counter by means of transforming the traditional classroom into a distributed learning environment through the introduction of virtual reality, one of the least-published—and possibly one of the most fruitful research topics--in the technology-based learning field (Lin & Lan, 2015).

3.2.4.2 Virtual Reality (VR)

What is VR? Despite having been used regularly throughout the last decade, the notion of VR has yet to be clearly defined (Sherman & Craig, 2003). Most studies describe VR as technologies that possess similar functions to mixed reality (MR) and augmented reality (AR) that are used for virtual environments or virtual worlds. Key attributes include creation, immersion, and interaction (Lan, 2020) and are acknowledged in much of the literature (Brooks, 1999; Costello, 1997; Fuchs, 2017; Jerald, 2015; Legault et al., 2019; Milgram & Kishino, 1994). A major goal of virtual reality is to allow users to interact with or manipulate the environment as seamlessly as possible (Costello, 1997; Jerald, 2015; Legault et al., 2019; Milgram & Kishino,

1994), but the device-driven definitions for virtual reality also frequently ignore the processes or effects of using these systems (Steuer, 1992). While definitions for VR have not yet been agreed upon, we will operate with the working definition based on the traits that are agreed upon (creation, immersion, and interaction) as we discuss VR and language learning in the next section. Distributed Language and cognition are porous in that the relationship between entity and events is interdependent. Our Distributed Language Learning Environment is broadly encompassing to the degree in which technology such as VR is co-constitutive with pedagogy, content, and person employment of material artifacts (Zheng & Tian, 2020).

3.2.4.3 CFL and VR

Given the fact that VR and language learning still maintain a separation between language and non-cognitive competencies (Lai, 2017; Tang et al., 2012; Wang et al., 2019; Xie, Chen et al., 2019), it's understandable that CFL in the VR context would also waver between these two aspects, with a majority of the work addressing the linguistic domain. However, we can see clearly that recent research seeks to compensate for the lack of non-cognitive findings in this area. For example, Wang et al. (2019) discussed the notion of *partnership* to interpret the relationship between 3D virtual worlds and language learners. Xie, Chen et al. (2019) demonstrated how participants' prior experiences promoted critical scrutiny of the VR locale, which allowed them to make connections beyond what was presented. For example, Tang et al. (2012) examined emergent assistance and leadership behavior patterns among others in a virtual situated environment. And Lai (2017) presented student feedback on a virtual home design project that uncovered a range of non-cognitive skills, including agency, appreciation for the development of self and others, friendship and bonding between students and teachers, collaboration, and cultural awareness. What these studies lack is a learning environment that unifies both sides and allows them to develop simultaneously. In the next section, we will address the methodology for designing a cognitive ecosystem learning environment that resolves this issue.

3.3 Methods

3.3.1 Design-Based Research (DBR)

The project is framed in the paradigm of design-based research (DBR), which is an emerging methodology for researching innovative educational designs (Palalas & Hoven, 2013). In this part, we will first introduce the definition of DBR and explain how its goals correspond to our aims in the project. Then, we will analyze some of its distinctive features which further guide us to design the learning environment and answer the research questions we encounter in designing.

3.3.2 Definition and Goals of DBR

DBR researchers mostly share similar definitions of DBR. For example, Cobb et al. (2003) argued that DBR is a means of developing theories targeting domain-specific learning processes and designing elements and exploring "how these elements function together to support learning" (p. 9). Similarly, Wang and Hannafin (2005) defined it as "a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation […] leading to contextually-sensitive design principles and theories" (p. 7). In this sense, DBR is expected to achieve the following two major goals.

The first goal is to design learning environments that support learning in specific contexts (Barab & Squire, 2004; Rodríguez, 2017). In other words, outcomes from DBR should produce work that serves real-life problems. The real problems we hope to address in our project are not only those previously identified in CFL learning and teaching but also the awareness of environmental issues in the learning ecology. To this end, participants are expected to perceive and act on real-life affordances available to them in the VR environment, engage in both self and group learning, and, because of the combination of VR and classroom environment, ultimately "actualize particular affordance networks in the real world" (Barab & Roth, 2006, p. 5).

The second objective of DBR is to refine existing theories or to create new theoretical understanding (Rodríguez, 2017). As Barab and Squire (2004) emphasize, DBR "strives to generate and advance a particular set of theoretical constructs that transcends the environmental particulars of the context in which they were generated, selected, or refined" (p. 5). The recontextualized theories will be applicable to similar and contextualized learning environments. Thus, by adopting DBR in the design of the ecological VR learning environment, we hope to expand our understanding of the Distributed Language perspective and work toward developing a distributed learning model that will inform future similar research in educational contexts.

3.3.3 Features of DBR

One salient feature identified and emphasized by DBR researchers is its highly interventionist nature (Cobb et al., 2003). Different from the traditional empirical predictive research in which a hypothesis is put forward and independent variables are tested in a controlled environment, DBR emphasizes exploring the critical variables that interact with each other in naturalistic settings. Undoubtedly, the interplay of variables adds complexities and dynamics to the real-world settings as well as the VR environment. What happens is "social organizing" in a cognitive ecosystem that, among other things, uses technology (and people). Therefore, they suggested that researchers in the field of educational technology should adopt more systematic and collaborative methods of investigation to address these complexities. Thus, DBR was selected as an approach that allows researchers to enact designs in authentic learning

and instructional settings, identify critical variables or elements in complex educational contexts, and make timely adjustments or bring up new hypothetical designs to better inform learning practices (Rodríguez, 2017).

Yet, one problem that comes along with DBR's interventionist nature and naturalistic quality is that DBR research is "dynamic, messy, and extremely challenging to capture and replicate" (Rodríguez, 2017, p. 368). Therefore, in addition to sharing designed artifacts, DBR researchers also need to provide rich descriptions of the context that the local dynamics represent. One typical method of unfolding the design process is a narrative, which is the method we will use in elaborating our design, as can be seen in the following sections.

Additionally, DBR is characterized by its iterative cycles of design. The iterative design is strongly associated with researchers' reflective analysis and inquiries as well as cycles of enactment and refinement. Through numerous stages of revision and invention, knowledge is generated, and theories are refined. Furthermore, the outcomes in one cycle both provide "an explanatory framework that specifies expectations that become the focus of the investigation during the next cycle of inquiry" (Cobb et al., 2003, p. 10) and guide and inform continuing research of relevance.

The iterative process in DBR is also a response to the complex reality/system in the educational context we discussed before. With multiple variables at play, it is hard to report significant results with a one-off study, let alone apply findings from those results to future studies. Therefore, the use of an iterative cycle of design and redesign allows for the investigation of critical factors and limitations as well as the generation of transferrable and useful results (Amiel & Reeves, 2008, p. 35).

It is noteworthy that when designing the profile of role players, we went through constant reflection and developed new conjectures in order to better help players immerse in their roles and scaffold them in the problem-solving situations provided in the VR. Starting from long readings with playing characters' detailed information in a single form to the multi-layered readings in different forms, the portfolio design process is a representation of the iterative cycles of DBR.

In summary, as an iterative, interventionist, theory-oriented, and theory-building methodology, DBR allows educational researchers to tackle the complexities in naturalistic contexts and provides practical solutions following cycles of "design-enactment-reflection-refinement" (Wong et al., 2011, p. 1785).

3.3.4 Research Questions

The main goal of this chapter is to delineate the process of our design of creating an integrated dynamic teaching and learning model. We seek to answer the following questions in order to sculpt our model:

How do we design multi-layered profile portfolios that scaffold learners and help them embody themselves in the expert roles in and out of VR?

How does a DLLE allow us to distribute the divide between student- and teacher-centeredness in favor of event-driven activities?

How do we design a DLLE that holds learners' experiences and learning opportunities in VR and out-of-VR accountable for language learning?

3.3.5 Materials: VR Technology

With the continuing evolution of immersive virtual reality headsets and controllers, there are a variety of choices and options that can be made for gameplay. One that seems to have minimal usage in SLA research due to its relatively recent development is the Oculus Quest (Xie, Chen et al., 2019). This headset and its two hand-held controllers act as a standalone device, which creates the most significant incentive for usage in research. It does not require base stations for setup, meaning that it can be utilized in any indoor setting and can be used while seated or in a designated area for the headset to track real-world movement. With the controllers, players are able to interact with predetermined objects in the environment and, although the user does not have a complete haptic response, can feel through vibrations in the controller whether they successfully picked up an object or not. Due to its standalone capability, there is no need to invest in powerful desktop computers to operate virtual reality programs. One possible misconception that may arise is that only the person using the Oculus Quest headset would be able to see *bizhu wanshang*, but due to innate capabilities in the headset, the user can also project what they see onto a different screen, such as a desktop monitor or TV, allowing nearby participants to see the environment as well.

The ability for other nearby peers to see the environment without putting on the headset is an essential aspect of this design. Because only one member of the group needs to be within the actual virtual reality at a time. This helps mitigate VR fatigue and motion sickness, so that as soon as one player feels uncomfortable, they can take off the headset and pass it to a different member. The act of students choosing who will be the controller for the group and the negotiation of actions and reactions between the players is another critical component of this design. It allows for all to participate and to work together and maintain a constant stream of communication.

3.4 Findings/Results

3.4.1 Design of a Distributed Language Learning Environment Model

What does a Distributed Language Learning Environment look like and what is it not? How does Distributed Language prioritize experiencing and languaging deal with learning language skills and skills beyond? For an immersive environment

to become a learning environment, it needs to be theoretically underpinned, pedagogically constitutive of technological features, and relationally challenging to the learners (Zheng & Tian, 2020). A learning environment with an immersive space, a physical place with reading resources available, and other artifacts embedded is a good start. A narrative inviting participation, co-laboring, and coordination need to be designed to engage learners in languaging, scaffolded learning and use in the dynamics of role-playing, reading, talking, and "living" (Cowley, 2019). This can occur in peer interactions, familial activities, and participation in public events.

Contextualizing the concept of Distributed Language in the Panda Reserve predicaments, we propose an ideal DLLE model, which (1) reflects real-world ecological problems (climate change, resource depletion, scarcity of water and food, threats to wildlife), (2) engages language learners in critical/harmonious discourse about the environment and ecological issues, (3) connects learners with experts (e.g., from forestry, wetlands, and conservation) and current research, (4) enables language learners to transform the virtual ecology through coordinated actions, and (5) attunes learners in activities that develop mindfulness in speaking to someone from another culture, (6) cultivates mindfulness in thinking about and using environmental resources, and (7) helps develop skilled linguistic actions that support sustainability and harmonious relationships.

All four skills—reading, writing, speaking, and listening as shown in Table 3.1—as well as cognitive and metacognitive skills, such as problem-solving and collaboration, are supported by the carefully designed VR environment. That is, learning in the VR environment draws on them while not necessarily separating them but integrating what they can in playing the game. There is a coherent, contextualized storyline, including NPCs doing various jobs. In the out-of-VR space, there are multi-scalar levels of reading materials in a printed and digital format.

3.4.2 An Example: Design of Multi-Layered Player-Character Profiles

3.4.2.1 Why Are Player-Characters Needed?

The decision to create profiles for players to choose and embody is two-fold: The first part is practical. Our narrative around the village *bizhu wanshang* has many NPCs in order to have a living, breathing village. There need to be villagers, such as a village foreman, a shop owner, and a veterinarian. To reduce the programming and rendering burden, as well as VR time to avoid potential dizziness and motion sickness, we thought of World of Warcraft (WoW) games and their effectiveness on the embodiment of players in multitudes as well as the depth of game roles (Zheng & Newgarden, 2012) and their affordances for skilled linguistic action (Newgarden & Zheng, 2016; Newgarden et al., 2015). Thus, we decided to provide a similar experience to the players in *bizhu wanshang* by providing roles for learners to fill.

Table 3.1 Overview of the cognitive learning ecosystem and skills areas addressed with examples

Environments and microenvironments	Examples	
VR space		
Player-VR environment	(R/W) Posters/Signs (R/W) Journals/Notebooks (R/W) Documents (R/W/S/L) Messages (R/W/S/L) Artifact Exchanges (R/W) Books	(R/W) Letters (R/S/L) Recordings (L) Environmental Sounds (R/W/S/L) Environmental Conditions (R/W/S/L) Learning Products
Player-NPC	(R/W/S/L) Conversations (R/W/S/L) Artifact Exchanges (R/W/S/L) Learning Products	
Player-Self	(R/W/S/L) Notes/Multimedia (R/W/S/L) Articles (R/W/S/L) Artifact Exchanges	(R/W/S/L) Personal Reflections (R/W/S/L) Learning Products
Player-Team member(s)	(R/W/S/L) Conversations (R/W/S/L) Notes/Multimedia (R/W/S/L) Articles	(R/W/S/L) Artifact Exchanges (R/W/S/L) Learning Products (R/W/S/L) Reflections
Physical Space		
Player-Environment	(R/W) Posters/Signs (R/W) Journals/Notebooks (R/W) Textbooks (R/W) Documents (R/W/S/L) Messages (R/W/S/L) Artifact Exchanges	(L) Environmental Sounds (R/W/S/L) Environmental Conditions (R/W) Books (R/W) Letters (R/S/L) Recordings (R/W/S/L) Learning Products
Player-Self	(R/W/S/L) Notes/Multimedia (R/W/S/L) Articles (R/W/S/L) Artifact Exchanges	(R/W/S/L) Personal Reflections (R/W/S/L) Learning Products
Player-Team member(s)	(R/W/S/L) Conversations (R/W/S/L) Notes/Multimedia (R/W/S/L) Articles (R/W/S/L) Artifact Exchanges	(R/W/S/L) Learning Products (R/W/S/L) Reflections
Player-Coordinator/teacher	(R/W/S/L) Conversations (R/W/S/L) Notes/Multimedia (R/W/S/L) Articles (R/W/S/L) Artifact Exchanges	(R/W/S/L) Learning Products (R/W/S/L) Reflections

(continued)

Table 3.1 (continued)

Environments and microenvironments	Examples	
Artifacts		
Physical artifacts	(R/W/S/L) Inventory Items (R/W/S/L) Physical Technology (phones, computers, tablets, A/V equipment) (R/W) Posters/Signs (R/W) Journals/Notebooks (R/W) Documents	(R/W/S/L) Messages (R/W) Books (R/W) Letters (R/W/S/L) Learning Products (R/W/S/L) Reflections
Remote artifacts	(R/W/S/L) Inventory Items (R/W/S/L) Multimedia (R/W) Posters/Signs (R/W) Journals/Notebooks (R/W) Documents (R/W/S/L) Messages	(R/W) Books (R/W) Letters (R/W/S/L) Learning Products (R/W/S/L) Reflections
Holographic artifacts	(R/W/S/L) Inventory Items (R/W/S/L) Multimedia (R/W) Posters/Signs (R/W) Journals/Notebooks (R/W) Documents (R/W/S/L) Messages	(R/W) Books (R/W) Letters (R/W/S/L) Learning Products (R/W/S/L) Reflections

R = Reading; W = Writing; S = Speaking; L = Listening

Secondly, learning to become chosen experts is presumed to boost players' agency, responsibility, and confidence. As they play, they will have a choice to alternate between two roles, themselves and the PCs.

It is not the focus of this paper, but with careful readings of philosophical perspectives and their consequential influences of environmental ethical positions, we learned three worldviews distributed across East and West philosophies: anthropocentric, ecocentric, and anthropocosmic perspectives (Weiming, 2001). In aligning with three concurrent philosophical debates, we designed storyline narrative, NPCs, and PC profiles according to cultural multi-perspectivity and pluralism.

3.4.2.2 Expert Profile Creation

To design the PC profiles, we first interviewed four experts whose professions corresponded with the four roles provided in the VR world; these interviews were audio recorded. The interview questions (see Appendix) were designed before the interview to better understand the interviewees' backgrounds and perspectives. Three interviewees are speakers of Mandarin Chinese, and one is an English speaker. We transcribed the interview audio and translated it into Chinese and English, respectively, which would better serve the researchers in creating the storyline and the

profiles. Then, we summarized the interviewees' backgrounds and philosophies as reflected in the interviews.

It is worth mentioning that the different philosophical perspectives of the four interviewees are related to their professional fields; thus, we set the tone of the PC perspectives based on the results of the interview. For instance, the business administrator is characterized as a Confucian, the forest manager a Neo-Confucian practitioner, the herbalist is human-oriented, and the mental health professional (spiritual healer) is an ecological applicator.

Based on the interview results and the perspectives we included, we borrowed and adapted the interviewee's stories and perspectives in creating the long profiles. Yet, there are several problems associated with the long profiles. For one thing, players will be overwhelmed by the long descriptions at the beginning. For another, the mere description without any vivid examples in real life is difficult for players' embodiment in the roles. Thus, we decided to scaffold players in experiencing the roles and forming the roles' perspectives by providing multi-layered readings.

3.4.2.3 Game Play Setup

In playing the game, players will be grouped into three-member teams and immerse themselves in the virtual reality village *bizhu wanshang* to explore the effects that humans have on the ecosystem. To set out for such an immersion, the narrative alerts the player that the village is currently in urgent need of help in the areas of forestry management, business administration, herbalism, and mental health. The players will be compelled to choose one of these areas to claim their expertise. They will then embody those roles they selected and activate their roles by learning to be an expert, for example, a spiritual healer. In the process of finding solutions to the environmental challenges distributed in various NPCs, players in groups of three will collaborate and coordinate in their respective roles, and in the meantime, learn and use language in solving the problems embedded in the VR narrative and NPCs.

To better help the PCs immerse themselves in the VR, we supply PC profiles attached to their roles, which the PC will choose at the beginning of the game. In the game that we are developing, participants will encounter problems that are not merely "tasks" for them to do. In fact, instead of having a predictable path, the learners may take different paths toward solving any given problem. In doing so, the latter can encourage identity development and individualized learning, even while players work together. In order to solve these problems, learners will be scaffolded with multi-layered profiles (see Table 3.2) that help them explore the PC roles they choose and gradually embody into those roles.

The first layer of reading includes the roles' name, gender, nationality, age, educational and work background, as well as one or two brief, introductory sentences reflecting their belief systems. These will be handed out to the students in the form of hard copy readings that will be assigned to the participants after they have chosen their roles; because participants will not have access to the readings before selecting

Table 3.2 Multi-layered portfolios design

Layer	When	Format	Content	Example profile of Forest Manger
First	After players choose their roles	Profile cards (hardcopy)	Brief introduction of the roles' name, gender, nationality, age, educational and work background, and belief	森林经理 名字: 王林 年龄: 36 教育背景: 本科东北林业大学林学, 大学就对林业感兴趣。大学主要的课有林学概论, 森林经营管理学。 硕士和博士: 中国林业大学林业信息技术。用科技实现林业管理 工作背景: 中国林业大学教授
Second	When the characters encounter some situations relevant to their interests or their thoughts	Pictures and pop-up information	Some information related to the roles' interests and thoughts	"这个地方真美, 让我想起我以前拍的一些照片。我爱给树拍照, 光、影和树的结合是最美的。我喜欢田野调查, 在树林里, 感受四季, 看树叶的颜色的变化, 触摸树木, 测量他们, 给它们拍照, 是我觉得最幸福的时刻。"
Third	Incidents embedded in the storyline when participants conversed with the NPCs	Readings (hardcopy and digital)	PC's perspective toward a specific incident	"你应该顺应自然啊。你知道道家吗? 他们提倡道法自然。在过去, 我们没有抗生素, 所以人们只能用一些土方子, 比如将咬人后被杀掉的那条狗的脑浆取出, 等狗脑风干后敷在病人的伤口处, 从而以减轻病人发病的症状以及传染的风险。在现代社会, 技术和医学的进步了, 我们已经可以有效治疗感染, 预防狂犬病, 那么为什么不用呢?"

their roles, we will get a much more accurate measurement of their first impressions of these roles.

The second layer of reading will be embedded in the VR space in the form of image artifacts and callouts that direct players to relevant details of interest, which they can choose to explore or ignore. For example, based on the interview, we learned that the forest manager loves photography, so a short text with his previous photography works will pop up when the players encounter photogenic scenery in the game, or they may choose to manually capture moments of personal interest as they travel around. The reading will say something like:

> I have loved fieldwork and photography since I was an undergraduate. Walking in the forest, touching the trees, looking at the color of different trees, viewing the light and shadow, and taking pictures of the trees is the most enjoyable experience of my life. [translation from interviews conducted in Chinese]

The third layer is provided when the participants talk to NPCs, which will reveal the PCs' perspectives toward specific problems to provide just-in-time feedback and suggestions for future actions. For example, in the first scenario, the three players will meet a farmer in VR who is worried about fall armyworms in his field. The farmer will need the players' help in their roles as a forest manager, for example, since for more than six months, the government has ignored his requests for additional pesticides. The fall armyworms dilemma is one of the problems the players need to negotiate and solve. Before the players start to discuss how to address the armyworms issue, they will encounter another incident: The farmer's daughter was bitten by a dog. The doctor suggests that his daughter needs to get the rabies vaccine and take antibiotics, and then players' philosophical stances will be displayed in the form of readings in hard copies. For example, the forest manager delivers his rational opinion toward this incident as follows,

> You should follow nature; Dao operates in accordance with natural and ethical conditions of all things. In the past, we didn't have this antibiotic, so people used to do a local treatment, such as using the dried brain plasma of the aggressive dog to put on the wound (Gegedeama, 2020). In the modern world, technology and medicine advancement have reached a point where we can effectively treat infections and prevent rabies, so why don't we take advantage of that?

This third-layer reading will help deepen players' understanding of the PCs' philosophical perspectives embodied in the reading. Also, this reading will serve as an advanced organizer and reference that players can return to in order to inform their choices as experts in a selected domain as they start to help solve environmental problems.

3.5 Discussion

3.5.1 Balancing of Scaffolding, Emergence, and Improvisation

How do we design to scaffold learners with multi-layered profile portfolios that help them embody themselves in the expert roles in and out of VR?

Throughout the multilayer reading, players will encounter the PCs' perspectives three times. After encountering the three different philosophical perspectives embedded in the narrative and NPCs, embodying and combining processes will occur: The players either combine the different perspectives of the PCs or combine the perspectives of the role they choose with their real-self perspectives, or both. This process is individual and leaves space for the players' improvisation. No matter what the result of combining is, the rendering process must happen organically in order for players to transform their perspectives. When facing the problem-solving scenario, the participants should find a solution to the problem through stating their transformed perspectives and negotiating and compromising with each other. By doing so, they can finally make use of values realizing through languaging processes. Hard copy readings and real-time negotiation will balance time spent in VR and out. The scaffolded layers provoke perceiving, embodying, and combining perspectives multiple times, and then expressing and negotiating between different perspectives contribute to a Distributed Language Learning Environment.

Learning and enacting all these skills are in a co-constitutive relationship (Ames, 2008; Cowley, 2019). However, the result is not only a combination of them but something more complex than the mere sum of the constituent processes. This is referred to as *emergence* (van Lier, 2004). As shown in Table 3.1, language skills will be enacted and embodied in an incessant flow of different types of overlapping interactivity when experiencing in and out-of-VR worlds. Doing group activities, such as problem co-identification, problem co-solving, and coordination is interspersed with individual activities such as reading and making plans, which are common actions. Whilst working along these planned activities, creative use of language will take place via emergence and improvisation, the hallmarks of action that a Distributed Language Learning Environment can enable. Moreover, the more predictable activities, such as the teaching of reading and writing should not be the ends, but rather a means to the end. An immersive environment that shapes learners' languaging in Chinese should be critically sought after. In other words, what can a learner do with what they read and discuss? Prospective coordination (Newgarden et al., 2015) and intermittent languaging activities between reading, looking up resources, and writing (Zheng et al., 2019) have proven effective in massively multiplayer role-playing games and virtual environments. In light of these dynamic patterns found in previous research in similar types of environments, our design of DLLE with the new VR component of Oculus Quest will shed new light on demonstrating how immersive environments in VR and acknowledging Distributed Language views can be effective and functional for languaging experiences and language skills development.

3.5.2 DLLE: Distributing the Divide Between Student/Teacher Centeredness to Event-Driven Activities

How does a DLLE allow us to distribute the divide between student and teacher centeredness in favor of event-driven activities?

When immersed in an environment that allows students to play, be creative, and experience language, the commonly well-accepted boundaries of language capital between learner and teacher fade. As a result, knowledge and experiences of other domain developments in the learners contribute to problem-solving just as much as information that is encountered through the game. To encourage this process, we proposed three microenvironments: the VR, the physical world, and the physical/remote/holographic artifacts. Since, the VR scale reflects the same environmental predicaments that exist in reality, it mirrors the real world where multiple events are happening, and multilayered resources are available. Players will not only immerse themselves in VR but also jump out of VR to go back to the physical space: The vivid VR environment, the conversing about environmental concerns between PCs and NPCs, and the engagement with a VR-rendered narrative all ideally would embody the players in a world that needs their help. After players encounter the environmental problems afflicting the NPCs of *bizhu wanshang*, it is our hope that they would feel morally and compassionately compelled to figure out solutions as an expert.

It is at this point, when just-in-time support will be provided. Support can be from what they learned from the NPCs, from modified graded hard-copy readings, and from perspectives gained through coordination and co-laboring. This lifts up the places to events, thus relational dynamics can take place depending upon what is at fore at the time. In this process, players will embody themselves through the PC perspectives in and out of VR combined with their real-self perspectives.

Organically, this implies a kind of non-localness to the roles of teacher and student. Under the distributed umbrella, these roles hover above the material artifacts and physical and virtual spaces—constantly in flux and waiting to be activated. The respective role is event-driven rather than a static concept. This is important because the learners will practice perspective taking by drawing on different ways of doing the same things and using the same resources to do different things. One moment the narrative might assume the role of the teacher and the next, the teammates or the NPCs. Conversely, each of these also harbors the potential to become the student. To complete the picture of a distributed view, we add the non-local, ecological, and dialogical nature of language. As a symbiotic force, language resists and undermines "any simple division between subject (the observer) and object (the observed)" (Cowley, 2011a, p. 6), and it is language that mediates the fluctuations in these student–teacher roles.

3.5.3 *DLLE: Distributing the Wall Between Classroom-Based Formal Space and Technology-Based Informal Space to a Harmonious Dialogical Place*

How do we design a DLLE that holds learners' experiences and learning opportunities in VR and out-of-VR accountable for language learning?

Rather than deconstructing the wall between inside and outside of the classroom, we create place-based activities to leverage and optimize ecological niches of both spaces. Even though traditional classroom environments are authentic in their own right, without the space of an immersive environment to play, tinker, and be with the target languages inter-bodily and intra-bodily over a prolonged time, learners are deprived of opportunities to experiment with what they learned in formal settings and engender novel knowledge, practice creativity, and contribute to society. In both spaces, besides applying and creating, more importantly, they would learn how things are interrelated, how multiple perspectives can be valid for one thing, and how people indeed are interdependent and need each other to thrive and to become. What is the glue that holds these two spaces together? The obvious answer is the players. In this cognitive ecosystem, players are not input receivers, but rather observer-actors (Cowley, 2019; Zheng et al., 2019). Under this cognitive ecosystem, the players and objects/material artifacts cannot be separated into subjective or objective entities; rather, together they co-constitute language. By the same token, the conceptualized VR space and out-of-VR space to the DLLE are merely different places that provide unique ecological niches for players to deploy their affordances for certain actions. Therefore, as seen in Table 3.1, there is multilayered interactivity, most of which is known from game studies conducted from a Distributed Language perspective since a cognitive SLA study would not take an interest in the process of interactivity, except between the players.

Player character and self-interactivity are rarely studied in massively multiplayer online role-playing games studies where a player picking a role to play is the most common way to embody game play. Our design of PCs is inspired by such a game feature, and is supported by the DL principle of dialogicality. The portfolios serve as biosemiotic resources for participants to dialogue with themselves. Naturally, this can lead to the collision of participants' own values and the roles they will play in VR. Either way, in encountering issues in the game, such as portrayed inter-NPC conflicts, criminal activities, and a range of conflicting worldviews, participants will have to enact their problem-solving skills and make critical decisions by acting in and out-of-the VR. These decisions will eventually depend on using culturally gathered perspectives, cooperation, and coordinated action, i.e., values realizing, and is likely to promote harmonious discourse. That way, the game does not only offer real languaging contexts in two spaces, but it might also help users to learn about new perspectives and new ways to care, and to make use of these in light of the characters' and the environment's well-being.

3.6 Conclusion

It is our hope that through our proposed Distributed Language Learning Environment model, we will be able to move closer to bridging the gaps of literature concerning CFL and language learning in the VR context and illustrate how using virtual reality can be a symbiotic process that gives rise to languaging experiences along with other spaces and material artifacts. Technology should not be used as a replacement for its low-tech predecessor (Coleman & Yamazaki, 2017). As we have demonstrated in our design, language learning can be reconceptualized as coordination of events with both aesthetic and ethical values and intention. If such coordination is distributed across the physical, virtual, and artifactual environments in the traditional CFL context, we can help CFL or any foreign language learning context work past their theoretical and practical bottlenecks as well. By utilizing a Distributed Language perspective as the main theoretical standpoint, we are freed from the Princeton method or other code-views of language in their pedagogical applications that universally teach lexicogrammar before experiencing them in context. Furthermore, we harnessed four main concepts under the umbrella of Distributed Language—embodiment, values-realizing, affordances, and scaffolding. These have all proven to be useful in designing our DLLE. Lastly, we have begun to address the ethical concerns of language education by using an aspect of radical ecolinguistics to explore how by design we can help language learners to care about our common responsibility of caring for our earth. Thus, we think our findings and discussions have shown the process, through thick description, of creating a sense of urgency for players to compassionately and mindfully tackle the problems in *bizhu wanshang*, all while engaging in languaging, coordination, experiencing, negotiation, and the caring processes both in and out of VR.

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Appendix

Interview Questions

1. 可以简单介绍一下自己吗?
2. 能简单介绍一下您自己成长的经历吗? (学习经历, 工作经历)
3. 您能简单描述一下您的工作吗? (job description)
4. 您觉得自己是怎么变成这方面的专家的?
5. 您在学习的过程中, 都学什么? (大学, 研究生, 博士)
6. 你是怎么一步一步有自己往高级管理方向发展的想法的?
7. 除了学习以外, 还要做什么才能实现自己的梦想, 目标?
8. 遇到困境时, 怎样解决?
9. 您觉得什么对您成为专家是特别重要的?
10. 作为一个专家, 您觉得在未来10年, 怎样改变环境问题?

Interview Questions (Translation)

1. Could you please introduce yourself?
2. Could you please share your stories of your educational experiences and working experiences?
3. Could you please briefly describe your job?
4. How do you think you become an expert in your field?
5. During your BA, MA, Ph. D. program, what did you study?
6. Could you please describe how you have the idea of moving toward senior business and managerial administrator (or mental health specialist, forestry manager, herbalist), in detail?
7. What else would you like to achieve for your life in addition to studying or what you are good at currently?
8. How do you face problems or predicaments when they appear to your life?
9. What do you think is particularly important for you to become an expert?
10. As an expert, could you please give us some suggestions on how people can change environmental issues in the next 10 years?

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Chapter 4
Levels of Immersion for Language Learning from 2D to Highly Immersive Interactive VR

Aleshia Taylor Hayes, Tetyana Kucher Dhimolea, Nanxi Meng, and Geneva Tesh

Abstract This discourse provides an overview of the levels of immersion that immersive media educational tools provide in terms of interactivity and immersion, ranging from 2D displays on a flat screen to Highly Immersive Interactive (HII) experiences rendered in a Virtual Reality Head Mounted Display (HMD). These immersive media provide a range of affordances for learning, such as the feeling of physical presence in remote locations, social learning, experiential learning through replicable simulations, and social interactions. The article maps the levels of immersion to learning objectives associated with language learning.

Keywords Virtual reality · Learning technology · Immersive media · 360° video · Language learning · Second language acquisition · Affordances

4.1 Introduction: Immersing Students to Increase Learning

Many in the global academic community anticipate that immersive media such as virtual reality (VR), augmented reality (AR), mixed reality (MR), 360° videos, and other media tools will transform education by improving student learning outcomes, engagement, and general satisfaction with the learning process (Fidopiastis et al., 2009; Fonseca & Krauss, 2016; Dede et al., 1996; Hayes et al., 2013). One of the biggest challenges of language learning is finding opportunities to practice a language in real-world scenarios (Soto et al., 2020). Several theorists have proposed that

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immersive media have the potential to provide this experience for learners (Carrier et al., 2017; Lloyd et al., 2017). The effective development of such tools would require a great deal of expertise from many disciplines. While there is a great deal of optimism surrounding the potential of VR to expand education as we know it, it is important for practitioners to remember that any technology is a tool, and tools should only be used if they enhance the learning experience in some way.

This chapter begins with an overview of immersive media, explores the interactions and experiences afforded by different levels of immersion, reviews some educational outcomes of immersive media implementations, and explores examples of immersive media tools that have been used for language learning. Finally, this discourse closes with a discussion of the affordances of the levels of immersion and trade-offs to consider when deciding which immersive media to apply for certain learning objectives.

4.2 Levels of Immersion

The levels of immersion afforded by different implementations of immersive media impact not only learners' user experience, but also their learning outcomes (Hayes et al., 2013). The costs of immersive media tools are not limited to hardware; there are also costs associated with software, such as design, development, testing, and delivery. These costs are still prohibitively high for many theoretical immersive learning experiences. Figure 4.1 outlines a continuum of levels of immersion currently available for language learning in immersive experiences based on the level of interactivity and immersion across varying implementations of hardware and software.

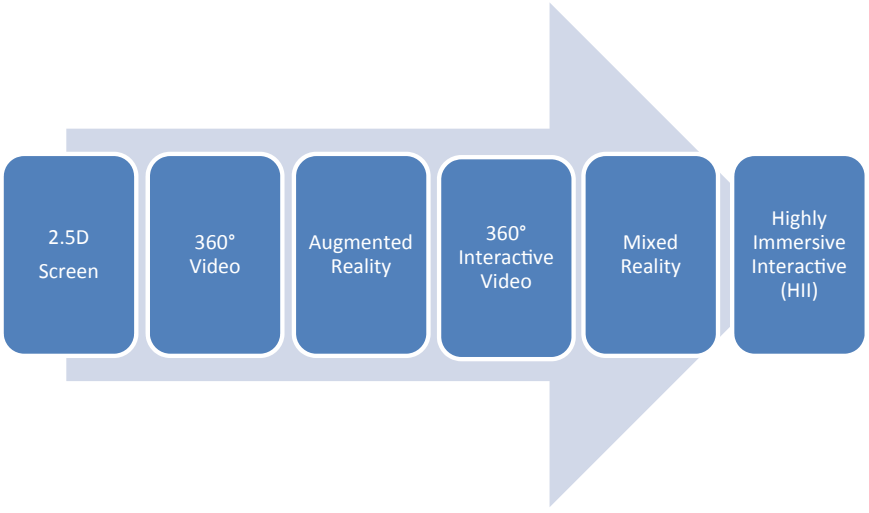

Fig. 4.1 Levels of immersion for educational immersive mediums

4.2.1 Virtual Experiences on a Monitor (2.5D)

A virtual environment experienced on a flat screen is also referred to as a 2.5D immersive environment, due to the simulated 3D nature being presented on a 2D medium. Users gain a sense of immersion through control, and sometimes even creation of, their own personal avatars through which they interact with different objects and people. 2.5D virtual environments can also be represented as 360° videos. A 360° camera can record experiences in 360° around it and provide videos, similar to a panoramic view. Users can display such videos with a traditional monitor or screen to move the image and explore the full panoramic view with a mouse, a modality Fonseca and Kraus (2016) refer to as *monoscopic video.* Although not fully immersed, users can still get the sense of immersion through fully displayed panoramic views in contrast to traditional videos. Another implementation of 360° video display through VR headset is discussed under the section '360° Video' due to its higher level of immersion.

4.2.2 Augmented Reality

Augmented Reality (AR) overlays digital information on top of physical objects or environments. Azuma (1997) pointed out the three characteristics of AR: (1) Combines real and virtual (2) Is interactive in real time (3) Is registered in three dimensions. That is to say that users can 'see' and experience both the physical environment and digital information presented at the same time in the context of each other. The layers that AR adds to the real world can be sensory-based, such as graphics or sound, or data-based (Farshid et al., 2018). Most commonly, this technology comes in a form of mobile device applications which uses the device's camera to scan the environment and generate augmented elements, making it highly accessible in an educational setting (Akçayır & Akçayır, 2017). While AR is considered an immersive experience, when using this technology, users remain completely aware that they find themselves in the actual, physical world.

4.2.3 360° Video

As mentioned in the previous section, videos taken by 360° cameras can be displayed not only by a traditional monitor, but also through a VR headset as immersive video that allows users to turn their head and enjoy the 360° look-around. When users wear an HMD resembling goggles, the corporeal reality is replaced by the visual stimuli, and a stronger sense of immersion is presented to the users. Unlike viewing a screen display, users wearing a VR headset are blocked from the physical world, and the images provided in a neuro-typical way and can be received as three-dimensional,

hence immersive video. Although users are not able to interact with the environment, the sense of being in the fully immersive environment can still boost the overall experience.

4.2.4 Mixed Reality

Before the merging of an explosive amount of VR at the consumer level, mixed reality (MR) attracted a great amount of research and attention in virtual learning. MR refers to the blending the physical and the digital worlds to create experiences with which users can interact (Milgram & Kishino, 1994). MR has largely included experiences that were displayed with varying levels of immersion from large flat screen displays to immersive room size environments, in which the virtual space is displayed on the walls surrounding the users. Room scale experiences rendered in a Cave Automatic Virtual Environment (CAVE) display a 3D virtual space in a cube with display-screen faces surrounding the user, often controlled with two handheld controllers (Cruz-Neira et al., 1993). While CAVE experiences are more immersive, MR learning experiences have been designed to be displayed on flat screens as they were more accessible to learners (e.g., Dede et al., 1996; Hayes et al., 2013). The advent of body tracking technology through infrared cameras enabled the flat screen experiences to create the illusion of presence. Also, the ability to track a user's body movements allowed users to interact with virtual objects on a large screen using their body as the controller.

Along with recent technological advances, the definition of MR has been transforming to reflect the development of emerging immersive technologies. Today MR has evolved to combine the benefits of the HMD with body tracking and new technologies to offer a more seamless blend between the real world and virtual information. By wearing a mixed reality head-mounted display (HMD), such as the Microsoft HoloLens or Magic Leap, users can see and interact with holographic representations of virtual objects in the real physical space displayed before their eyes. Unlike AR, which can only render imagery on top of the real world, MR can manipulate real-world objects with computer-generated constructs, allowing users to experience hypothetical scenarios (Farshid et al., 2018).

4.2.5 Interactive 360 Experience

Interactive 360° experience is provided through a simulation of a real location. With 360° panoramas, videos, text, and narrations, the simulation environment allows users to explore a location without physically going there. The 360° panoramas provide the opportunity for users to look in any direction and to navigate and interact with the images, videos, and information embedded in the simulation (Prasetya, 2017). The

advantage of interactive 360 experience is providing users a safe, virtual experience for a relatively low cost.

4.2.6 Highly Immersive Interactive (HII) Virtual Reality

In highly immersive interactive (HII) VR, the user is immersed in the environment by wearing a VR headset, which blocks the view of the surrounding physical environment and replaces it with the sights and sounds of a virtual space. Some of these HII experiences enhance immersion even more by including devices to simulate the sensations of touch, taste, smell, and movement. The most immersive types of virtual reality provide users more than a simple representation of functional knowledge; they provide users with an experience. In some cases, children were unable to distinguish virtual experiences from memory (Segovia & Bailenson, 2009). John Dewey detailed the concept of providing experiences for deeper learning and transfer in his 1938 book *Experience and Education.* Dewey's approach to constructing learning experiences can be applied to the development of virtual learning experiences (Aiello et al., 2012).

Researchers have found the use of HII virtual reality has been effective in many scenarios from delivering therapy to reducing phobias to flying aircrafts and even training people with traumatic brain injuries on activities of daily living (Blascovich & Bailenson, 2006; Doer et al., 2001; Fidopiastis et al., 2009). Similarly, there is evidence to support the idea that higher levels of immersion and interactivity increase the impact of virtual experiences, particularly in the higher quality VR headsets (Hussein & Nätterdal, 2015).

4.3 General Educational Affordances of Immersive Media

All levels of immersive media afford the user the capacity to experience virtual objects and individuals that simulate real-world objects and individuals. Tools that are used in traditional language learning classrooms, from flashcards to workbooks, have also been recreated in virtual spaces displayed in 2.5D, AR, VR, MR, 360° video, and HII experiences. The HII tools have the potential to allow learners to engage with Kolb's components of experiential learning from concrete experience, reflection, abstract conceptualization, and active experimentation (Kolb et al., 2001).

4.3.1 Novel Presentation of Instructional Content

Immersive media tools can provide learners with opportunities to be presented with content in novel ways. This novelty may increase engagement with the content. Few studies have addressed the novelty effect to evaluate the sustainability of tools, so it

is important that the industry create more longitudinal studies that identify learning that occurs once the novelty effect has passed. However, integrating multiple tools in a language learning implementation may mitigate for the novelty effect (Tsay et al., 2020).

4.3.2 Feeling of Physical Presence in Other Locations

Immersive media can provide learners with opportunities for virtual field trips by transporting them to locations where they can apply their language learning in context. These experiences are possible at multiple levels of immersion. The sense of presence, or being there, that is created by immersive experiences makes them ideal for creating field trips. Immersive media field trip experiences exist for the array of VR headsets. Similarly, Google Maps and Google Street View are available for students to explore geography in low-cost VR headsets as well as the high-end headsets such as the HTC Vive or Oculus Rift. HII virtual field trip experiences that allow learners to explore and interact with elements at a specific site are available via personal computer in the Oculus Store and the Steam distribution marketplace.

Cowans (2018) described using Google Expeditions in an Adult Migrant English Program in Australia. Through cardboard VR viewers, learners went on virtual field trips to the Aurora Borealis, Venezuela, New York City, Yosemite National Park, and the Great Barrier Reef. The field trips engaged learners and provided opportunities to practice listening comprehension, note-taking, and other language-related skills. Cowans argued that the experiential element of VR promotes retention and allows students to understand concepts better.

4.3.3 Social Learning Through Social Interaction

Bandura and Walters (1997) asserted that social interaction and connection are essential to learning. HII VR is uniquely capable of simulating and affording social interaction and connection. Social interaction with real and artificial individuals in HII virtual experiences has led to improved social skills, new relationships, and increased social confidence (Bailenson et al., 2004).

Even simple AR games such as Pokémon GO provide ample opportunities for social interaction as learners interact through a global, multilingual forum. Godwin-Jones (2016) explored the benefits of using such AR games in the language classroom, touting the popularity of Pokémon GO as an easy way to find a huge number of players, which in turn provided learners with more opportunities to interact and develop sociolinguistic competence.

4.3.4 Experiential Learning Through Replicable Simulations

People learn many skills by doing (Aiello et al., 2012); current experiential VR opportunities range from learning and practicing yoga or football to providing first aid (Louka & Balducelli, 2001; Patel et al., 2006). HII VR headsets, haptic stimuli, and physical models can stimulate the sense of touch to accurately represent the tasks. 360° experiences can also provide opportunities for learners to reflect on their behavior and conduct abstract conceptualization, but they will not gain the concrete experience or opportunity to actively experiment. This difference in the depths of experiential learning may be the deciding factor for some on the level of interactivity and immersion needed for the task.

4.3.5 Collaborative Spaces for Collaboration

Virtual reality developers have been expanding the offerings of collaborative spaces available. There are both professional and social spaces in which individuals can interact with each other while immersed in VR. These spaces are currently only available in the mid to high tier VR headsets, but developers are working to expand their user base by making the experiences available across platforms and on various hardware devices. Similarly, some developers (e.g., Rumii and AltSpaceVR) have taken steps to allow users to choose whether to engage in their virtual space in a range of VR headsets or on a traditional computer monitor. Not only does this allow users to choose to engage even if they do not have a VR headset, but it also allows them to alternate between experiences as well as to engage with users who are using different interfaces. This is significant because this flexibility may improve the persistence of users in the environment and increase interactivity, and studies have already demonstrated that persistence in language learning programs are positively correlated with having a human partner, as opposed to a chatbot (Fryer et al., 2017).

4.4 Immersive Language Learning Objectives

The goal of most language learning classrooms is communicative competence in the target language. Traditionally, linguistic learning objectives for language learning developed to achieve this competence include four basic language skills—speaking, listening, reading, and writing. Vocabulary and grammar, including spelling, syntax, and pronunciation, are considered *associated skills* (Vernier et al., 2008) which serve as tools that language learners use to create messages. Although they do not constitute separate skills, knowledge of grammar and vocabulary is necessary for a learner to effectively construct messages.

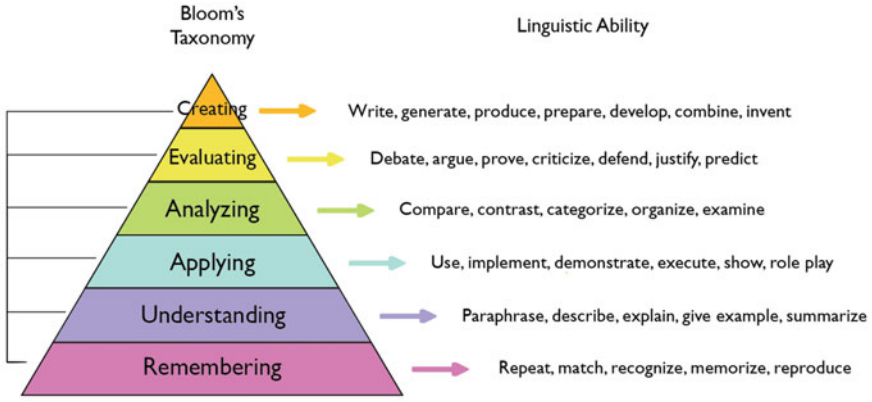

Fig. 4.2 Bloom's taxonomy aligned with corresponding linguistic abilities

These components are essential for any language classroom, but to reach the highest level of communicative competence educators need to integrate culture into all four traditional language skills. Language is a highly dynamic entity shaped by the society (Armour-Thomas & Gopaul-McNicol, 1998), and authentic exposure of learners to the culture of the target language is becoming increasingly important for effective language learning. Educators emphasize the importance of providing the cultural context of the target language to ensure learners' proficiency in intercultural communication in that language (Ali et al., 2015).

A source frequently used by language teachers is Bloom's Taxonomy, which is a hierarchical ordering of learners' cognitive skills utilized by most educators to develop learning outcomes for lesson plans and curricula. Six categories highlighted in the taxonomy are easily adaptable to reflect a language acquisition process. In the case of language learning, Bloom's Taxonomy is less of a hierarchy and more of an interdependent set of skills each building on one another and being constantly reinforced in language practice (Fig. 4.2).

In the context of immersive language learning, it is important to understand how VR technologies can help learners develop four basic language skills (speaking, listening, reading, and writing), associated skills (grammar and vocabulary), and cultural competence, while reinforcing cognitive tasks appropriate for their language proficiency levels.

4.4.1 Communicative Skills

There is a dynamic interplay between speaking and listening skills in second language acquisition. Language programs frequently integrate listening and speaking skills into one course and address them as a unity skill with common learning objectives. The main goal of mastering these skills is the learner's ability to understand and use

the target language in the desired context, such as daily interactions, academic situations, or specific workplace environments. This goal is achieved through progressive development of learner's listening comprehension, discussion, visual literacy, note-taking, presentation, and critical thinking skills. Pronunciation is also frequently targeted in this domain.

The lowest levels of speaking comprehension include the learner's ability to produce simple sentences following the instructor's example. Often, they are a part of the exchange of personal information when introducing self and others, or common everyday situations. Intermediate learners can produce longer speech on a specific or an impromptu topic and are better prepared to recognize and analyze discourse structures (e.g., determine the main topic of a speech, note details such as names, dates, and detect and correct errors). Advanced learners would be able to prepare and present long speeches, engage in critical reflections, as well as analyze and synthesize information from multiple aural sources utilizing advanced listening strategies.

Some researchers focused on the ways that 360° videos can improve language learners speaking skills. In Xie, Ryder, and Chen's (2019) study, Chinese learners were preparing oral presentations about different historical places in China using Google Expeditions which allowed them to 'explore' historical sites. During the presentations, students acted as guides to the historic places. In preparation of their presentation, they had to organize the information, select the most important information pieces, and combine all the pieces to deliver the presentation. 360° video helped students develop advanced speaking skills as well as sparked interest in learning the content and the culture of the target language.

Another example of interactive 360° video used to develop communicative skills is *ImmerseMe*. *ImmerseMe* is an innovative tool for language learning that allows learners to interact with pre-recorded 360° videos of native speakers in a variety of situations. They ask questions and the software provides learners with choices of different responses. Participants in Soto et al. (2020) study noted that this 360° video experience allowed them not only to develop communicative skills, but also reading skills. This example shows a promising potential of interactive 360° video technologies to synthesize multiple language skills in a single immersive language learning experience.

Researchers frequently refer to *Second Life*, a 2.5D immersive videogame featuring the exploration of a virtual world, as an effective tool to develop learners' oral performance in their targeted language (Lan et al., 2016). Learners display improved oral communication competence as well as increased motivation to learn the language when they were exposed to a 2.5D learning environment as opposed to learning through conventional instruction or learning materials.

Similar studies with larger sample sizes would be beneficial to confirm the findings provided in the above examples, but at this stage we recognize 2.5D and interactive 360° videos to be promising technologies that have the potential to improve language learners' communicative skills.

4.4.2 Reading and Writing

Some researchers investigated how AR-based mobile learning materials can assist language learners in composition writing. In Liu and Tsai's study (2013), EFL students used an AR-based mobile app that provided them information about different buildings and scenic spots as were walking around the campus. AR experience helped learners gain content knowledge that they used in their English writing and use that knowledge as a stepping stone to build on their past experiences. AR-based mobile learning also assisted learning with vocabulary and expressions that they later used in their writing assignments.

Researchers have also explored the potential of 2.5D immersive games such as *Second Life* to improve Chinese language learners' writing skills (Lan et al., 2019). After performing virtual explorations of the world in *Second Life* to collect ideas for their writing, students demonstrated increased writing motivation and performance. Learners were able to prepare a pre-writing plan and exhibit an overall better performance than the learners who have not engaged in that immersive experience.

Earlier we have mentioned *ImmerseMe*, a virtual reality immersive language learning platform that mostly targets the development of communicative skills. Users also reported their reading skills activation as they were reading through many possible ways they could respond to the virtual native speakers' questions (Soto et al., 2020). Meaningful textual information in VR environments encourages learners to read and process the information by synthesizing it with speaking and listening skills.

4.4.3 Grammar and Vocabulary

Grammar and vocabulary are frequently referred to as language skills, but they stand out from the four traditional skills as they are key components to effectively develop listening, speaking, writing, and reading. While second language learning goes beyond the limits of memorizing grammar rules and vocabulary items (Vernier et al., 2008), it is undeniable that these components are at the core of any language and are necessary for effective language learning.

Language learning goals traditionally include the correct use of grammar structures and vocabulary in controlled and spontaneous productions. At the beginning levels of language proficiency, learners are expected to demonstrate basic competence by identifying and reproducing tense structures, simple grammar constructs, and recognizing different parts of speech. Progressively, students demonstrate a more advanced proficiency by examining the ways different grammar tenses and constructions are used and implementing them in speech scenarios. In combination with four language skills, advanced learners are able to justify their grammar choices and incorporate their grammar knowledge in producing original thought in a spontaneous setting.

Vocabulary development is an ongoing learning process which is interwoven with all language skills. Some common strategies for teaching vocabulary include using flashcards, context clues, in-sentence practice, word-word method (stimulus–response), singing songs, and keeping a notebook of words, among others. Similar to grammar, learners' demonstration of their vocabulary knowledge is guided by their anticipated levels of language cognition determined by their proficiency, as illustrated in Fig. 4.2 listed above.

4.4.3.1 Grammar

Over the last decade, classroom teaching has undergone a huge shift from 'teacher-centered' to 'student-centered' learning, but this shift is particularly difficult for subjects that were historically approached using rote memorization techniques. That is why, traditional grammar classrooms have been known for their generally low student interactivity. Immersive virtual reality is becoming a game-changer in this area as it offers a highly interactive environment for learners with the potential to increase student engagement and help them achieve their learning outcomes and improve their overall language learning experience.

An example of teaching grammar in virtual reality is presented by Kruk (2014) who used browser-based virtual world (2.5D) to teach the second conditional structure to English high-school learners. It should be noted that the students were brought into the virtual space only at the late stages of their practice. Students were introduced to the topic of second conditional through a multimedia presentation and teacher's examples, and the initial practice of the structure was conducted through browser-based matching, translation, multiple choice, and gap completion activities. Once the students passed the *remembering* and *understanding* stages, they were invited to use their knowledge in a 2.5D virtual space—a browser-based virtual world *Yoowalk* (http://www.yoowalk.com/). Students *applied* their knowledge by communicating with the virtual residents using example questions in the second conditional and *created* new knowledge by generating their own questions. The treatment group performed significantly better than the control group who studied the second conditional following successive units of their coursebook, which indicates that 2.5D virtual spaces can be effectively used to teach grammar on higher levels of language cognition.

4.4.3.2 Vocabulary

In many cases of vocabulary learning, students are introduced to the vocabulary outside their intended context by means of repetition (Heidari-Shahreza & Tavakoli, 2016). Common methods of vocabulary learning include flashcards, translation, and word-word associations, but they do not provide contextualized learning experience that would ensure students' correct use of these words in the future. A dynamic interaction between contextual, semi-contextual, and de-contextual strategies of teaching

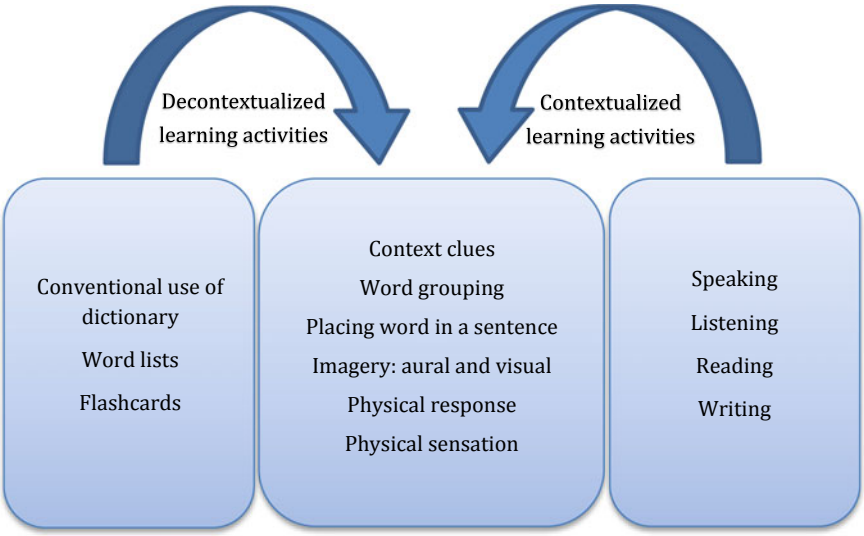

Fig. 4.3 A dynamic classification of common vocabulary learning strategies based on their levels of contextualization

vocabulary is needed to ensure effective learning (Shen, 2003). Figure 4.3 emphasizes the importance of using decontextualized techniques in combination with more interactive activities and in the development of four basic language skills.

Vocabulary memorization has gained a prominent spot in the context of immersive technologies used for language learning. The systematic review conducted by Dhimolea et al. (2021) has shown that, compared to all language skills, vocabulary learning in VR was the most frequently researched topic since 2015. Researchers have been investigating the potential of various levels of immersion to improve learners' vocabulary, specifically HII experiences, 360-degree immersive videos, and mixed reality. In the context of HII VR, language educators have been exploring immersive VR technologies that incorporate spatial navigation in addition to visual features to determine if physical interactions in VR environments can provide more effective learning experiences when compared to learning with 2D images or text (Legault et al., 2019). In the study by Legault et al., participants were able to move and interact with items in HII environments, iVR Zoo, and iVR Kitchen, while learning words of corresponding items in Mandarin Chinese. This example demonstrated the successful use of immersive VR technologies for vocabulary retention by using semi-contextualized strategies.

In another example, 360° videos were used to teach ESL learners essential vocabulary related to their scientific interests in psychology and counseling (Heidari-Shahreza & Tavakoli, 2016). The videos were related to basic skills in those fields and incorporated subject-specific vocabulary. 360° videos used in this study proved to be effective in increasing vocabulary retention. Despite the high level of immersive interactivity in the examples above, it is worth noting that they demonstrate the

successful use of VR technologies for the lowest level of cognitive ability, namely *memorization,* and do not provide immediate functional context to use the acquired vocabulary in practice.

Unlike pre-programmed settings described in the previous examples, MR allows learners to learn new vocabulary based on the surrounding context and objects using a mixed reality platform *WordSense.* The platform has been prototyped in *object to word* and *word to object* modes which display vocabulary on top of the real object, or a 3D image based on the processed written content in their environment respectfully. WordSense manages to blend reality with content in a seamless way that helps learners achieve contextual affinity (Vazquez et al., 2017). The system also allows learners to dynamically link vocabulary to their definitions, examples in sentences, videoclips, and recorded pronunciations, making it a promising technology for vocabulary retention in a highly contextualized environment.

4.4.4 Cultural Aspects

Language educators argue that it is important to include culturally relevant interactions in addition to learning a foreign language. Knowing cultural aspects also helps learners stay engaged in the language learning process because they feel more connected with the language and the native speakers of that language.

VR spaces offer students safe environments to practice both language and cultural elements of communication without the danger of unintentionally mistreating someone or being misunderstood. One such space called *Crystallize* was adapted from a 3D videogame to allow immersive VR experience teaching learners embodied cultural interactions, such as bowing in Japanese greetings (Cheng et al., 2017). The participants expressed overall enjoyment of the immersive VR experience and perceived a high involvement in Japanese culture. While this example did not provide any conclusive findings measuring the language acquisition, it provided a valuable demonstration on how VR yields a sense of immersive presence in the participants which is a valuable opportunity to develop cultural competence in and engagement with the target language. The Common European Framework of Reference for Languages (2005) defines existential competence as the learner's ability to have an openness toward other cultures and new experiences. Existential competence drives curiosity and motivation, thereby leading to a greater willingness to communicate. Studies by Barrett et al. (2020), Berti et al. (2020), Cowans (2018), Garcia et al. (2019), Kaplan-Rakowski and Wojdynski (2018), and Monteiro and Ribeiro (2020) have demonstrated ways in which immersive learning experiences can increase curiosity and motivation.

Researchers have found that Learning language can help foster learners' cultural and intercultural competency (Nechifor & Borca, 2020). Knowing cultural aspects also helps learners stay engaged in the language learning process because they feel more connected with the language and the native speakers of that language. Scholars have found that Immersive virtual environments can be applied to foster learners'

cultural competency, especially cultural self-awareness, through the target language learning. Immersive virtual environments can also be applied to identify and address learners' stereotypes about cultural differences among different countries that relate to their target language. In the study by Berti et al. (2020), Italian learners used 360-degree videos and HMDs to immerse themselves in ordinary environments in Italy and compare them to their expectations. Through these experiences, learners were able to better understand their own attitudes, generalizations, and stereotypes about the culture of this country. Immersive media can help language learners identify and address new cultural layers generally not encountered using traditional pedagogical methods, which can promote learning motivation and increase their cultural competence.

4.4.5 Social and Emotional Dimensions

Researchers increasingly believe that learning a language is a social activity which includes cognitive, behavioral, and emotional dimensions, and is most effective through collaboration with other people (Melani et al., 2020; Philp & Duchesne, 2016). Sociocultural learning theory (SCT) conceptualizes that language learning is a social practice that occurs in a specific sociocultural context (Lantolf, 2000). Similar to social practices, emotional practices are also instrumental for language learning, because human thoughts, emotions, and feelings are an integral part of human development (Wang, 2005).

Philp and Duchesne's (2016) model of language learning describes engagement as a multidimensional construct that incorporates social and emotional dimensions of engagement with other learners. These dimensions are particularly challenging to address during the times of the global pandemic with limited opportunities to travel and interact with native speakers and language learners. The affordances of immersive technologies offer a unique advantage to these media as they can help learners achieve the sense of physical, social, and emotional presence in remote locations. For instance, Barrett et al. (2020) used the multi-user VR learning environment, *Mozilla Hubs* to replicate a Chinese language learning environment. This HII environment offered users behavioral freedom, customizability, and full linguistic immersion unrestricted by resources needed to travel to the countries of their target language. The learners reported high levels of perceived usefulness of this medium and increased motivation due to the social nature of language learning associated with the VR technologies.

2.5D virtual learning environments such as *Second Life* also offer opportunities for socialization and for rapport building between students and teachers (Chen, 2016). Language learning experiences in *Second Life* allow students to engage in spontaneous social interactions (Jauregi et al., 2011) under authentic learning conditions which are otherwise impossible to re-create in a traditional classroom. These interactions also elicit collaborative practices which were beneficial in the sociocultural context of language learning (Peterson, 2012). Therefore, immersive technologies

provide an arena for effective learner-centered social and emotional interactions that offer valuable opportunities for target language practice.

4.5 Affordances of Levels of Immersion and Language Skills

The following table identifies which learning objectives are currently addressed using the different levels of immersion. Each one of these levels of immersion affords the novel presentation of instructional. 2.5D, 360° video, MR, interactive 360°, and HII VR also all provide the sense of presence or 'being there.' That sense of presence is most useful in learning skills that are related to place, which include all of the language learning objectives from vocabulary to reading and writing (e.g., reading and recognizing signs or paying a bill) to culture. Social interaction is possible in 2.5D experiences, mixed reality, augmented reality, interactive 360° video, and HII, but not in traditional 360° video. Experiential learning through replicable simulation takes more planning and development time and is only truly feasible in 2.5D, MR, interactive 360° video, and HII VR. The degree of immersivity of an experience is richer with higher levels of immersion and interactivity. Future research will tell if the level of immersion impacts learning outcomes or sustained learning. Finally, because collaboration requires a high level of interactivity, only 2.5D, MR, AR, and HII afford collaborative spaces.

Language learning in 2.5D, mixed reality, and HII VR all afford the user experiences of novel presentation of instructional content and afford a degree of physical presence, social learning through social action, experiential learning through replicable simulations, and collaborative spaces for collaboration. The degree and extent to which these provide the experiences still needs to be explored in the literature and in large-scale comparative analysis. Conceptually, one might hypothesize which levels of immersion would afford deeper and more authentic social learning and experiential learning experiences, due to the level of interactivity.

4.6 Limitations and Trade-Offs

With so many choices appearing on the market that claim to help with language learning, it is important to consider the costs and benefits of each tool as compared with the learning objectives. Some learning objectives may be met well with low-cost experiences that offer less immersion, while other learning objectives may be best served with higher cost highly immersive interactive experiences.

While theories of experiential learning, Bloom's taxonomy, and individual studies guided our analysis of which tools would be ideal for different learning objectives, it would be useful to have a comparative analysis of students using each level of

immersion for each level of skill in order to determine which skill is better taught using which VR technology. This kind of study will take a great deal of time, as many tools are not available across devices. Another limitation is that tools for some languages are more fully developed, for example English Language Learning tools may be more developed than tools for languages that are not in high demand.

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Chapter 5
Implementing Virtual Reality–Enhanced Tasks in Chinese Language Teaching

Miao-fen Tseng and Ziyi Geng

Abstract Virtual Reality (VR) has great potential to enable immersive, interactive, and intuitive language learning. Several studies have discussed the effectiveness of VR in language learning (Collentine in Language Learning & Technology. 15:50–67, 2011; Schwienhorst in Computer Assisted Language Learning 15:221–239, 2002), yet such attempts in teaching Chinese as a foreign language are still rare. Using the VR technologies Unity and Google Cardboard to enhance language learning, this study explores the design and effects of VR-incorporated tasks in Chinese language classrooms. Twenty-seven American college students participated in the study, with proficiency ranging from novice-high to intermediate-low levels. A combination of quantitative and qualitative analysis was employed to assess learners' perception of their language learning experience and evaluate their motivation, engagement, and confidence. The results show that learners' self-perceived experiences in VR-incorporated language learning were quite positive, and that VR-incorporated tasks enhanced their motivation, engagement, and confidence. Reflections on the use of the VR technology and directions for future study are discussed at the end of the study.

Keywords Virtual reality · Task design · Task implementation · Learners' perceptions · Chinese language teaching and learning

5.1 Introduction

Virtual Reality (VR) has been increasingly influential in various disciplines. Through VR's immersive and experiential effects in games and environments including *Second Life*, *Active Worlds*, *Quest Atlantis*, and *World of Warcraft*, users can maximize their creative, imaginative, and experimental capabilities. In recent years, these benefits have expanded into the educational field, as educators and investigators have suggested that VR may "improve our digital and cultural literacies, understand more

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fully the links between immersion, empathy and learning, and develop design skills that can be used productively to exploit virtual spaces" (Warburton, 2009, p. 425). For example, VR enables people to visit a faraway museum without traveling there, and VR videos enhance training for natural disasters by allowing trainees to more directly feel the potential effects and better predict and prepare. Such implementation of VR has undoubtedly furthered the development of the educational field, especially by bringing hard-to-achieve field experiences into the classroom; the adoption of VR in these disciplines has become increasingly prevalent (Angulo & Velasco, 2013; Warburton, 2009). However, its application to language teaching and learning, especially in Chinese as a foreign language, remains unexplored and deserves further examination. In addition, in VR's early stages, the developer had to, for the most part, control the tool or environment, which meant the settings were predetermined and educators were not able to customize them for their specific teaching objectives. Some recent tools and platforms, such as Unity and Google Expedition, have been more open to further adaptation by the users. This new flexibility gives educators more freedom to design VR tools to fulfill their pedagogical goals and objectives.

Therefore, in the current study, we investigated the functionality and feasibility of 12 applications (apps) and tools, focusing on their pedagogical value and appropriateness in teaching Chinese as a foreign language in the United States. Using these tools, the study exposes students to simulated authentic Chinese language and cultural environments, which many of them have never experienced before, with the goal of enhancing their language performance. The study aims to incorporate two series of selected apps and tools: (1) Unity, Google Poly, and HTC VIVE goggles; and (2) 360° videos and pictures, Google Expedition, and Google Cardboard. Used in Chinese language courses, these tools help instructors to create full immersive environments for learners, in order to foster their autonomy, motivation, and active engagement. Additionally, this study evaluates the effectiveness of different VR apps and tools incorporated for student-centered communicative tasks. Based on analysis of both qualitative and quantitative data gathered in this groundbreaking project, the study will propose effective strategies and offer recommendations for incorporating VR apps and tools in language instruction.

5.2 Virtual Reality in General Education

While VR technology has been applied in movies, theme parks, and games, its development has also influenced the field of education. VR is defined as "a system that aims to bring simulated real-life experiences, providing topography, movement, and physics that offer the illusion of being there" (Smart et al., 2007). Educators are increasingly using these appealing features to create theme-based virtual worlds in which students can have semi-authentic experiences, which is especially valuable when the real environments are not easily available.

In the earlier stages of VR development, educators used two-dimensional (2D) text-based VR tools and environments, such as domains that multiple users could use

at the same time (Lin & Lan, 2015). With further advancements, three-dimensional (3D) VR tools and environments, including for example *Active Worlds* and *Second Life*, have taken the place of the 2D tools, because they more closely simulate the real world. Although many of the 3D VR environments and tools were originally developed for commercial and business use, educators have put considerable efforts into adapting these technologies to teaching. For example, Angulo and Velasco (2013) developed a VR environment to support architectural design and reported positive feedback from the participating design-major students; Izatt and colleagues (2014) developed a novel VR application called Neutrino-KAVE which functions as a visualization and data interaction application. VR has also been used in medical education fields including nursing, medical professional training, and surgical training (Freina & Ott, 2015). Ribaupierre and colleagues (2014) examined the development and use of VR in health care training and discussed the importance of virtual experiences in teaching.

The preliminary findings of these first attempts at developing VR for education suggest that VR can offer great advantages for learning, such as allowing direct experience of objects and events that are physically out of reach, and supporting training in a safe environment. Freina and Ott (2015) also reported that VR "increases the learner's involvement and motivation while widening the range of learning styles supported" (p. 138). Although these studies were conducted using a variety of VR tools and platforms, very few of these tools were originally designed for education purposes. Jones (2006) found that because many existing VR environments are meant for gaming instead of education, enormous time and effort required to adapt them and create new educational materials, resulting in grave inefficiencies.

5.3 Virtual Reality in Foreign Language Teaching

VR has proven educational benefits in math, nursing, science, aviation, and social studies, to name a few. However, research into VR in language education is still in its infancy, and mostly exploratory (Bonner & Reinders, 2018). One of the biggest documented advantages of using VR in language classrooms is reduction of distractions. By blocking out visual and auditory distractions, VR tools and apps fully immerse learners in the content they are viewing and exploring (Gadelha, 2018). Cognitively, VR supports "embodied" and "extended" cognitive activities that stimulate thinking and body movement (Atkinson, 2010).

Research on VR in language education may employ single or multiple existing VR tools. Several language educators have experimented with the online 3D game *Second Life* for its affordance, effectiveness, and impacts on cultural involvement, oral interactions, and motivations. Developed by Linden Labs, *Second Life* is a multiuser virtual environment in which participants are able to freely create their contexts for interaction using visual, text, and audio modes (Jauregi et al., 2011; Schwienhorst, 2002). Jauregi and colleagues (2011) adopted *Second Life* to investigate its impact on the learning of several languages. Data collected from their questionnaire, completed

by 430 foreign language learners of Dutch, Portuguese, Russian, and Spanish, show that VR experiences from *Second Life* have positive effects on cultural, linguistic, interpersonal, and motivational issues. Deutschmann and colleagues (2009) designed oral participation tasks in *Second Life* and compared the effectiveness of language courses with the *Second Life* tasks to those without. Results indicate that meaningful VR-based tasks that include authentic and collaborative elements have a direct impact on learner participation and engagement. Liou (2012) examined how *Second Life* could be used in a computer-assisted language learning (CALL) course for 25 college English learners in Taiwan. The researchers designed four tasks for student orientation in *Second Life*: chatting, pedagogical activities, peer review, and a *Second Life* platform tour. Their findings reveal strong student motivation and engagement. They also observed that "sound pedagogy with appropriate tasks, instead of 3D virtual software alone, guides applications advancing toward language learning objectives or sense-making in student learning" (Liou, 2012).

Cheng and colleagues (2017) investigated the impact of the 3D VR game *Crystallize* on the study of cultural interaction, such as Japanese bows, on 68 Japanese language learners. They found that VR technology provided "an opportunity to leverage culturally relevant physical interaction, which can enhance the design of language learning technology and virtual reality games" (Cheng et al., 2017, p. 541).

For teaching English as a foreign language, Liaw (2019) adopted a VR social networking site, *vTime*, which allows users to socialize in immersive virtual environments. The study investigated students' intercultural communication learning and found occurrences of rich intercultural communication in learners' interactions in VR environments. Learners were also found to be enjoying the VR activities. However, the study also reported that some students doubted the effectiveness of VR in language practices in general, and further investigation into such concerns may be needed.

Vázquez and colleagues (2018) examined kinesthetic learning in Spanish language education by using *Words in Motion*, a VR language learning system that "reinforces associations between word-action pairs by recognizing a student's movements and presenting the corresponding name of the performed action in the target language" (Vázquez et al., 2018, p. 272). Comparing effects on learners in VR to those in non-VR learning experiences, the researchers used knowledge of 20 transitive verbs as their assessment of effectiveness. The study revealed that VR did not affect immediate learning gains of the verbs, but did result in higher retention rates after a week of exposure, compared to the non-VR learners.

Madini and Alshaikhi (2017) explored the acquisition of English-for-specific-purposes (ESP) vocabulary of postgraduate students using 360° videos in VR headsets. Specifically, they examined whether VR headsets helped the 20 participating learners enrolled in the Didactic Terminologies in English Course to retain vocabulary related to their field. The study found positive vocabulary retention through pre- and post-test evaluations, and suggests a need for further research on learners' perception of vocabulary learning using VR.

Adopting multiple tools, Bonner and Reinders (2018) investigated the capabilities of Augmented Reality (AR) and VR in English language education. In their study,

three VR activities were introduced: (1) more realistic presentation practice through 360° videos and VR; (2) VR video creation; and (3) orienting students to a reading topic through 360° videos. The study also raised concerns related to using different kinds of VR tools, such as privacy and security for language educators. Mohsen (2016) compared the use of an online video simulation game that allowed Arabic learners to drag various virtual-surgery devices during a knee surgery simulation, to that of another group of learners who watched a YouTube video of the surgery. The pre- and post-test results showed that the students who played the game demonstrated significantly better language performance in vocabulary than did those who watched the video.

The preceding studies have looked in fruitful ways at VR in language teaching and learning, but none of those described thus far have dealt specifically with Chinese as a foreign language. There are a very few studies that have. Several by Grant and Huang (2010, 2012), involved a series of tasks that the researchers designed and implemented in *Second Life*. Tasks included purchasing train tickets and inquiring about accommodation. To accomplish them, students had to communicate with nonplayer characters in "Chinese Island," a customized area within *Second Life*. Grant and Huang found that learner-to-expert dyads—as opposed to learner-to-learner interactions—generated better results in remedial error correction while resembling interlocutors' interactions in real life. Their findings show that VR enables students to conduct communicative tasks through collaborative work, increasing their engagement in learning.

Also focused on VR in Chinese language teaching, Cheng (2018) performed an exploratory study investigating four case studies. The study found that a seventh grader's final version of an essay included more words and longer sentences after the student had watched AR videos and experienced a virtual tour of Beijing through VR technology. Cheng's study employed a four-step learning strategy that led to better outcomes for essay writing in Chinese characters: (1) read a sample article; (2) learn to use adjectives to modify observed objects and scenes and expand the sentences created; (3) understand the concepts of writing a well-structured paragraph; and (4) produce a short essay. The study concluded that VR technology can reduce students' learning anxiety, help satisfy individual learning needs, and offer cultural and real-life experiences for learners.

Until now, research on VR and language teaching and learning is still in an embryonic stage of development in terms of scope, focus, and the range of languages investigated. The majority of studies into VR and language education reported a positive impact of VR tools on learners' motivation and a measurable benefit of simulated virtual environments. Researchers have also developed various tasks in accordance with language teaching objectives for more focused and effective VR-incorporated learning. However, these studies have mainly focused on utilizing the existing tools and software, and language educators have very limited access to the development and design process of the tools. When researchers in this field have designed tasks, they have been restrained by the limited range of the original technology designs. As Stockwell (2007) mentioned, "the most important responsibility for those teachers

who make the decision to use technology as a part of their language learning environments is to ensure that they are familiar with the technological options available and their suitability to particular learning goals" (p. 118). However, educators and students' agency have not been reflected in any of the reviewed studies. Also due to the inflexibility of technology design and resultant inability to closely support teaching goals, current language task design is mostly aimed at developing general language functions instead of focusing on the specific linguistic structures essential for novice learners moving toward intermediate language proficiency.

5.4 Tasks in Foreign Language Teaching

The above-reviewed literature about VR in language education has shown some evidence of the effectiveness of using tasks in VR-incorporated teaching. A task in the language education field generally refers to a communicative problem to be solved by language learners using their own language resources (Ellis, 2009; Skehan, 1998). A task has a primary focus on meaning and should be performed in real-life situations. Therefore, tasks are learner-centered and designed to generate authentic use of language in connection with real-world communication needs. Considering tasks by type, one widely adopted classification was developed by Ellis (2003), who proposed as a main criterion a task's structure, meaning whether a task is focused or not. A focused task has a specific objective: the use of a particular targeted linguistic feature during meaning-oriented communication. By contrast, an unfocused task does not have a predicted outcome in terms of specific linguistic features. Each of these two broad types of tasks coincides with different pedagogical purposes, and instructors may choose to design and implement contextual, situational, and goal-appropriate tasks. In another classification scheme, which places authenticity as a criterion for dichotomizing tasks, Richards (2001) distinguishes pedagogical from real-world authentic tasks. It is important to note here that the degree of authenticity is decided by instructors' local judgment rather than through a formulaic, scientific measurement. A third scheme is by Willis and Willis (2007), who identify seven types of tasks involving different degrees of higher-order critical thinking skills and cognitive development based on different pedagogical purposes: listing, ordering and sorting, matching, comparing, problem-solving, sharing personal experiences, and projects and creative tasks. Finally, taking interaction as the central guiding principle, Pica et al. (1993) list task types as jigsaw, information gap, problem-solving, decision making, and opinion exchange, some of which are most commonly used in language classrooms.

For tasks in a curriculum, there are two types of course design: task-based language teaching (TBLT) and task-supported language teaching (TSLT) (Long, 1988; Skehan, 1998). TBLT refers to instruction in which tasks are the core components of curriculum and syllabi. TSLT, sometimes called the "weak" version of TBLT, refers to a more flexible approach in which tasks support the entire curriculum and

syllabi, along with other language teaching methods already in use (Ellis, 2003; Littlewood, 2007). Tseng (2014, 2019a) has created a wide array of tasks in alignment with commonly taught topics in Chinese as a foreign language for novice learners moving toward an intermediate level of proficiency. The tasks, which are either pedagogy-oriented or authenticity-focused, include clearly identified communicative modes, can-do statements, instructional procedures, and accompanying rubrics that are well suited for a TSLT curriculum. Looking toward curriculum design, Tseng (2021) has contributed to the field of teaching Chinese as a foreign language by creating a sequence of authentic tasks with a list of authentic materials essential for the development and implementation of TBLT courses geared toward intermediate and developing advanced learners.

Regardless of type and model, language teaching tasks are proven to have significant pedagogical value in communicative language teaching and demonstrable effects on language proficiency, motivation, and cultural awareness. Regarding their connection with VR applications, both focused and unfocused tasks have the clear goal of authentic interaction in real-life situations, which is in line with the educational potential of VR applications. Peterson (2006) finds that VR can efficiently create or simulate an authentic and immersive environment that triggers language learners' motivation, agency, and cognitive-founded output and communication. As Long (2017) stresses, increasing learners' motivation is key in developing pedagogic and target tasks. The combination of task design and VR technology therefore emerges as an exciting explorative domain for research in this study.

5.5 The Study

The current study adopts a TBLT curriculum in which tasks, enhanced by VR technology, are created and implemented as a summative assessment to strengthen and evaluate language learning at the end of an instructional topic. Specifically, this curriculum implements four focused tasks that are enhanced by VR technology and include pre-selected topics and language functions in two levels of Chinese language classes. This preliminary study attempts to answer the following two research questions:

(1) Do immersive virtual experiences created by VR technology foster language learning, and to what extent?
(2) What are students' perceptions of VR technology? To what extent does VR technology enhance learners' motivation, engagement, and confidence?

In order to answer these two research questions, both quantitative and qualitative data were collected to investigate students' perceptions about their language learning and motivation, engagement, and confidence in participating in the focused tasks enhanced by two types of VR technology.

5.6 Research Methods

A combination of quantitative and qualitative analysis was employed to supplement each measure. Quantitative data were collected through a questionnaire composed of a set of 5-point Likert scale questions and short open-ended questions on learners' learning experiences in VR-incorporated tasks, using Unity and Google Cardboard. The data were organized in four categories based on the research questions: (1) learners' perceptions of language learning with Unity-enhanced tasks and (2) Google Cardboard-enhanced tasks; and (3) learners' motivation, engagement, and confidence with Unity-enhanced tasks and (4) Google Cardboard-enhanced tasks. Descriptive statistical analysis was utilized for quantitative analysis due to the relatively small size of the study.

Qualitative data were coded and analyzed based on grounded theory. Grounded theory is a research methodology that operates almost in a reverse fashion from some of the more established modes of social science research of the positivist tradition. Unlike positivist research, a study that employs grounded theory is likely to begin with a question, or even with the collection of qualitative data as primary research material (Davis, 1995). For the current study, despite the overarching scope provided by the research questions, there is no pre-set hypothesis about the potential findings, especially in terms of students' perceptions. Therefore, the researchers read the entire data sets, selected contents relevant to the study purpose, and categorized based on the nature of the data collected.

5.6.1 Participants and Settings

The study was conducted in a southeastern public university in the United States. Students enrolled in Elementary and Intermediate Chinese language classes were invited to participate in the VR experiments completed through Unity and Google Cardboard. For participants in both levels of classes, the VR-enhanced tasks were part of their daily required class activities, but completing the follow-up survey was completely voluntary. Table 5.1 gives a summary of the number of students across two levels of language proficiency.

Table 5.1 Number of student participants in four VR tasks

Tasks	Scenarios	Elementary Chinese	Intermediate Chinese
Task 1: Unity-enhanced Task 1	Scenario 1	13 (2 male, 11 female)	14 (5 male, 9 female)
	Scenario 2	0	14 (5 male, 9 female)
Task 2: Unity-enhanced Task 2		13 (2 male, 11 female)	14 (5 male, 9 female)
Task 3: Google Cardboard-enhanced task 1		13 (2 male, 11 female)	14 (5 male, 9 female)
Task 4: Google Cardboard-enhanced task 2		13 (2 male, 11 female)	14 (5 male, 9 female)

Of the 16 students taking the Elementary Chinese course, 13 participated in the VR tasks and completed the post-task survey. Of the 15 students taking the Intermediate Chinese course, 14 participated in the VR tasks and completed the post-task survey. Ultimately, a total of 27 students took part in the VR-enhanced tasks and completed the survey. Of the 13 Elementary Chinese learners, 2 were male and 11 were female. Of the 14 intermediate Chinese language learners, 5 were male and 9 were female. Their ages ranged from 18 to 22 years old, with a mean of 19.7 years old. Their language proficiency ranged from novice-high to intermediate-low levels. Since the second scenario of Unity-enhanced task 1 required language knowledge and skills that the Elementary Chinese course students had not learned, Elementary Chinese language learners did not participate in the second scenario of Unity-enhanced task 1.

The VR tasks were developed in accordance with the curricula of Elementary Chinese and Intermediate Chinese, focusing on specific topics covered in the course syllabus. The curricula of the participating Chinese courses used *Integrated Chinese* as the main textbooks. The following sections introduce the pedagogical and technology design of the tasks as well as the implementation process in the Chinese language classrooms.

5.6.2 The VR Tools

After experimenting with more than 10 VR tools and analyzing their pedagogical applications, two sets were selected in this study: (1) Unity, Google Poly, and the matching 3D Google headsets; and (2) Google 360 videos/pictures and Google Cardboard headsets. In the following sections, Unity refers to the tasks using the first set of VR tools, and Google Cardboard refers to the tasks using the second set of VR tools. Unity is a cost-free cross-platform game engine that is highly customizable and handy for educational use. Unlike other VR applications, Unity allows instructors to be fully involved in the process of the technology part of task design, not just the pedagogical part. The instructors can easily get familiar with the user-friendly interface of the software, and they can include diverse objects in the VR world that they create based on their pedagogical needs. Using Unity, they can also create an interactive virtual world that enables users not only view to the scene but also to move around and touch and move objects in the virtual world. All instructors participating in this study received about 10 h of software training, as they were designing the projects at the same time. Accompanying Unity was Google Poly, a website with premade 3D objects, such as buildings, furniture, and plants that could be added to the VR world. The VR goggles the students used in class were HTC VIVE, a VR system that includes visual and audio access and a remote controller to navigate and move objects in the VR world.

Google Cardboard involves a simpler type of goggles than the HTC VIVE; these allow users to view the VR world, but do not allow as much interaction between the user and the VR world objects as the HTC goggles do. However, Google Cardboard is easy to carry, install, and view, and it has lower requirements for space and

supporting equipment for activities. Since Google Cardboard is a viewing tool, the instructors took 360° pictures in selected scenes in China using their cellphones and professional 360° camera: the Ricoh THETA V 2 × 14.0 MP Ultra HD Camcorder. They then organized the pictures into Google Expeditions and added supporting text and audio materials. In class, instructors sent students a web link generated by Google Expedition, which they could open from their phones and which enabled them to attach their phones to the Google Cardboard goggles.

5.6.3 An Overview of Four Tasks with Unity and Google Cardboard

Student participants completed a total of four tasks during the study. The tasks closely aligned with the pedagogical objectives for creating semi-authentic immersive learning experiences, whereby learners stayed "within" the target language and culture most of the time. The design of the tasks included multidimensional prompts to maximize students' interaction in the target language. In addition, the authentic feeling of space and natural sense of direction imparted by the VR tools significantly eased the pressure of "imagining" directions in the classroom, allowing students to focus more fully on the language tasks. Concerning the specific features of the two VR tools, Unity was selected for the first two tasks, and Google Cardboard for the remaining two tasks.

Tasks using Unity focused on developing students' language proficiency in two main language functions: describing space and physical settings, and communicating about the physical movements of a person (giving and following directions) and objects (giving and following instructions when moving objects). A virtual 3D world featuring street views, a certain part of a city, or a dormitory was created specifically for learners to implement the communicative tasks in collaboration with their classmates. Tasks using 3D pictures and videos and Google Cardboard focused on creating immersive, authentic, and information-rich environments in which students could develop their communicative and presentative skills in the target language. The 3D pictures and videos of authentic settings were created in China before the study started; they included street views, shops, and restaurants. In class, students were asked to conduct communicative and presentative tasks, including ordering food and drinks after reading a menu, describing directions, and discussing public transportation.

All four tasks involved two-way interactions that required collaboration between two learners, facilitated by the instructor or tutors on site. Following is a synopsis of the four tasks enhanced by Unity and Google Cardboard, outlined in four aspects: task type, instructional topic and level, linguistic structures and functional foci, and scenario.

5.6.3.1 Task 1. Unity-Enhanced Task: Cleaning and Describing Your Apartment in Beijing

Instructional topics and level. The first task using Unity and related tools was designed to support learning of the topics "apartment" and "housing" in Elementary Chinese and Intermediate Chinese.

Linguistic structures and functions. The linguistic structures that this task focused on were the "ba" construction (subject + 把 + object + verb + other element) and existential sentences (place + verb + 了 or 着 + numeral + measureword + noun). The language functions were communicating about physical movements of objects (giving and following instructions when moving objects) and describing space and physical settings.

Task type: Information gap. In each pair of students, one viewed the entire virtual world using the HTC VIVE goggles, and the other viewed a screen that only partially displayed the virtual world.

Scenarios. Two scenarios were set in this task to elicit students' language output.

Scenario 1: You are studying abroad in Shanghai. This is just your third week here. You have rented an apartment. Your potential girlfriend/boyfriend is visiting your place, but you cannot be back in time to clean the apartment which is very messy. Please call your roommate and let him/her help you organize the apartment. Please remember that you only have a vague idea of what is in the room and you are not video calling. Therefore, you need to check where things are. Start the conversation from the beginning of your phone call.

Scenario 2: You had fun with your friend and are now resting in your apartment. Suddenly, your Chinese friend in the US called and want to see your new apartment. Virtually show her or him around by introducing your room and furniture. The Chinese friend may ask detailed questions, such as, What's on the table? What's on the couch? Are you eating American food? etc. Start the conversation from the beginning of your phone call. [Only Intermediate Chinese students were required to complete this part of the task.]

5.6.3.2 Task 2. Unity-Enhanced Task: Looking for a Peking Duck Restaurant in Beijing

Instructional topics and level. The second Unity task aimed at supporting the topic "directions" in Elementary Chinese.

Linguistic structures and functions. The linguistic structure that this task focused on was direction and location devices. The main function practiced in this task was describing space and physical settings and communicating about a person's physical movements (giving and following directions).

Task type: Information gap. In each pair of students, one viewed the entire virtual world using the HTC VIVE goggles and the other viewed a screen that only partially displayed the virtual world.

Scenario. You are visiting Beijing. You would like to meet with your Chinese friend in a Peking Duck restaurant in a busy shopping plaza which is not very far away from your hotel. Your friend knows the area well and he/she is guiding you on the phone. Follow his/her direction and find the Peking Duck restaurant.

5.6.3.3 Task 3. Google Cardboard–Enhanced Task: Visiting a University Campus and Ordering Food in the Dining Hall in Shanghai

Instructional topics and level. The first task using Google Cardboard and related tools was designed to support the learning of the topics "direction" and "dining" in Elementary Chinese and Intermediate Chinese.

Linguistic structures and functions. The linguistic structures that this task focused on were direction and location words, Chinese food words, and topic-comment sentence structure. The language functions to be practiced were communicating physical surroundings, and ordering and discussing food and flavors.

Task type: Role play. In each pair, one student performed as the student who studied abroad, and the other student performed as his or her language partner in Shanghai.

Scenario: You are studying abroad in Shanghai. Today is your first day on campus. Walk around the campus and find the dining hall where you will meet with your language partner in Shanghai. Order food in the dining hall based on the recommendation of your language partner.

5.6.3.4 Task 4. Google Cardboard–Enhanced Task: Riding Subway Lines and Meeting with Friends in a Milk Tea Shop in Shanghai

Instructional topics and level. The second task using Google Cardboard and related tools was designed to support the learning of the topics "transportation" and "dining" in Elementary Chinese and Intermediate Chinese.

Linguistic structures and functions. The linguistic structures that this task focused on were direction and location words, public transportation words and phrases, Chinese snack and drink words, and sequencing devices in sentences. The language functions to be practiced were communicating physical surroundings, and ordering and discussing drinks and flavors.

Task type: Role play. In each pair, one student performed as the student who studied abroad, and the other student performed as his or her language partner in Shanghai.

Scenario: You have been studying in Shanghai for a few days. Your Chinese friends told you there is a very tasty milk tea shop not very far from the University. Ride two stops of the Shanghai Subway with your Chinese friends to go to the milk tea shop. Ask him/her as many questions as you wish about how to ride the subway and what flavor of milk tea is good.

5.6.4 Instructions for Using Unity and Google Cardboard for Task Completion

Before students began to engage in the tasks, they received training on how to use the VR tools as a pre-task. The step-by-step instructions for using Unity in tasks 1–2 and Google Cardboard in tasks 3–4 are outlined below. They are in principle identical in Steps 1–3, except for differences in detailed implementation and an added presentation in Step 4 for Tasks 3 and 4.

5.6.4.1 Step-by-Step Instructions for Using Unity to Complete Tasks 1–2

The Unity-related tasks were conducted in a media lab where HTC VIVE goggles were available. Students were assigned to pairs to participate in the two role-playing tasks. Each pair took turns and spent about 15–20 min to complete each task. The implementation of the Unity tasks included three steps, as follows:

Step 1. Technology training. Although the young generations are often exposed to new technologies, some students are not familiar with the VR world, so basic navigating and controlling techniques were introduced at the very beginning of the activity. Each student also experienced wearing the goggles and moved around the virtual world for about one minute to reduce the distractions of a new technology before engaging in the language task.
Step 2. Language warm-up and instructions. After technology training, the instructors led the class in a five-minute warm-up session and gave instructions about the language structure and procedure of the task.
Step 3. Task performance in pairs. In each pair, one student wore the HTC goggles to navigate/move objects in the VR world, while the other student gave instructions. In each scenario, the students took turns and switched roles when performing the task.

During the activities, the instructors or tutors provided language support and corrective feedback related to the language foci.

5.6.4.2 Step-by-Step Instructions for Using Google Cardboard to Complete Tasks 3–4

The Google Cardboard-related tasks were implemented in the regular classrooms. Students were also assigned to pairs to participate in this role-playing task. Each pair spent 10–15 min to complete the task. The implementation of the Unity tasks included the following four steps:

Step 1. Technology training. Students used their own cellphones to look at the 360° pictures and slides with the assistance of Google Cardboard. Therefore, before the

VR activity, the instructor guided the students to set up their cellphones properly and let them briefly experience the Google Cardboard VR world.
Step 2. Language warm-up and instructions. After technology training, the instructors led the class in a five-minute warm-up session including instruction about the language structure and procedure of the task.
Step 3. Task performance in pairs. In each pair, both students wore the Google Cardboard to view the 360° pictures and communicate to complete the task. In each scenario, the students took turns and switched roles when performing the task.
Step 4. Concluding presentation of the tasks. After the pair work, students were required to present their discussion and communication by answering questions such as "What kind of food did you order in the dining hall?" and "How did you get to the milk tea shop?"

While students were working in pairs, the instructors walked around to provide support and corrective feedback related to the language foci.

5.7 Results and Discussions

The results of the study are organized by the two research questions on students' perceptions of language learning and their motivation, attitudes, and confidence. Since the design of VR tasks is made possible through the two types of VR tools and apps, Unity and Google Cardboard, four subcategories of discussions follow accordingly.

5.7.1 Students' Perceptions of Language Learning with Unity-Enhanced Tasks

Both quantitative and qualitative data were collected to investigate students' perceptions about their language learning, especially the learning of specific linguistic structures. Table 5.2 shows the participating students' perception of their learning on a 5-point Likert scale. Students rated their perceptions of using specific linguistic structures and functions from Strongly Disagree, rated as 1, to Strongly Agree, rated as 5. Items 2, 3, and 5 inquired about students' perceptions of the learning of linguistic foci and language functions emphasized in the second scenario of Unity-enhanced task 1, in which only the 14 students from the intermediate course participated. Therefore, the results of items 2, 3, and 5 are calculated based on the participation of 14 students in total.

The results show that students mostly perceived as very positive the ability of Unity activities to foster their language learning. First, the survey shows that all participating students agreed that their language learning improved through the Unity activities.

Table 5.2 Students' perceptions about linguistic structure and function learning in Unity tasks

Survey items	1 strongly disagree	2	3	4	5 strongly agree
1. I understand and am able to use "把" structure better through VR activities	0(0%)	0(0%)	0(0%)	4(15%)	23(85%)
2. I understand and am able to use "着" and "了" structure better through VR activities (for Intermediate Chinese students only)	0(0%)	0(0%)	0(0%)	1(7%)	13(93%)
3. I understand and am able to use direction and location devices better through VR activities (for Intermediate Chinese students only)	0(0%)	0(0%)	0(0%)	2(14%)	12(86%)
4. I can better give/follow instructions about moving objects	0(0%)	0(0%)	0(0%)	5(19%)	22(81%)
5. I can better describe interior settings (for Intermediate Chinese students only)	0(0%)	0(0%)	0(0%)	3(21%)	11(89%)
6. I can better give and follow directions	0(0%)	0(0%)	0(0%)	5(19%)	22(81%)
7. I can better describe exterior place and physical settings	0(0%)	0(0%)	0(0%)	5(19%)	22(81%)

Note Only 14 students from Intermediate Chinese participated in the second scenario of Unity-enhanced task 1 and completed items 2, 3, and 5 of the survey revealed in Table 5.1

Most strongly agreed that they could understand and were able to use the specific linguistic structures emphasized in the tasks, including the "把" structure (85%), the "着" and "了" structure (93%), and the direction and location devices (86%). Second, regarding the learning and practice of language functions, all students believed that they could better communicate for the specific purposes at which the tasks aimed. A majority of the students strongly agreed that the VR activity effectively helped their learning of the language functions: 81% strongly believed that they could better give or follow instructions about moving objects; 89% strongly felt that they could better describe interior settings; 81% strongly felt that they could better give and follow directions; and 81% strongly believed that they could better describe exterior place and physical settings.

Students' qualitative reflections also show that they believed the VR activities effectively fostered their language learning. For example, one participant mentioned in the survey having "never used '把' in such an authentic environment" and felt that he or she gained "deeper and more direct understanding of when and how to use this structure." Another student wrote that the VR activities helped him or her "become more comfortable with forming sentences about location since we had to use it a lot with repetition in conversation." Regarding the language function, one student described feeling able to "ask direction confidently when I go to Shanghai next summer after this activity."

In addition to pointing to the effectiveness in helping students' learning of specific linguistic structures and functions, participants' comments also reveal their perception of the activity as of great assistance in applying what they had learned in class. For example, several students stated that the activity helped them remember what they had learned in the previous classes, and that VR was a cool way to apply what they had learned to a realistic scenario. Students also felt that the VR activities further improved their conversation skills:

> The activities were very interactive. It provided us with new ways to use Chinese conversationally which really helped me with my conversational skills. I also think it was a more intensive way of learning because in class me and my classmate would use notes or other ways to facilitate our conversation. I don't think that is going to happen in the real world just like in VR.

Beyond the benefit of better practicing interactive skills, some students also thought that the Unity activities were able to help them practice language outside of the classroom setting: "it forced us to think more like we would outside of an educational setting—it was harder to speak in that setting than I would have thought." Students also mentioned in the survey that what triggered them to speak in class was the instructor's guidance and PowerPoint slides, while in the VR environment, it was the semi-authentic and information-rich surroundings that triggered them to converse without much rehearsing. Such differences helped them to better prepare themselves in a potential future real-world situation.

5.7.2 Learners' Perceptions of Language Learning with Google Cardboard–Enhanced Tasks

Table 5.3 shows the participating students' perceptions of their learning on a 5-point Likert scale. Students rated their perceptions of using specific linguistic structures and functions from Strongly Disagree, rated as 1, to Strongly Agree, rated as 5.

These results show that students mostly perceived positively the ability of the Google Cardboard activities to help their language learning. First, the survey shows that all participating students agreed that their language learning improved through the Google Cardboard activities. Most participants strongly agreed that they could understand and were able to use the specific linguistic structures emphasized in the

Table 5.3 Students' perceptions about linguistic structure and function learning in Google Cardboard tasks

Survey items	1 strongly disagree	2	3	4	5 strongly agree
1. I understand and am able to use direction and location words better through VR activities	0(0%)	0(0%)	0(0%)	3(11%)	24(89%)
2. I understand and am able to use Chinese food/drink/snack-related words better through VR activities	0(0%)	0(0%)	0(0%)	6(22%)	21(78%)
3. I understand and am able to use topic-comment sentence structure better through VR activities	0(0%)	0(0%)	0(0%)	3(11%)	24(89%)
4. I understand and am able to use sequencing devices in sentences better through VR activities	0(0%)	0(0%)	0(0%)	4(15%)	23(85%)
5. I can better communicate physical surroundings	0(0%)	0(0%)	0(0%)	3(11%)	24(89%)
6. I can communicate better in ordering and discussing about food/drink/snack and their flavors	0(0%)	0(0%)	0(0%)	4(15%)	23(85%)

tasks: direction and location words (89%), Chinese food/drink/snack-related words (78%), topic-comment sentence structure (89%), and sequencing devices in sentences (85%). The slightly lower number in the learning of Chinese food/drink/snack-related words was further explained in some students' qualitative reflections, which indicated that some new words had appeared in the VR environment when they looked at the authentic menus, especially in the Chinese milk tea shop. Such exposure to words about drinks they had never learned before had caused some distraction and difficulty in looking for and using the previously learned words.

Second, regarding the learning and practice of language functions, all students believed that they could better communicate for the specific purposes at which the tasks aimed. A majority of the students strongly agreed that the VR activity effectively helped their learning of the language functions; 89% strongly felt that they could better communicate physical surroundings, and 85% strongly felt that they could communicate better in ordering and discussing food/drink/snack and their flavors.

For the Google Cardboard activities, students did not reflect much on how the VR activities fostered their learning of specific linguistic features, although they confirmed this in their ratings in the survey. However, several students wrote that the

VR activities helped them acquire skills in language function, and especially that the VR environment fostered their focused attention on the function. For example, one student stated,

> When ordering food in the university cafeteria [during the VR activity], me and my classmates were so focused on discussing which dish we wanted to have. We were using all we learned to fulfill this task since the 360° picture looked so real. I wouldn't focus my mind this much in regular classes.

Many students also commented on the meaningful aspect of the Google Cardboard activities. They reported that the authentic VR surroundings created by 360° pictures from China made them feel that they were granted the opportunity to apply what they had learned to real-world scenarios. "I never imagined that I could either ride subway or order milk tea in Shanghai even if we learned related stuff," one student mentioned, "but now I think I can do both."

5.7.3 Learners' Motivation, Engagement, and Confidence with Unity-Enhanced Tasks

Table 5.4 shows students' motivation, engagement, and confidence in Unity-enhanced Tasks. Overall, most participating students held very positive impressions of the Unity-enhanced tasks. The results indicate that 11% of the students felt motivated in the Unity activities and 89% strongly agreed that Unity activities motivated them in learning Chinese. The survey results also show that students felt very engaged

Table 5.4 Students' motivation, engagement, and confidence in unity-enhanced tasks

Survey items	1 strongly disagree	2	3	4	5 strongly agree
1. I feel motivated in learning Chinese through Unity VR activities	0(0%)	0(0%)	0(0%)	3(11%)	24(89%)
2. The Unity VR activities are very engaging	0(0%)	0(0%)	0(0%)	1(4%)	26(96%)
3. I feel more confident speaking in similar real-world contexts in the future	0(0%)	0(0%)	0(0%)	3(11%)	24(89%)
4. I feel comfortable speaking in virtual environments	0(0%)	0(0%)	0(0%)	2(7%)	25(93%)
5. The goggles and related tools are easy to use	0(0%)	0(0%)	0(0%)	3(11%)	24(89%)

in the activities. A total of 96% stated that they felt very engaged in the Unity activities. Regarding students' confidence, 89% of the participating students strongly felt that they would be more comfortable speaking in the similar real-world context in the future.

The participating students also rated their perceptions of their comfort levels in speaking in a virtual environment and their attitudes about the technology tools they were using to navigate or interact with the VR world. Findings show that all of them felt comfortable (7%) or very comfortable (93%) in speaking in the virtual world, and most of them agreed that the VR tools were easy to use (89%).

Qualitative data also reveals students' positive attitudes regarding their motivation, engagement, and confidence. Most students believed that the tasks "can be more beneficial to Chinese learning" as compared with regular class activities. Beyond feeling motivated about language activities in VR environments, their motivation also extended to the long-term learning of Chinese. For example, one student stated:

> In the VR world, I was able to see myself speaking and doing things in China. It gave me an opportunity to convince myself that I will be able to survive in China with the things I learned in class. I am glad I've learned this language and will definitely learn more to prepare myself for the future.

In addition, the Unity activities motivated students to further explore cultural and intercultural aspects of China. For example, some students mentioned that it was very interesting to see Starbucks, Pizza Hut, and hotdogs in the virtual world, and they were curious about Western foods' current trend in Chinese cities.

Concerning engagement, many students described the Unity-enhanced activities as "really fun," "unique," and "engaging," and they felt that they were fully immersed in the VR world while using Chinese to accomplish the required tasks. Several students mentioned that they were focused on the tasks even more than they were in the regular classroom, because the VR environment provided them with distraction-free surroundings where only task-related objects and texts existed. Many students reflected that they would have liked to have more Unity activities to practice different kinds of structures that they were learning in class. However, some students also mentioned some side effects regarding their engagement in learning when using Unity. As one student mentioned, "because it [VR] is fun, people may get carried away while playing and not engaging in the overall purpose of the activity."

Qualitative findings also support participating students' ratings of the Unity-enhanced tasks as having a positive impact on their confidence in speaking Chinese. They felt that being able to speak in a semi-real environment before the "real thing in China" was very beneficial to their mental preparedness and confidence levels, especially in speaking. Some reported that being in a foreign environment "could be very intimidating," and the VR environment gave them "an opportunity to rehearse the potential future." One student wrote,

> I always thought that being in a foreign country with all the things I don't know, like the unfamiliar streets and the language. Today when I walked in the [virtual] shopping district in China, I realized it is not that bad. I am able to recognize many words on the streets and this gives me confidence in future traveling.

5.7.4 *Learners' Motivation, Engagement, and Confidence Through Google Cardboard-Enhanced Tasks*

Table 5.5 shows students' motivation, engagement, and confidence in Google Cardboard–enhanced tasks. Overall, the findings of the Google Cardboard projects show positive perceptions and attitudes from participating students.

All students were motivated in the task, and 89% were very motivated in learning and practicing Chinese through participating in the activities. Students also felt very engaged in the Google Cardboard activities. All participating students agreed that the activities were engaging, and 85% felt they were very engaging. Regarding their confidence in speaking in Chinese, 19% stated that they felt more confident in speaking in similar real-world contexts in the future, and 81% reported feeling very confident after practicing through the Google Cardboard activities. In addition, most students (93%) claimed that they felt very comfortable speaking in a virtual environment. When rating the ease of use of Google Cardboard and related tools, 85% of the students stated that they were very easy to use; however, a few participants did experience some difficulties in the technical setup and use.

In the reflection section of the survey, students reported that they felt "very excited to look around a real Shanghai," as they felt they were "truly surrounded by the Chinese shops." "It is a fun way to learn Chinese," one student wrote; "I hope we can do more of this in class." According to them, the authentic 360° pictures of China served as a bridge between what they practiced in the regular classroom and the real scenario in China. Such a bridge also showed them the gap between what they knew and what they needed to know to communicate in China. In their survey answers,

Table 5.5 Students' motivation, engagement, and confidence in Google Cardboard–enhanced tasks

Survey items	1 strongly disagree	2	3	4	5 strongly agree
1. I feel motivated in learning Chinese through Google Cardboard activities	0(0%)	0(0%)	0(0%)	3(11%)	24(89%)
2. The Google Cardboard activities are very engaging	0(0%)	0(0%)	0(0%)	4(15%)	23(85%)
3. I feel more confident speaking in similar real-world contexts in the future	0(0%)	0(0%)	0(0%)	5(19%)	22(81%)
4. I feel comfortable speaking in virtual environments	0(0%)	0(0%)	0(0%)	2(7%)	25(93%)
5. The Google Cardboard and related tools are easy to use	0(0%)	0(0%)	4(15%)	3(11%)	20(74%)

several mentioned that after seeing the 360° pictures of subway stations and shopping malls in Shanghai, they wanted to research more on the related language, cultural, and societal information online and review more about linguistic devices related to location and purchasing, so that they could better fulfill the communicative task in the real-world context in the future.

The information-rich surrounding created by Google Cardboard also motivated students to learn new Chinese words. In many of the 360° pictures, Chinese words were everywhere, since the photographs were taken in busy commercial areas. Students reported feeling a little overwhelmed at the beginning but becoming used to it after a while. Some mentioned that they had "never felt so eager to learn new Chinese words." As one student stated,

> It was a bit scary when looking at so many characters [in the shopping mall picture] which I have never learned about, but gradually I figured some them out by guessing from the stuff inside of the stores. This is an interesting journey and I really want to learn more words after this so I can recognize more next time.

In addition, many students enjoyed the feeling of cultural involvement when viewing 360° pictures. "Being in China is different from looking at the pictures of China on the slides in class," one wrote; "this is a very cool culturally immersed experience."

Some students raised concerns about the Google Cardboard–enhanced tasks. Concerning their confidence in speaking in similar real-world contexts, a few students wrote that they were very excited looking around in the VR environment, which affected their actual language practice, so that they needed more time to be able to feel confident about performing the communication tasks. Some students also mentioned that during the activities, they were not communicating with their partners while wearing the Google Cardboard goggles. Instead, they put the goggles down and only then started their interactions and negotiations. Therefore, several students were not literally speaking in the virtual environment. This is related to one of the common phenomena during the activities: some students reported feeling very dizzy when looking at the 360° pictures, and they had to take the Google Cardboard goggles off frequently to relieve the dizziness. In addition, several students mentioned that their cellphones were not compatible with the application needed to run the 360° pictures, and they had to spend a long time looking for alternative ways to participate in the activities.

In sum, the original goal of implementing VR tasks in Chinese language teaching was to enhance students' language learning, motivation, engagement, and confidence in a simulated authentic environment. The findings of the study show that the tasks created with Unity and Google Cardboard mostly achieved such language educational purposes.

First, both types of VR-mediated tasks effectively fostered students' language learning, as evident in students' self-assessments. Through the design of focused tasks, students worked collaboratively to use predetermined language functions and structures in the VR world's immersive and semi-authentic surroundings. In an active learning environment created by a combination of a real-world scenario and

photographed scene, learners were able to better perceive themselves as conversing in real-life conversations and solving real-life problems. Further, in terms of technology and task design, the instructors' onsite support substantially contributed to students' self-perceived improvement in language learning. Whether in a classroom or in a VR studio, the instructor's scaffolding and feedback guided the students to be able to use targeted linguistic devices in order to achieve expected language functions and to engage in genuine meaningful interactions.

Second, the current study bolstered the findings of the studies summarized in the literature review that students hold very positive attitudes about the VR-incorporated tasks. Beyond recording students' feelings of "fun" and "exciting," as documented in the existing studies, we found that Unity-incorporated and Google Cardboard–incorporated tasks enhanced students' motivation and engagement in Chinese language learning, although each type of task achieved this goal in different ways. One of the unique features of the VR world created by Unity is that it imparts full physical immersion and a feeling of realism to the users. Learners are able not only to view the 3D world but also to interact with it: they can engage in physical movements in the 3D world and touch and move the objects there. Such features help learners to feel more engaged with physical behaviors and memories, which may significantly contribute to their perceptions of motivation and engagement. In contrast to Unity, the VR world created by 360° pictures and Google Cardboard was very information-rich, which means that viewers are immersed in an entirely foreign language environment with Chinese texts, people, and nonverbal elements. Learners can experience a more real surrounding than in the Unity-related tasks, since the 360° pictures present real streets, restaurants, and shops in China, while in Unity, the scenes are only simulated with some authentic pictures attached to the VR objects. Aided by Google Cardboard, students experience a more authentic virtual tour of China, which may be one of the main contributors of improved motivation and engagement. Considering the learning design and technology of the tasks, it could be beneficial to find a combination of Unity and 360° pictures to maximize the advantages of both sets of tools.

5.8 Reflections on the Use of VR Technology

Currently, second language acquisition literature lacks guidelines and principles for incorporating VR tools and apps into the language classroom. In light of the findings summarized in the aforementioned sections, the following are some notes of caution largely pertaining to pre-task preparation to increase learners' familiarity with VR technology and after-task reflections on how VR-related tasks could have been carried out more smoothly.

It is worth mentioning that the Unity-incorporated tasks were completed in the media lab, where only one pair of students performed the task at a time, with the instructor and their classmates observing on the spot. This gave the instructor more opportunities to fully support each acting pair and to attend to their here-and-now needs. This, however, is the downside of the Google Cardboard–enhanced tasks,

which were conducted in regular classrooms where all students performed the tasks at the same time. Not all students could get immediate support and attentive guidance from the instructor, as they could in the Unity-enhanced tasks. This may explain the slightly higher ratings of students' self-perceived language improvement in the tasks enhanced by Unity.

Despite such differences in technology features and foci, tasks supported by each type of VR are empowered to increase learners' confidence in speaking. One thing to note, however, is the slightly lower confidence level observed in the Google Cardboard–related tasks. This might result from a sense of detachment between viewing through Google Cardboard and speaking the language at the same time. Since the Google Cardboard goggles are easy to take off and put on, some students took their goggles off when speaking and relied on their short-term memory of the 360° pictures that they had just seen. This may have negatively affected the authenticity and synchronicity of real-life communication with native speakers. This pitfall may have led students to perceive their language performance with less confidence and as less authentic than it could be.

As mentioned in the previous section, one reason for a sense of detachment between viewing and speaking in the Google Cardboard–enhanced tasks was the dizziness issue. This can likely be easily resolved by trying out the goggles for a second time to help learners get used to them. Advising students to turn slowly when viewing the 360° pictures is also very helpful to relieve dizziness. The dizziness issue was never reported or observed in process of implementing the Unity-enhanced tasks.

While both Unity and Google Cardboard tasks have proven to have positive effects on students' learning, motivation, and engagement, there exist several challenges in the refinement and adjustment of task design and planning. One of these challenges is associated with the limitations of technology devices, equipment, and applications. For the Unity-related tasks, one of the concerns raised by many students was scheduling. Since space in the media lab was limited, the entire class needed to be divided into two to three groups, which created scheduling inconveniences for students and instructors. With the relatively expensive equipment that Unity-enhanced tasks require, it is impossible to install a compatible well-functioning computer and bring the more expensive goggles into a regular classroom. With the Unity-enhanced tasks mainly performed in a supervised setting with a VR specialist present, no major technical issues occurred in the implementation of the Unity-incorporated tasks, whereas technical issues did arise when students used their cellphones to complete the Google Cardboard–enhanced tasks. The major problem lies in the fact that individual cell devices are hard to manage, navigate, and reformulate without technology support being provided in a regular educational setting for immediate problem-solving. Some students did not even have smartphones, so the 360° pictures would not display correctly or at all on their phones. A recent update of the cellphone system also caused some unexpected issues, which prevented some students from viewing through Google Cardboard. To plan more carefully ahead of time, a detailed and well-thought-out procedure is needed to ensure that students are technologically well-prepared in order to successfully perform the language tasks. This relies on a better-conducted technology orientation beforehand.

Another challenge is monitoring students' emotions and foci. It is observed that students' overexcitement and emotions may cause distraction from performing tasks. VR is a new and innovative technology, and students may never have experienced it before. Although excitement contributes in part to a higher level of engagement, the new technology does cause distraction, especially for the first time. It was observed that students were better able to focus on the tasks the second time they used the technology, so the more the students try it, the less overexcited they feel. One possible solution could be to extend the technology training time to give students more time to adjust to the new surroundings and explore the virtual world before they actually start interactive tasks.

5.9 Conclusion

The current study is a preliminary investigation of students' perceptions of and attitudes toward four communicative tasks facilitated by two types of interactive VR tools and apps, Unity and Google Cardboard, in an American university. Through incorporating focused communicative tasks, the VR-enhanced tasks proved to have a positive impact on fostering students' self-perceived language learning and enhancing their motivation, engagement, and confidence in Chinese learning, especially speaking. Although these findings are very encouraging, the study does have limitations in several aspects.

One concern is simply that the current sample size is relatively small, and further research should include a greater number of language learners across a wider range of proficiency levels, either through cross-sectional studies or longitudinal studies. Currently only a very small percentage of studies—27 out of 167 studies—focus on language learning (Reisoğlu et al., 2017), and the sample sizes tend to be very small (Wang et al., 2019).

VR technology increasingly emerges as a vital tool with the potential to transform how language can be taught and learned, through careful selection and implementation of technology. However, there is ample room for expansion in both scope and depth in follow-up research. The current study focuses on proficiency levels from novice-high to intermediate-low. Another set of pedagogical experiments should involve solid intermediate and advanced learners to test different types of task design and effects.

The current study also included a very limited set of linguistic structures and functions, and expansion beyond this set is another area for further exploration. The development of more tasks involving different linguistic structures and functions, aided by the incorporation of VR design, whether the same or different from this study, is critically needed in foreign language teaching and learning in general, and in Chinese language teaching and learning specifically. It is well recognized that with the current limitations of VR technology in language teaching and learning, it seems feasible to design tasks to fulfill pedagogical goals, partially or completely, through acquisition or enhanced learning of spatial arrangement, object movement,

and directive information. Hypothetically, as VR continues to advance and becomes more accessible, more language functions will be the foci of studies. Along the same lines, vocabulary learning and development in four language skills may be potential areas to investigate in the near future.

In terms of methodology, an important consideration is that the current study is purely descriptive and does not include a control group. Future studies should include both an experimental group and a control group to compare learning in two different learning contexts: a traditional learning context without VR technology and a newly created learning context that incorporates VR technology. Both groups should have identical curricular and pedagogical objectives. Findings from this type of comparative study will contribute to experimental design and deepen our understanding of the roles VR technology can play in different dynamics and settings.

Future studies are also needed that further refine task design and link tasks closely to language gains. Tasks might be compared to a chameleon: nuances in design matter a great deal. In the current study, role play and information gap, which are among the most frequently implemented communicative tasks in any foreign language classroom, serve as a great starting point for a simple task design. Given that VR is still emerging, simplicity in tasks is still key. It is believed that future developments in VR technology will make its application to pedagogy more versatile and thus satisfy a greater diversity of language learning needs. These technologies hold great promise for the foreign language teaching and learning community.

Finally, the current study is limited in terms of analysis, which is in the form of learners' self-perceptions; these, it may be safely assumed, may differ from actual, objective improvements in language learning. Given VR's limited capacity and the constraints on task design those limits impose, the current study did not successfully record learners' language output for further analysis. Admittedly, evidence-driven outcomes in language development, both short-term and long-term, are needed to supplement and strengthen self-perceived results. This capability awaits further advances in VR technology that will make possible the recording of speech and saving of written language output for substantial investigation.

Most generally, there is a great need for more studies into the possibilities and challenges of VR in foreign language teaching and learning (Lan, 2020). Future studies can place core emphasis on task design and implementation and the application of 3D VR technology in close alignment with instructional goals. There is a great deal to explore. A fundamental question that has been guiding second language researchers and practitioners has been how best to incorporate technology into language teaching. This question is all the more salient now, given the great promise of and rapid changes in VR technology.

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Chapter 6
Into the Real World: Autonomous and Integrated Chinese Language Learning Through a 3D Immersive Experience

Yanjun Wang, Matthew Grist, and Scott Grant

Abstract To find ways to promote out-of-class autonomous Chinese language learning with technology, the Chinese programme at a regional Australian university provided its undergraduate Chinese as a foreign language (CFL) student with an additional learning opportunity in order to practice and thereby reinforce communicative language skills in an extant immersive 3D multiuser virtual world (3D MUVW) created in Second Life (SL), Chinese Island (CI) (https://www.youtube.com/watch?v=3EYZueyp1go&t=2s) developed by a major Australian urban university. This chapter presents a semester-long pilot study that aimed to investigate students' perceptions of this learning resource, particularly to explore whether this integrated approach can assist Chinese language educators in fostering autonomous learning out of the classroom. Through analysis of individual and group interviews, the study found that the resources afforded by CI were beneficial for students' learning of Chinese language and culture beyond the classroom. In addition, the findings could inform Chinese language educators about how to better prepare students for intensive and immersive study abroad. The chapter concludes with pedagogical implications and directions for further research.

Keywords Chinese as a foreign language (CFL) · Autonomous learning · Immersive 3D multiuser virtual world (3D MUVW) · Second Life (SL)

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6.1 Introduction

The concept of autonomous learning has been broadly explored (Kozlova, 2018) for many decades in the areas of education and training, as well as in the specific field of foreign language learning (Little, 2003). Since the term was first brought to prominence by Holec (1980), the growing focus on lifelong learning globally has further heightened the importance of autonomous learning (Lai et al., 2016). In a paper presented to the European Seminar on Foreign Language Learning Needs in Educations Systems, Mackiewicz (2002) highlighted the importance given to foreign language learning as a key basic skill that forms part of lifelong learning by the European Union. The learning of foreign languages in Australia, as a key part of the heightened need for intercultural competence for participation in the global economy (Fernandez, 2007), has been widely recognised throughout all levels of government. Acknowledging the importance of foreign language learning and the role of technology in that process, from 2014 to 2020 the Australian Federal Government invested A$27 million in the Early Language Learning Australia (ELLA) programme. Young children are exposed to languages other than English using play-based apps that are designed to encourage ongoing language learning in later years (Australian Government, 2020). In 2012, the then Prime Minister Julia Gillard announced Mandarin Chinese as one of the six priority Asian languages to be offered in Australian schools (Australian Government, 2012) and Mandarin continues to be one of the most in-demand languages in Australia today (Yun, 2020), although there has been a significant drop-off of Australian-born students learning Mandarin in recent years (Bolton, 2019).

Learning a foreign language is a challenging task. This is particularly true for Mandarin Chinese, which has been described as an extremely difficult language for native English speakers to learn (DeFrancis, 1984, p. 126; Orton, 2010). The US Department of State's Foreign Service Institute classifies Mandarin Chinese as one of the "super-hard languages" that are exceptionally difficult for native speakers of English to master.[1] Bearing in mind this intrinsic difficulty, any learning opportunity beyond the classroom with the target language is considered crucial for achieving any level of mastery. The continuing development of technology "increases the accessibility to learning materials and expands learning experiences beyond the classroom" (Navarre, 2019, p. 5), factors important to the cultivation of autonomous learning. In the context of Chinese as a foreign language (CFL), Lai (2017) proposed the importance of making connections between in-class and out-of-class learning experiences by supporting learner autonomy with technology.

In the past decade, "the rapid rise in Chinese teaching and learning has provided new opportunities for students around the world, but new challenges have arisen as well" (Orton & Scrimgeour, 2019, p. 126). As a result, CFL educators nowadays are facing an increasing diversity in terms of the students' personal experiences, motivations, aspirations, and skills for learning. Wang (2016) indicated that for "adult learners who had experience of learning more than one foreign language

[1] https://www.state.gov/foreign-language-training/

in addition to English, their knowledge is no less than their teachers, and sometimes more realistic and practical" (p. 69). These new learning contexts suggest that any foreign language programme should adopt a range of pedagogies and teaching strategies to make learning engaging, interesting, and meaningful. Nevertheless, from a pedagogical perspective, CFL has long been dominated by traditional teacher-oriented and textbook-driven approaches that leave little room for independence and creativity (Wang, 2016). Chan (2001) stated that knowledge in a traditional Chinese learning setting is "transmitted by teachers rather than discovered by learners through their own methods" (p. 507). Moreover, Chinese textbooks commonly fail to expose students to authentic language in authentic contexts. Therefore, the reality of a conventional CFL classroom reveals the needs to respond to new contexts by searching for solutions to maximise and expand students' autonomous learning outside the classroom with the help of technology.

According to Reinders and Benson (2017), most language learning research studies have been carried out within the classroom and, up until now, recognition and practice of autonomous learning in CFL has yet to be well understood (Wang, 2016). Most importantly, inspired by the extensive literature on the significance of learner autonomy using technology in language learning (Little et al., 2017; Reinders & White, 2016), this study attempts to explore the learning experience provided by Chinese Island (CI) in a small sample of CFL students at a regional university in Australia. The principal objective of this project was to examine the integration of a 3D multiuser virtual world (3D MUVW) into the curriculum of the formal Chinese programme to support autonomous learning. Overall, it was anticipated that this initiative may have proved to be beneficial for CFL learners to advance their Chinese language learning in contexts and situations that organically resemble the real world.

6.2 Context of the Study

The Chinese language is considered an increasingly important language in terms of economic and social significance for Australia (Australian Government, 2020). In response to this context, and in order to meet the demand for access to diverse modes of learning (Wang, 2016), the regional university in which this study was based has successfully implemented an online Chinese introductory course for the last three years. The implementation of the fully online offering has resulted in steady growth in student numbers in the Chinese programme since 2018. As a result, compared to previous years, the overall participation in Chinese language study has been correspondingly increasing at this regional university due to this new addition. Despite some obvious advantages of online offerings (e.g., accessibility, flexibility), it is equally important to keep in mind that there are some inherent disadvantages, such as lack of face-to-face (F2F) communication and difficulties with student self-regulation (Gilbert, 2001).

It is worth noting that unlike other major urban Australian universities, this regional Australian university is in a geographically isolated location, which is not

in proximity with any foreign language community. This may potentially pose a challenge for students who seek to learn foreign languages due to the lack of interaction with speakers of the target language and limited opportunities to actively use the language outside the classroom. CFL learners—particularly those who choose to study fully online—are no exception. Furthermore, as discussed previously, because of classroom constraints and textbook limitations, CFL students have limited opportunities to practise spoken Chinese that relates to real-life situations while in the classroom. Although an in-country study experience can potentially partly remedy this situation, this may not be feasible for students at the university who come from low-socioeconomic status households (Grant et al., 2018).

Acknowledging this regional university's strategic goal of boosting high-impact learning experiences and engagement in active, authentic learning, with the increasing number of beginning level students learning Chinese online, the need to offer them an effective and engaging learning experience is imperative. The Chinese programme at the university in which this study was conducted is fully committed to "finding ways to tackle the challenge, especially to provide frequent, sustained opportunities to hear the language in natural contexts, and inviting opportunities to use it productively" (The Asia Education Foundation, 2009, p. 12). This chapter attempts to show whether providing students with resources such as CI would enable them to apply knowledge learned in the classroom in quasi-personal communication in a virtual world. This may also help students learn to become independent learners "through promoting virtual communication and collaboration so that learners may participate in the larger community of the target language and culture and continue with their learning" (Navarre, 2019, p. 5). Specifically, the students undertaking multi-level undergraduate Chinese language study at this regional university were offered the chance to practice and thus reinforce their linguistic and intercultural development in a 3D MUVW (CI).

6.3 Literature Review

6.3.1 Definitions of Autonomous Learning

Han (2014) argued that defining the concept of autonomous learning is "the most difficult question to define" and that "any answer to it is likely to be subjective" (p. 21). Schwienhorst (2003) also commented that "many researchers and theorists find the concept of learner autonomy hard to grasp" (p. 428). However, as a baseline, Henri Holec's original 1980s definition of autonomous learning has been posited as being "universally accepted" (Little, 2007). In his report to the Council of Europe entitled *Autonomy and Foreign Language Learning*, Holec defined the autonomous learner as one who has "the ability to take charge of [his or her] learning" (Holec et al., 1980, p. 3). From this basic foundational definition, over time, a wide range of more nuanced definitions have emerged. Kozlova (2018), drawing on sociocultural theory,

highlighted the fact that autonomous learners are active agents who choose their actions consciously with an awareness of how those actions will affect their learning. From a constructionist perspective, Lai (2017) and Çakici (2015) also highlighted the active role autonomous learners play in their own learning process. Çakici (2015) argued that "the key to succeed in learning depends on allowing each individual to construct his or her meaning, not to make them memorise and repeat another person's meaning" (p. 32). Furthermore, Çakici (2015) drew together a common thread among the various definitions by arguing that learners are not just involved in their own process of learning; rather, within that process they make a connection the world outside the classroom and the learner's own "beliefs, ideas, and thoughts" (p. 32).

6.3.2 Autonomous Language Learning

Benson (2006) further argued that, in addition to learners taking more control over their learning in both inside and outside the classroom, language learning autonomy is about learners taking more control over the purposes for which they are learning a language. For many learners, a desire to reach some level of proficiency is one of the main purposes in studying a foreign language. Little (2007) argued for the crucial integration of "the development of learner autonomy and the growth of target language proficiency" so as to place the focus firmly on the intended outcome, which is proficiency in the target language (p. 15). While these two elements are crucial, there are, however, a number of constraining factors in the learner's pursuit of autonomy. Learners do not always show enough initiative (or have the ability) to structure their own learning, and so autonomy needs to be encouraged and supported in a targeted manner (Fonseca-Mora & Arnold, 2016). According to Tassinari (2017), teachers play an important role in promoting language learner autonomy. In addition to motivating them to take charge of their own learning and setting realistic goals, teachers also need to provide students with appropriate materials to facilitate autonomous learning. At the same time, the degree of autonomy a language learner can achieve at any one time is also constrained by what the language learner "can do" in the language being learned (Little, 2007). Educators have a crucial role to play in designing learning environments and activities that both maximise the use of what learners "can do," offer them structured opportunities to extend themselves beyond what they think they "can do," and help them make connections between what they are learning and the outside world.

Much research has been done on what constitutes a "good language learner." For Lai (2017), citing Carol Griffiths (2008) who was writing on the findings of Rubin about a number of characteristics of the "good language learner" (Rubin, 1975), one of the common characteristics of a "successful" language learner is that of autonomous action in the form of "practice the language they are trying to learn (for instance by seeking out native speakers and initiating conversations)" (Lai, 2017, p. 3). In concert with Lai, Griffiths, and Rubin, Çakici (2015) also argued that an

autonomous language learner develops the ability to use the language being learned in situations outside their classroom or normal learning environment. Yeh and Lan (2018) emphasised the importance of learner reflection, stating that autonomous language learners learn "more efficiently and effectively" as a result of regular reflection, which enables them to take greater control of their learning process, which in turn drives their motivation to learn.

6.3.3 The Importance of Lifelong Learning and the Role of the Teacher in Autonomous Language Learning

In a paper entitled "Teacher's Role in Developing Learner Autonomy: A Literature Review," Han (2014) analysed in detail a number of commonly used terms that on the surface appear to be concepts similar to autonomous learning. These terms include "self-instruction," "self-direction," "self-access," "distance learning," and "out-of-class" learning. Han (2014) identified a key difference between autonomous learning and these well-known modes of learning. Han (2014) argued that these terms describe ways of learning by oneself, but say nothing about the "capacity to learn by oneself" (p. 22). Han (2014) made the salient distinction that "autonomous learners may well be better than others at learning by themselves… but they do not necessarily have to learn by themselves" (p. 22). Citing Holec's (1980) definition of autonomous learners as being ones that are able to "take charge of one's own learning" (Han, 2014, p. 23), it is here that Han situates the role of the teacher. For Han this role consists of aiding autonomous learners to take responsibility for making decisions about their own learning. With this perspective in mind, Han (2014) identified three key factors in achieving learner autonomy: the learner's willingness to actively take the initiative for their own learning (learner attitude); development of the learner's capacity to learn independently through training and teacher support (learner capacity); establishing a supportive environment that includes appropriate guidance, facilities, and learning materials (learning environment) (p. 23).

In the digital age of the modern era, technology has come to play an ever-increasing role in our everyday lives (Yurdakul, 2017). The World Economic Forum (WEF) in their The Future of Jobs Report (2018) argued that the Fourth Industrial Revolution wave of technological advancement is "set to reduce the number of workers required for certain tasks," but at the same time will create new jobs that will require re-skilling and up-skilling of employees (p.v). In addition to businesses and governments providing appropriate support for these transitions, the WEF report emphasised the importance of individual employees taking "a proactive approach to their own lifelong learning." The report argued that employees will need "a mindset of agile learning" as they shift to "new, previously unimagined futures" (p.ix). In the field of higher education, Blanschke and Hase(2015) argued that the internet and social networking are "game changers for the knowledge industry" (p. 76), with their popularisation creating a knowledge revolution (Lai et al., 2016), empowering students

to learn "what, where, and when they want, and throughout life in response to need" (Blaschke & Hase, 2015, p. 76), but that these new ways of learning have left "higher education institutions scrambling and institutional leaders, teachers, and learner roles in a state of flux" (p. 75).

In the field of foreign language learning, like Han (2014) and Lai et al. (2016) saw a critical role for teachers in fostering learner attitudes towards and capacity for autonomous learning and facilitating the development of a "set of essential skills" that enable learners to use information and communication technology outside the classroom to become successful language learners and lifelong learners (p. 703). However, a key finding from their 2016 study was the existence of a mismatch between teacher and learner expectations in terms of the "degree of teacher involvement and the specific roles teachers could play" (p. 719). Students expected teachers to provide greater support in terms of recommending both appropriate technological resources and effective cognitive strategies for the use of those resources. Contrarily, teachers often mistakenly assume that because their students are technically savvy and familiar with the digital world (that they are "digital natives" [Prensky, 2001]) they therefore also have a strong capacity to use technological resources for autonomous learning (p. 717). This adds further support to Han's (2014) view that the "capacity to learn by oneself," to learn autonomously, is something that needs to be fostered in addition to any skills required by the method adopted for learning (p. 22). Lai et al. (2016) argued that teacher support for learners' autonomous use of technology outside the classroom for learning requires a multidimensional approach that incorporates encouragement (to address learner social and affective needs), recommendation of appropriate resources (to address learner metacognitive needs), sharing of learning strategies (to address learner cognitive needs), and in-class technology use (to promote learner use of technology outside the classroom) (p. 718).

6.3.4 Learner Autonomy and Virtual Worlds

In recent decades, the variety of information and communication technologies has expanded significantly. In addition to a range of 2D technologies such as blogs, wikis, online video platforms, online chat platforms, etc., multiuser 3D virtual worlds are gradually becoming more common. According to Technopedia (2020), virtual worlds are online custom-built simulated worlds where users interact with each other using avatars that are either text-based, two-dimensional or three-dimensional. Virtual worlds are characterised by persistence and interactivity. There are two broad types of virtual world: entertainment-based and social interaction-based. The former consists mostly of games, while the latter focuses on social interaction, education, and training. Pellas et al. (2017) further categorised social interaction-based virtual worlds into: social virtual worlds (users coexist in a persistent environment without specific goals, story lines, classification systems, etc., where the underlying virtual world architecture is provided and hosted by a commercial operator at a cost); open

source virtual worlds (similar to social virtual worlds, but the virtual world architecture is free and can be hosted by users on their own servers); collaborative learning worlds (multiuser virtual worlds where both the underlying virtual world architecture and the virtual facilities are provided and hosted by a commercial provider).

From Kozlova's (2018) perspective, the combination of a problem-based task with an additional exploratory component in a 3D virtual world can promote learner autonomy for foreign language learners. Tasks provide learners with a reason to produce and process language, while the technology generated environment provides them with a means to communicate and collaborate and potentially stimulates interaction through visual and auditory cues. However, she found that the key to achieving the desired communication outcome of negotiation of meaning was clarity of instructions and task design which requires students to share information with peers and instructor-controlled player characters in order to be able to complete the task.

Collentine (2011), on whose work Kozlova (2018) partly based her study cited above, concluded that while 3D virtual worlds do have the potential to encourage language learner autonomy, and through autonomous learning and input received encourage language production, achieving autonomous learning requires a well-defined task to be completed in the virtual environment. Collentine's (2011) study also revealed the complexity of the relationship between autonomy, input, and production in a 3D virtual world.

Lan (2018) argued that while advanced technologies like 3D virtual worlds can promote authentic and autonomous learning, they cannot inherently guarantee effective and autonomous learning. Appropriate pedagogical design, evaluation, and learning technique analysis are critical to realising these outcomes. Yeh and Lan (2018) demonstrated the enhancement of learner autonomy in a 3D virtual environment based on the three elements outlined in Lan (2018). Primary school learners of EFL were required to explore the 3D environment, create their own learning materials and learning contexts, engage in role play, and then make videos of their interaction during the exploration and creation process of their role play. The study found that the lesson design and 3D virtual environment helped participants to learn "how to make their own decisions and evaluate their creations" (Yeh & Lan, 2018, p. 705), both key factors in promoting learner autonomy.

6.4 Research Design and Methodology

6.4.1 Research Objectives

The broad objectives of the research activity reported on in this study were to identify—in relation to the presentation and delivery of an interactive online resource for Chinese learning—aspects of the ways in which learners used it that were relevant from the analytic viewpoint of autonomous learning. One element of this was the investigation of which aspects of the resource appealed to learners, and what factors

undergirded that appeal—since understanding those aspects of a resource that are likely to have appeal to learners is, prima facie, beneficial for being able to showcase the resource in ways that will tend to foster uptake, and the desire to engage with a resource is potentially an important precondition for autonomous learning. This is equally true whether a resource is deployed in formal learning or assessment tasks, or (as in the present case) is made available as an optional resource.

CI has been designed to support self-paced exploration by learners, and its learning activities and interactive functions are accessible independently of the constraints of class scheduling. Just so long as they have a computer and an internet connection, students can engage with the learning activities embedded in CI. No other users need to be online at the same time in order for this to occur. The data collected for the present investigation can broadly be categorised as retrospective student self-reports of their experiences while using CI, and these data were therefore interrogated to ascertain what they could reveal about aspects of autonomous learning, such as the issue of appeal discussed above. In a process beginning with the provision of information about the resource and then moving on to learners using it themselves in a self-directed and low-stakes context, learners were forming their own conceptualisations about the resource and then, in light of their experiences, revising them. These conceptualisations were what the research team wanted to capture, in order to discover what they implied about autonomous learning.

Summarised in statement form, this project investigated how students dynamically constructed meanings around CI, taking into account both the contributions of instructors and of learners, in order to discover how the meanings thus constructed were implicated in the expression of autonomous learning as seen in the participants' use of the resource.

6.4.2 Participants

A pool of potential candidates was formed from within the entire student body currently enrolled at any stage of the undergraduate-level Chinese programme at the regional university referred to above. This Chinese programme consists of three consecutive tiers, generally attempted over three successive years (or partly via intensive in-country delivery mode during vacation periods). There are no prerequisites for admission to the beginner level, or first 100-level, unit, other than the stipulation that students must not already be above the beginner level in terms of their Chinese language skills. Subsequent units generally require successful completion of earlier units, or other demonstration of linguistic competency.

The language of instruction at the university is English, and the textbooks used in the Chinese programme are annotated in English. Participants for the present investigation were sourced from students within the candidate pool who had responded to the invitation to participate in a survey (see below). Of 28 survey respondents, 64% identified as female, and 36% as male. 79% were under 30 years of age, and 14% were aged 46 years or older. 53% stated that they grew up with a monolingual

English-speaking family background, but the survey did not differentiate between different levels of exposure to other languages among the remaining students. All but two survey participants studied in on-campus mode, and 57% of respondents described themselves as being familiar with computer gaming. All but one participant rated their home internet connection as high-speed. Seven of these 28 mixed-level undergraduate CFL students were interviewed.

6.4.3 Research Design

All students in these three cohorts received presentations by email, and, in many cases, in class, describing and demonstrating some of the features and affordances of CI. Information and instructions were also uploaded to bulletin boards in the online learning management system (LMS) space provided for each cohort's respective Chinese course. The learning resource was presented as an optional study tool, for which use or lack thereof would not be a factor in determining a grade for any assessment task in the learners' respective courses of study. After these students had been given at least eight weeks to gain familiarity with the resource and explore it at their leisure, they were invited to participate in a survey asking them about their experiences and views in relation to CI, and later also invited to participate in a follow-up interview or focus group. Whether participants were interviewed singly or in small groups depended on logistical factors. This chapter reports on the results of the interview phase of the investigation.

All participants at both stages of data collection were volunteers, and the size of the pool of eligible candidates was not large enough to make feasible the randomised selection of interviewees. It should be remembered, also, that the data used in this investigation have been drawn from a group of individuals who have already demonstrated a certain amount of self-motivation in the sense of volunteering, firstly, to spend their own time in exploring and using the resource, and, secondly, to participate in research activities where they were to be asked about their experiences. Moreover, it should be noted that many degree programmes at the university permit the introductory levels of Chinese to be included as non-core, or elective, units. Because of this, many of the students in the Chinese programme have already demonstrated a certain degree of agency and self-direction simply in virtue of making that particular choice of subject.

Taking these factors into consideration, the number of volunteers in both phases of the investigation was considered sufficiently high—in proportion to the size of the cohorts in Chinese language courses at the university—to give the investigators confidence that the data obtained would be broadly representative of those cohorts. This confidence was bolstered by the observation that the overall response to the resource was favourable in both datacollection phases, suggesting that the interviewees were, in their turn, broadly representative of survey respondents.

6.4.4 Data Collection

Participants were interviewed one-on-one, or in a group of two interviewees, by a researcher who was not, in the relevant semester, an instructor to any of the students. Interviews were conducted on a semi-structured basis, with a set of questions having been provided to interview candidates prior to the interview. These questions were used as conversation starters in the interviews, and interviewees were informed at the start of the interview that the questions would be used flexibly.

Questions and responses were recorded digitally in audio format, and later transcribed by the same researcher who had conducted the interviews. One participant elected to provide answers in written format, due to difficulties with interview scheduling. Interviews were conducted over a two-week period and transcribed as soon as practicable after each interview. This enabled the researcher conducting the interviews to dynamically adjust their specific delivery of the flexible, semi-structured interview schedule for subsequent interviews in light of interim hypotheses already forming in their mind on the basis of interviews already conducted, in the manner described by Merriam (2009, pp. 170–173).

Transcript data was anonymised (using aliases, which appear in this chapter when participants' direct speech is quoted) and, after the last interview was completed, collated into a single word-processing document for thematic analysis. The procedure followed, with only minor deviations, was the six-step process set out in Braun and Clarke (2006, pp. 86–93). The research team's focus was on explicit and implicit thematic meaning of participants' statements, as discussed by Saldaña (2011, p. 10), and not on variables of discourse, so hesitations and on-the-fly corrections by speakers were not indicated verbatim in the transcript, unless the researcher considered that these significantly illuminated the speaker's meaning. The collected data amounted to approximately 10,000 words.

6.4.5 Data Analysis

In consultation with the other researchers, who were also provided with a copy of the anonymised interview data, the same researcher who conducted the interviews initially divided the text into topical segments or units, which were copied into spreadsheet software so that multiple annotations could be added to each identified segment. These annotations included the participant's allocated alias, and the investigator's summation of the content of each unit of text. These summaries, or codes, were in turn considered for threads that linked together various groupings of separate statements in terms of their subject matter, and the investigator added additional annotations, such as indications to the "mood" of the statement (e.g., curious, challenged, frustrated, or pleased), which provided a visual reminder to the researcher of the varying character between individual instances allocated to a given thematic grouping—these groupings being, at this stage, still provisional and subject to revision.

In the course of the process of refinement and reconsideration that was carried out over several weeks, these topic areas were further focused and consolidated to yield eight themes, offering an indicative overview of the thematic linkages between the identified textual segments, before applying any specific epistemological or heuristic focus to the data. After these topics were finalised, they (along with the individual text blocks allocated to each) were analysed again with a view to ascertaining what the statements could be construed to be saying about learner autonomy. In the course of this process, some individual coded text segments were moved from their existing theme into another, and some entire themes were amalgamated with others, ultimately yielding the six thematic categories that are reported in the following section.

6.5 Results

6.5.1 Theme 1—Communication (NPC)

Chinese Island contains many inbuilt scenarios where AI characters will respond to certain input situations that trigger a dialogue exchange with the player, which is conducted via Chinese language (keyboard-based) text chat, using simplified characters. Exchanges like this were demonstrated on-screen for students during in-class presentations about CI, and often involve transactional interplay, such as where a player visits the restaurant and orders food or drinks from the non-player character (NPC) waiting staff. If such an exchange is sustained until it reaches its intended conclusion, a visible change occurs in the in-world environment: in this example, the food or beverage is "served" to the player at their table.

This kind of communicative exchange task in the target language was included not only as an opportunity for rehearsal of dialogue skills and vocabulary, but more importantly as an instructional strategy that creates potential situations for learners to intentionally and reflexively engage with the Second Language Acquisition (SLA) process. This is partly due to the existence of a knowledge gap—the player does not know precisely what kind of chat input the NPC will be "expecting." As a result, they might be compelled to switch strategies if a first attempt does not produce the result they were aiming for, in a way that typically does not occur when two students are roleplaying from a script.

Additionally, it should be remembered that the task completion conditions are experientially richer than those of a more traditional roleplay, because it takes place in a culturally themed environment; because the interlocutor is visually not a peer of the student; and because the goal-state can contain a visible "reward" such as the above example of the arrival of a steaming hot virtual meal in front of the player's avatar. Such manifest changes within the CI virtual space serve as tangible and objective emblems of the interaction's successful conclusion.

Interviewees showed a clear awareness of the operation of these aspects in their learning while using CI to communicate with AI characters (NPCs):

> Yeah, and you could think about things, and it would reinforce stuff, and I would think, "Am I saying this the right way?" [Interviewer: So you try something and you don't quite get the right result, so you then try something a bit different.] Yeah, and then once you get that success from it, then you keep going. (Kathleen)

When NPCs used or expected unfamiliar speech patterns or vocabulary around familiar topics, participants recognised this as an opportunity to broaden their expressive range:

> … so if we had learned a different way of saying things, to mean the same thing, it wouldn't create the same responses that you would get. (Tania)
>
> And it's not overly different, and so it challenges you enough that you learn something new, and I actually appreciated that, because it's good to be able to get a different perspective, I suppose. You've gotta have all the modes. (Kathleen)

Students' responses also showed that they thought of the text-based medium of NPC dialogue as a "sandbox" for practising communication, per se, with applicability to other communicative modes, and more than one student noted in this context its de-inhibiting value for learners:

> … my weakness is speaking. I don't speak much, but I type the way I speak in Chinese, and … I construct the sentences, and … I say things in the island and try to apply what I have learned [in class] there. Soit's like – nobody can see me and so I can type in Chinese however I like, without feeling embarrassed, you know what I mean? (Abigail)
>
> As I was walking or participating in some of the interactions, in my mind I kept saying to myself "I can't wait to do this in real life." (Darren)
>
> [CI helps with] psychological inhibitions [such as] communicating with a stranger, worrying about being judged. (Darren)

6.5.2 Theme 2—Communication (Human)

While NPC dialogue was, by design, a key component of the learning activities in CI, students had also been made aware of the facility to interact with other users in real time, and this possibility strongly captured interviewees' imagination—particularly those studying in more isolated geographic or social contexts.[2]

Real-time interaction with humans in CI was indeed a prominent issue for interviewees, but this was primarily expressed in terms of a largely unfulfilled desire or brought forward as a counter-factual statement to illustrate interviewees' actual experience by means of contrast.[3] Some students who had spoken about the value of interactive elements of the environment, including AI characters and interactive

[2] Note here that "isolation" includes learners situated distantly from other Chinese speakers/learners, and not merely those living at a distance from larger population centres. In other words, it includes those who may be living in an urban area, but who are not personally in contact with Chinese speakers outside of the instructional context.

[3] A notable exception was the subset of participants who spoke favourably of their interactions with instructors who happened to be online during their visits to CI.

objects, nonetheless also indicated that they placed a higher value on interaction with other humans—or, in Kathleen's words, "chatting with other actual people":

> In a group of people, it's much easier – you can talk to people like in everyday life, so that will help us a lot, to improve … It's much better when you have people around you and you are interacting. (Abigail)
>
> Unfortunately, there weren't many opportunities that I found when there were other people playing around as well … and you know I was often alone and just clicking on things around [me]. (Tania)

Some students mentioned experiencing feelings of aloneness or loneliness when visiting CI in the absence of other visitors, while others spoke of their disappointment when other users had their own tasks to complete and were not willing or available to participate in spontaneous dialogue with them:

> It was quite lonely, when you were there, but if you went there when there were other people there, you sort of felt that you could chat with them, and that was good. (Kathleen)
>
> They would talk to each other, and there wasn't a lot of interaction in the chat. I tried like "Ni hao," and stuff like that, very simply, and no one responded. (Tania)

Interestingly, despite the high value participants placed on human interaction within the platform, they seem to have taken a relatively passive role in obtaining this, mentioning how they may have logged on with the hope that others might be online, or turned up to online "meet-up" opportunities advertised by the investigators. The investigators found no evidence of participants taking steps to instigate online encounters themselves, such as making arrangements with classmates to meet in-world at a given time. Instead, it seems that students relied on instructors to take the organising role:

> [There should be] more encouragement for students to talk to each other, but that's more of an external thing, I guess. (Tania)
>
> It would be good … [to do] that inclass, so there are other students in there at the same time. (Gregory)

6.5.3 Theme 3—Vicarious Living

As is suggested by the example above of students experiencing feelings of loneliness in the CI environment, participants quickly built a vicarious sense of self around their in-game representative, or avatar. This was also apparent in more positive senses, along the lines of Darren's comments above, where he discussed CI as a way of building skills for real-world interactions through combating "psychological inhibitions."

Participants attributed this, in part at least, to the cultural elements built into the interactive environment, which facilitated the building of the learner's sense of "being" in an environment that had Chinese characteristics. Barbara mentioned the Dragon Boat Festival as an example of the "really varied, and really creative ideas" that contributed to that sense, Darren spoke about how the "vibrancy of the settings"

triggered nostalgia for times he had been in Asia himself, and Abigail cited the background music selected for use in CI as an important part of why CI "is a great language learning area":

> When I was in the restaurant, you know how they play the Chinese music – like, normally I do listen to some Chinese music, and when I walk into the game – the Chinese Island – I could hear the sound that I am used to listening to. It makes me feel that it is a real – I feel like I am in China, if you know what I mean, in the restaurant. (Abigail)

More specifically, Darren also identified the name of the platform "Second Life" as apt to his experience in CI, as it produced a "curiosity and desire to engage with another version of myself" who could use the Chinese language to "[explore] the streets of China," adding that CI "psychologically [teleported] me into settings that I could imagine myself being in, overseas" and deepening his "psychological motivation to engage with the language."

6.5.4 Theme 4—Logistical Issues

Interview participants made frequent mention of technical issues (such as software installation), and also of the various difficulties they encountered in the course of learning what to do, and how to do it, in the CI environment. While much of this subject material lay outside the scope of the present investigation, it is worth pointing out that participants were generally situated towards the "less clarity/more discovery" end of a spectrum between the provision on the one hand of exhaustively comprehensive instruction, and purely self-directed exploration on the other. Some participants, accordingly, spoke of initial frustrations before they obtained benefits from using CI, and some mentioned having received additional individual guidance or encouragement from their instructors as a part of that transition from confusion towards familiarity with the resource. For example:

> And [the instructor] just gave me a couple of tips there, and I was off. I was able to interact easily and ask the questions to get the answers. [Otherwise] I would have just been fumbling for a bit longer. (Kathleen)

Some users experienced difficulties related to the software platform, which was also an issue for Kathleen, who found the control of her avatar's movement challenging, reporting "every time I did go in, that was what bugged me really—was getting up those stairs." This suggests that the issue of avatar control constituted, for her, a distraction from language learning. However, she persisted with her exploration, moving beyond the introductory restaurant area students were directed to undertake, and discovering other interactive cultural activities in CI such as Tomb Sweeping and Moon Festival. Overall, this was a rewarding experience for her, if paired with a sense of incompleteness:

> I loved collecting the moon cakes, and I didn't know what to actually do with them. So I couldn't like get the reward from collecting things, and I didn't sort of figure all that out, but I wasn't overly concerned about that either. (Kathleen)

6.5.5 Theme 5 —Views and Attitudes About CI

Several participants mentioned that their instructor's presentation about the platform had given them an initial enthusiasm, excitement, or curiosity about exploring CI. In many cases, this was coupled with a contrasting statement about how they would categorise CI, suggesting that the conceptions they had formed about it based on descriptions and in-class demonstrations were later supplanted by different, more informed conceptions based on user experience. For example, Franklin commented that his instructor had used the word "game" in describing CI, but in his own view CI was more of an interactive landscape.

Multiple interviewees also spoke about their disappointment that the software was not available on mobile platforms (e.g., tablet). Instructors would clearly not have given any indications in their presentations about CI being compatible with mobile devices, so this possibly indicates the existence of a "default expectation" of being able to use mobile apps to engage with online content, and that default expectation was able to be invoked by students because that possibility had not been explicitly marked out by instructors as being unavailable.

While the aforementioned initial impressions underwent some changes in the course of the participants gaining firsthand experience of the platform, these impressions continued to be favourable overall. Two students (Gregory and Darren) mentioned that CI was not the kind of product that they would normally engage with, but they were both optimistic about its potential, each offering their own suggestions about how it might best be integrated into the Chinese programme. Darren spoke about adding gamification or points, while Gregory was of the view that, if the resource had been used as a part of coursework—in the process building familiarity with its features and with how to use it—he would have been likely to continue to use it as a study tool outside the context of the formal study activities for which it had been deployed.

In a similar vein, Franklin and Tania stated that they would have spent more time using the resource if it had been a part of their coursework, suggesting that they conceptualised CI as something suitable for inclusion in the Chinese programme, if not as a tool for private study. Kathleen, by contrast, wished she had been introduced to CI earlier, commenting that after she had become familiar with it, she could see how it would have helped her to prepare for assessment tasks she had completed earlier in the semester.

6.5.6 Theme 6—Vocabulary Building (Interactive Environment)

Building on from the previous section, there was one particular conceptualisation of CI that stood out for the amount of time participants devoted to discussing it. This was the strong conceptual link between the interactive environment (i.e., elements in

the CI space that can be interacted with by the user) on the one hand, and vocabulary building on the other. On its most basic level, this conceptualisation refers to objects in CI that users can click on, and learn the name of that object—a functionality that appealed greatly to the learners:

> The element of the Chinese Island where you were able to click on objects and learn vocabulary was something I found quite useful, which complemented my more "traditional" approach to learning. (Darren)
>
> [The functionality around Pinyin and basic characters] is really useful … for beginning Chinese learners, because it is so easy – right in front of you – there is nothing esoteric, you just go for it. (Barbara)

This vocabulary learning function captured the imagination of participants so strongly that several discussed their disappointment that other elements in the environment, which were put there for structural or visual purposes for example, did not "teach" the user any Chinese vocabulary items. They wanted, as Tania put it, to be able to wonder, "Oh, what's the word for this?" when they encountered anything in CI, and for the interface to be able to tell them. Some interviewees reported having spent quite some time investigating which items did or did not come with vocabulary tips:

> I would try clicking on things, and it wouldn't come up with the vocabulary for it, even though that was sort of what was advertised. I wanted to know what this bird was that kept wandering past me, and it wouldn't give me the Chinese for it.[4] (Tania)
>
> I love the vocabulary and stuff, so that was one of the biggest things that I was excited about … I wanted to know the word for a certain thing, and I'd click it, and it was just a prop. But then like a painting or something … that was explained – but I was like "I don't want to know that – I want to know THIS." (Franklin)

6.6 Discussion

6.6.1 The Values Applied to Communication Functions Within Virtual Worlds

On the foundation of a brief introduction to the concept of CI, which included an on-screen real-time demonstration, students very readily formed the conceptualisation of CI as a virtual space within which language learning can occur by means of virtual communication with NPCs. The introductory presentation was intentionally streamlined, partly because the investigators did not wish to prejudice the impressions that students would form about the learning environment, and also because in-class demonstrations were necessarily of limited duration, on account of CI being presented to them as an optional extracurricular resource. The presentation focused on how to get set up and pointed out a few things that could be done in the environment, but

[4] Note that the bird she refers to is a feature of the Second Life platform itself—not something specific to CI.

did not give extensive guidance about how students should spend their time in CI. The team wanted to allow for the students to "construct [their] own meaning," in line with Çakici's (2015) definition, about the environment, and on that account it was considered that too much direction was undesirable, since it might create the conditions for unreflective instruction-following to occur, leaving learners little scope to express autonomy in their learning of Chinese.

As might be expected, once an initial phase of setup and familiarisation was completed (as will be discussed below), the constructed nature of the artificial reality environment swiftly became transparent to most participants, freeing up cognitive resources which students used to reflect on the activities and processes of their own language learning. Participants were able to easily identify with their on-screen avatar, thinking of its surroundings and tasks as their own. That identification appears to have enabled them to treat each entry to the virtual environment as a proxy for a real-world Chinese language encounter, and it accomplished that so effectively that learners were able to bring to bear higher-order cognitive processing and problem-solving approaches about language-learning issues that arose in the situations their avatar was in, with the result that it was natural for them to talk about these interactions afterwards from a language-learning perspective, describing (as in the example, above, of Tania and Kathleen's experiences) the linguistic strategies they had deployed within those interactions.

For this population of Chinese learners, then, the investigators found that communication activities with NPC characters were highly effective in facilitating autonomous learning. Only a very moderate amount of in-world behaviour modelling that specifically related to these interactions was provided, and students appear to have encountered little to no distraction or other hurdles to their engagement with the language-learning tasks embedded in the environment's NPC dialogue, instead quickly bringing their cognitive resources to bear on solving linguistic challenges. Accordingly, much of the time participants spent in discussing AI communication was devoted to recollections of the linguistic strategies they deployed in those interactions, indicating that at the time they had been heavily invested in self-directed engagement with the resource.

Interestingly, the same degree of self-directed engagement was not apparent when discussion turned from "simulated" conversation (with AI characters) to "real" conversation (with other online users). Interviewees spoke favourably about occasions when they had succeeded in engaging another online user in Chinese text conversation, although it was noted that in most cases this referred to conversation with an instructor. Apart from these instances, participants mostly reported that they had desired to engage in this kind of communication, but for one reason or another they had been unable to realise this goal. Accordingly, while students initially displayed initiative in seeking out interaction, if it so happened that no other users were online at the time, or that those in the space did not have the time or desire to chat at that time, the interviewees appear to have grown discouraged, thereby adopting a more passive stance towards their desired goal of human interaction in CI.

Rather than, for example, using LMS bulletin boards to organise an in-world meet-up with classmates, the participants' response to this setback was not characterised by resilience, even though their remarks made clear the disappointment they felt, suggesting a relatively powerful desire for this form of interaction with peers and instructors. This passivity reflects the finding of Lai et al. (2016) who observed that, in the eyes of students, instructors are the ones within whose role the task of organisation falls. Keeping in mind that, when presenting the resource to students, the functionality of communication with online users was not emphasised, the investigative team notes that this concept nonetheless generated substantial interest and emotional investment among students, but they relied heavily on instructors to facilitate the interaction they desired. Scenarios like this highlight the extent of influence an instructor has while introducing the features of a resource, when (as was observed here) an initially strong motivation apparently fell at the first hurdle. In line with Han's argument (2014, p. 23), the instructor should aim in these cases to create conditions where students can see how actions they could take might increase the likelihood of their desired outcomes being realised in the interactive space.

6.6.2 Delivering Skills Training—A Two-Tiered Support Model

The manner in which a resource is introduced to students is, then, an important determinant in how students will engage with it, especially if students will be working independently, at their own pace, and off campus. In this implementation, as was to be expected with interactive technologies that most students had not used before, there was a certain quantity of work that had to be done in preparing students to engage with higher-order reflections on the learning activities in which they were participating within CI. Broadly grouped together under "logistical issues" in the Results (see Sect. 5.4), above, these matters included technical issues (software installation and configuration, learning to control the movements of the on-screen avatar, etc.). Almost all participants had something to say about these technical questions, but, for most, these were a relatively trivial concern. Some participants also reported that, once these initial hurdles had been overcome, they encountered a higher-level logistical issue: discovering or ascertaining the objectives of their participation in CI.

Instructors provided an introduction to CI, as discussed above, that was primarily aimed at showcasing the online space and generating interest in the resource, and which introduced students to one venue in CI (the restaurant), demonstrating some (but not all) of that area's interactive functionality. In recognition of their relative lack of Chinese language skills, students from the introductory level course were given the additional prompt to engage the NPC waitress in a "personal introduction" dialogue, which was an exchange that instructors had selected for the purpose as it did not include any significant amount of unfamiliar vocabulary for these learners.

Accordingly, all students were provided with some level of guidance as to the higher-order question of what to do inside CI and had considerable space beyond this for free (undirected) exploration and discovery. It was this free discovery that interviewees spent much of their time discussing.

Kathleen's experience is representative of the responses from the bulk of participants. She reported having a favourable and curious mindset about the resource at the outset and went on to explore further areas of CI after engaging with the activities in the restaurant to which she had been introduced. Lastly, her responses ultimately implied a need for additional, more specific direction to support continued engagement with CI as it was deployed at the university—as an optional study tool. This shows that participants in Kathleen's position had, either on their own or with minimal instructor intervention, mastered basic in-world behaviours like communication with NPCs and the manipulation of in-world virtual objects. With high probability, all that would be needed for them to successfully navigate the inbuilt tasks in other areas of CI (e.g., buying ingredients from the wet market and bringing them back to the kitchen area behind the restaurant to prepare meals with them) would be a nudge in that direction, such as a suggestion that this task is one that they could attempt.

In order to facilitate the discoveries made by users like Kathleen, the research team used a two-tiered model of technical support, with in-class presentations and self-service access to illustrated, text-based reference materials forming the lower tier, and opt-in online chat (either in-world or via LMS) constituting the higher tier, along with email help-desk service. First-tier technical information was primarily delivered in self-service documentation, so that in-class presentations could focus on generating enthusiasm for the resource. All of these support mechanisms were provided by the investigators directly. Kathleen's use of second-tier support was more about the "what to do" issue, because it related to how to frame the textual responses in conversation with an NPC character in a way that would bring about the result she wanted to obtain. This is primarily a linguistic question, but other students also spoke of having obtained support for software-related issues, such as configuring Pinyin input methods for generating Chinese characters in chat.

The two-tiered model enabled the team to provide additional support in a targeted and tailored manner, aimed only at students who had expressed a need for it. As Kathleen's comments show, the extent of support that was necessary under the second tier was typically not large—just "a couple of tips," while some participants were able to explore to the limit of their curiosity solely on the basis of the self-help reference materials supplied digitally to the whole cohort. The investigators delivered CI in a self-paced and self-service mode, so as to allow for this differential, and also to preserve, as much as possible, the experience of discovery for the participants, without providing unnecessary "spoilers." Limiting the volume of information provided to students at any one time was also judged desirable so as not to undermine enthusiasm by overwhelming students with detail. Both of these concerns are of great relevance in the delivery of a non-compulsory resource, but the issue of how to foster favourable impressions of a resource among its users will be pertinent to anyone wishing their students to display autonomy in engagement with an interactive resource, whether its use be voluntary or mandated.

The two-tiered model, in this way, allowed the instructors to avoid overloading students with information by bracketing off certain issues that only some of them would actually go on to require. The uptake of second-tier support was relatively low, and most logistical matters broached by participants indicated an easily bridged knowledge gap. The investigators infer that, if self-service reference materials are of sufficient quality and digestibility, a two-tiered support model can be effective not only in terms of the administrative overhead involved in deploying 3D MUVWs as learning resources, but also in minimising the extent to which logistical issues intrude upon user experience, distracting the learner from engaging with language learning.

6.6.3 Managing Expectations to Facilitate Student Investment

As argued above, technical guidance needs to be made available in a manner that does not quash or stifle learner interest, whether by excess (too much, too soon) or by deficit. Analysis of participants' comments indicated that the focus on showcasing the features of the 3D MUVW in presentations to students was successful in generating favourable attitudes towards CI, and enthusiasm to engage with it. It is worth emphasising that this demonstration did not require students to use the product themselves in a computer lab, and so the element of anticipation, or delayed gratification, potentially also played a role in generating the enthusiasm observed among participants.

The two-tiered support model discussed above showed promise as an approach that avoids stifling motivation. However, the interviewees' responses also brought to the investigators' attention several dimensions in which the initial demonstration influenced the ways in which students understood and interpreted the features and affordances of the resource. The interpretations formed by students took some directions that the investigators had not anticipated, and it is hypothesised that this may have been because of the extensive scope students were given to interpret CI for themselves, due to the choice of a self-paced, extracurricular implementation. An example already discussed is the unexpected enthusiasm shown by students to engage in conversation in-world with other users.

It will be recalled that the delivery model adopted in this investigation was largely up-front, with students able to refer back to the provided reference materials at their leisure. This had the consequence that any students who did not seek the second level of instructor assistance formed their ideas about what the product was, or should be, on the basis of a fixed corpus of information delivered to them at the outset of the process. Users then revised these ideas in the course of their engagement with the resource itself. This situation, the authors believe, led to certain instances where participants initially extrapolated from the data they had been provided, and made an inference on the basis of their relevant life experience when they came to matters that

were not made explicit in the documentation supplied to them. A notable instance of this was students mistakenly assuming that the CI software could be used on a mobile device. Another was the unexpectedly high interest the participants showed in using interactive objects to study vocabulary.

3D MUVWs lend themselves well to the incorporation of vocabulary learning experiences that are associated with visually available objects inside the 3D space, whether these be relatively simple mouse-hover tool-tips, or more detail-rich experiences like the virtual vocabulary cards that the learner can collect through interaction within CI. While not explicitly mentioned by participants, the graphic and aesthetic properties of the Chinese script also create unique possibilities for incidental exposure to the written character, since the number of characters used in signage will typically be lower in Chinese than in alphabetic languages, making the individual character more visually prominent in Chinese signage. This feature of the language has been harnessed in designing CI and forms a part of the virtualised cultural environment that participants discussed in the Results (see Sect. 5.3).

The interactive elements, however, were discussed by participants in more detail, although these had not been showcased to them as the sole or major purpose of CI but were highlighted as an additional feature alongside the NPC interaction that formed the core of the material with which students were prompted to engage. Students appear to have appreciated this incidental and spontaneous mode of vocabulary exposure, whether they were consolidating prior learning or acquiring new vocabulary items. Most interviewees adopted the search for vocabulary tips as a side-quest in addition to other objectives they pursued within the space, and for some it almost became their primary objective.

Clearly, this feature of CI was one that students found both appealing and intuitive, and a part of its appeal for the participants may lie in its conceptual salience—learning vocabulary associated with a virtual object was a "purpose" for engagement that students could quickly identify simply by exploring the environment. Unlike a more literal quest—one that an instructor might assign to the learner, such as finding a particular AI character and negotiating a virtual purchase—a vocabulary tip gives its reward instantly, and collectively these interactive objects can provide a series of discrete and miniaturised learning experiences that students can engage in alongside, or after the completion of, their assigned task. This observation is tempered by the consideration that some participants assumed initially that they would be able to interrogate all objects in the environment for vocabulary tips—an expectation that the environment could not fulfil, as noted above in the Results (see Sect. 5.6).

When a 3D MUVW is being deployed within a more traditional, computer-laboratory paradigm that allows for real-time interaction between instructors and learners, it is to be expected that similar negotiations and clarifications of meaning would occur between the instructor and students, but these would likely be resolved more quickly than is possible in a more self-directed setting. However, this places the instructor closer to the directing end of the scale, making it less likely that students

will make adventitious use of any "Easter egg" experiences[5] that the environment affords. By contrast, self-paced deployments by their very nature place a greater reliance on the learner taking charge of their own learning experiences but carry the concomitant risk of students inferring "purposes" for themselves that the resource does not support. Accordingly, the investigators conclude that instructors should be alert to the opportunities that exist to gain leverage in terms of student motivation through increasing the conceptual space available for learners to construe their own impressions about the resource, while simultaneously taking care to construct sufficiently robust and unobtrusive scaffolding so as to forestall the investment of student effort and enthusiasm into goals that the resource will not permit them to pursue.

6.7 Conclusion

The present study explores the affordances and challenges of Chinese language learning on CI associated with autonomous learning in a Chinese programme at university level. This qualitative investigation inspects the potentials of CI to support Chinese language learning and teaching beyond the classroom at a regional Australian university. Drawing on narrative queries from seven students of a multiple-level undergraduate Chinese language programme at the university, this study identified several particular areas of interest: communication (NPC); communication (human); vicarious living; logistical issues; conceptualisations of CI; vocabulary building (interactive environment).

In relation to its pedagogical implications, the insights drawn from this study enabled the CFL educators who conducted the study to gain a better understanding of students' different learning styles and their levels of digital literacy skills. The results of the study show that the integration of learning resources such as CI into classroom teaching helps to foster autonomous learning outside the classroom. This is achieved through enhancing learners' awareness of the additional opportunities for interactive learning. These opportunities are provided by the affordances and design features of 3D MUWVs like CI. Hence, instructors should pay attention to strategic ways in which they can prime and scaffold learners to ensure successful use of technology, and to create additional opportunities for autonomous learning. In addition, with its explorative nature, this chapter could potentially serve as a valuable resource to those CFL educators who would like to research learners' out-of-the-classroom autonomous language learning through technology. The findings may support teachers of Chinese to "develop the necessary awareness and abilities to promote learner autonomous language learning with technology outside the classroom" (Lai et al., 2016, p. 720). This study has confirmed the findings of Lai et al. (2016) which found that students still expect their teachers to play a greater

[5] An "Easter Egg" is an element within a digital resource such as a computer game or a digital media disc, which has been intentionally placed by the content creators in an inconspicuous place, with a view to providing the end-user with a rewarding experience of discovery.

role in supporting their autonomous learning beyond the classroom in an effective way despite the huge amount of time they spend with technology outside the classroom. Likewise, Kozlova's study (2018) suggested that learner autonomy could be promoted in 3D VWs by improving the clarity of task instructions. In general, therefore, it seems that these factors could be important for CFL educators who need to select carefully the appropriate technological resources as well as provide students with adequate guidance. It is evident that CFL teachers play a vital role in guiding, monitoring, and evaluating the learning process to foster learner autonomy (Little et al., 2017).

This present study set out to understand the views and experiences of CFL students at a regional university that used a purpose-designed 3D MUVW for ad hoc autonomous learning. It is the first study to adapt a purpose-designed 3D MUVW to support the autonomous learning of CFL students at a regional university, and to then determine the effects of such an approach. It is anticipated this work will generate fresh insight into learner autonomy, which is important for successful language learning (Lai et al., 2016). Understanding how students perceive this additional learning opportunity may shed light on fostering lifelong learning as students learn to navigate and comprehend Chinese language and culture through real-world tasks in this online and immersive environment. "Such an understanding could inform the design of educational interventions that intend to boost learner's autonomous language learning with technology" (Lai, 2019, p. 292) in a meaningful and productive way.

Although the scope of this study is limited, its results indicate that both students' linguistic and cultural competence can be improved significantly through a 3D immersive experience. It argues that a synthetic immersive environment as an interactive learning space, like CI, outside the classroom has great potential to engage students of various learning styles by integrating technology to ensure learners maximise their Chinese language learning as well as their self-efficacy and abilities to "construct personal learning experiences" (Lai et al., 2016). However, it is imperative to acknowledge the issues such as "matching technological resources with specific language learning needs" (Lai et al., 2016), and the implications of its contribution to "the degree of learning autonomy and the level of social interaction in fully online language learning" (Lee, 2016). The present study lays the groundwork for future research which should involve more complicated research design focusing on how carefully designed, practical/tailored learning activities might fit into the curriculum. Moreover, tasks need to be attainable and conducive to student interest and motivation in order to inspire learner autonomy (Levy & Stockwell, 2006).

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Chapter 7
Integrating Augmented Reality and Virtual Reality Technology into Chinese Education: An Observation from Nine Cases

Hsiu-Jen Cheng

Abstract This study implemented a teacher training course with a five-phase model (discussion, hands-on activities, lesson planning, experimentation, and reflections) aimed at finding out the affordance of AR/VR technology in Chinese education, and highlighting the challenges intern teachers may encounter during implementation. The researcher conducted a longitudinal study in 2018 and 2019. In total, nineteen intern Chinese teachers participated in this study, forming nine groups that implemented nine AVR Chinese courses. The teachers' reports, instructional documents, videos, and participant-provided data were collected for data analysis. It has been concluded that most AVR was a helpful tool for learners of any age. AVR activities created by the teachers were associated with lower-level cognitive learning. The challenges were insufficient Chinese learning content on the market, time-consuming course preparation, technical issues, and a lack of pre-training guidelines. Finally, a well-developed training course is necessary to guide teachers in understanding the full potential of AVR technology in Chinese lessons. More discussions and suggestions were stated in the study.

Keywords Augmented reality · Virtual reality · Chinese language education · Teacher training

7.1 Introduction

According to an IDC report, it is estimated that global revenue from Augmented Reality (AR) and Virtual Reality (VR) technology will reach $160 billion by 2023 (Framingham, 2019). Goldman Sachs predicts fifteen million users will spend $700 million dollars in AVR technology by 2025 (Goldman Sachs Global Investment Research, 2016). Large technology companies like Facebook, Google, and Microsoft have invested considerably in AVR technology, suggesting that this innovative technology will not fade away anytime soon and availability of devices will only

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increase. Thus, more such resources can and should be integrated into educational settings. Renowned content providers, such as Discovery VR, National Geographic 360 videos, NASA, and ABC news, are already available for free (Johnson, 2019). However, there is still lack of AR and VR educational content for certain learning subjects, particularly Chinese language. Compiling quality content for this subject should involve more professional experts and educators. Teachers are the best content providers because they know second or foreign language learners need frequent authentic interactions and an immersive learning environment. AR and VR technology creates versatile and authentic virtual interactions by stimulating multiple senses to promote learning and long-term knowledge retention. Language learners immersed in a virtual world can engage in virtual conversations with a native speaking avatar (Douglas, 2017; Papin, 2018) and explore the target culture (Cheng et al., 2018) through mounted headsets. However, research of AR/VR technology applications in the language education field remains in its infancy (Hitchcock, 2017), and lacks classroom-based application. It is time for Chinese teachers to think about how to apply AR and VR technology in the classroom, and compile quality content for technology developers.

Current educators of teacher training programs should consider integrating this innovative technology into their teacher training lessons to prepare future teachers for regularly implementing and adapting this technology to their language classes. Language teachers who are not technology experts often need guidance and support to incorporate such new technologies into their lessons. Therefore, the researcher of this study conducted a teacher training course based on a sequence of five-phase strategies to guide Chinese teachers in implementing AR and VR technology into their courses. By analyzing the cases of AR and VR Chinese lessons implemented by the participants of the Chinese teacher training course, this study aims to (1) determine the affordance of the AVR technology in Chinese education and (2) highlight the challenges that teachers may encounter during implementation.

7.2 Literature Review

Recent and rapid development of virtual and augmented reality technology has impacted the ecology of education. For example, virtual reality users often wear a mounted headset to immerse themselves in virtual world where they can talk, walk, and make decisions freely. This can be a great tool for language learners who want to advance their real-time thinking and language skills (Hitchcock, 2017). To further understand the potential of AVR technology in education, the researcher of this study reviewed prior research associated with these topics: AVR technology and education, theories or approaches applied in AVR technology, and AVR technology in language.

7.2.1 AVR Technology and Education

AR and VR technology were first used in the1970s (Elmqaddem, 2019). At that time, many technical constraints prevented educators and teachers from adopting it for education. AVR technology was not considered common technology until 2013. With the technical advancement of mobile devices, manufacturers became interested in AR and VR technology again, which drove software development toward more interactions for consumers and a global interest among various industries (Jowallah et al., 2018). In Asia, especially in Taiwan's mass media news, 2016 was named the beginning of the AR and VR technology era and launched a global movement toward developing prevalent and inevitable AVR technology for the future. Thus, the need for its quick integration into education is increasing (Milman, 2018).

From an educational perspective, the global view is that educational settings are shifting toward technology-integration-orientation, and teachers should prepare to integrate AVR technology into their lessons (Peterson & Stone, 2019). Nowadays, although three instruction delivery methods are well-developed—face-to–face, online, and blended—the merging of AVR technology has redefined them. AVR technology can be distinct or combined with other methods. When combined, it provides virtual physical experiences for learning and reconnects learners to the real world through such virtual experiences. This allows students to fully engage in learning activities, share their observations with peers, and make predictions. Some behaviors, such as sharing and predicting, are not easily triggered within a classroom setting (Peterson & Stone, 2019), but AVR technology can be a potential tool to enhance a teacher's classroom. To encourage these behaviors in a classroom setting, teachers and educators must adjust their pedagogy and instructional strategies, which implies a need for formal AVR teacher training.

Many companies, such as Immersive VR Education, Unimersiv, Google Expeditions, Alchemy VR, Discovery VR, zSpace, Curiscope, WoofbertVr, and ClassVR have developed AVR technology platforms for educational uses, including numerous sample lessons, cases, and materials for different learning subjects and age levels. With rich and supportive resources from the market and successful evidence from pioneer schools (ClassVR, 2020), in-service teachers who are willing to use technology and pre-service teachers should be trained not only in its benefits but also its limitations (Jowallah et al., 2018; Sarigoz, 2019).

Regarding the benefits of applying AVR technology into lessons/schools, previous findings can be classified into four categories. (1) *increasing learning motivation.* According to Kavangh et al. (2017) analysis of VR research, this is the second most cited finding from previous studies across different subject areas (Jensen & Konradsen, 2017; Johnson, 2019). (2) *facilitating the concept of cognitive learning.* Through a low-cost and portable Google Cardboard VR learning system, Ray and Dab (2016) conducted a comparative study of 40 college students, the result showed that students from the VR group not only performed better but also participated more than students from the traditional strategies group. (3) *offering a secure environment.*

When VR is applied in education, it aims to provide an immersive and safe educational environment for students who need scenarios or trainings that are too difficult or dangerous to conduct in real life (Kaminska et al., 2019). (4) *blocking out other distractions while learning.* When users wear head-mounted displays, they become more focused on the learning context and are not distracted by noises from traditional classroom settings. This also promotes personalized learning (Bonner & Reinders, 2018).

Regarding limitations, the literature mentions five common drawbacks. (1) *cost.* Creating a realistic virtual environment requires powerful hardware, such as the Oculus Rift or HTC Vive, which are considered expensive alternatives to conventional education. Therefore, educators prefer low-cost and wearable options supporting AVR technology using smartphones, such as Google Cardboard. Educational simulations require better content and easy access as opposed to a high-end solution (Jensen & Konradsen, 2017; Kaminska et al., 2019). (2) *balance of pedagogy and technology.* While AVR technology is used in lessons/activities, teachers need to be aware of the combination of pedagogical strategies in conjunction with this technology (Bonner & Reinders, 2018), instead of being driven solely by the latest technological innovations. (3) *health issues.* Even though much research has reported users have enjoyed and preferred immersive learning environments with AVR technology support, side effects such as dizziness and nausea, named cybersickness or VR sickness, have been known to occur. Weech et al. (2019) concluded a negative correlation between users' presence in VR environments and their sicknesses. Although more empirical studies are needed to examine the relationship between cybersickness and users' presence in AVR integrated courses, teachers are expected to be aware of the dilemma of how to maximize student immersion while minimizing sickness. (4) *security issues.* Online activities may create new dangers such as harassment, so Bonner and Reinders (2018) suggested using password-protected spaces, where teachers can monitor students' activities, and creating secure learning AVR environments, where students can express their opinions. Personal information should not be shared outside of the classroom. (5) *lack of content.* Jensen and Konradsen (2017) pointed out that most VR simulators were created for self-learning and were not designed for different pedagogical strategies or learning levels. For classroom use, instructors prefer the ability to create or edit content.

For teachers who would like to try AVR technology in their courses, previous educators have made some pedagogical and research suggestions. (1) low-cost options. Johnson (2019) having two years of AVR integration experience in a middle school, suggests that teachers begin with low-cost options, such as Google Cardboard, Nearpod, and 360-degree videos; choose high-quality content tied to curriculum; and have discussions with other teachers. (2) When applying AVR technology in education, instructors should focus on how and for what purpose the AVR technology should be used rather than whether AVR technology should be used at all (Jensen & Konradsen, 2017). (3) Prolonged and repeated investigations on learning progress are needed, especially in authentic educational settings rather than laboratory learning environments (Jensen & Konradsen, 2017).

7.2.2 Theories or Approaches Applied in AVR Technology

When applying innovative technology in instruction, instructors with a teaching philosophy can successfully drive their faith to implement lessons with new modes, tools, or pedagogy. Educational theories can be a key role during this process. In terms of applying AVR technology, the researcher of this study lists some educational theories below that may apply to AVR technology.

Dale's Cone of Experience. According to Edgar Dale's Cone of Experience, it shows the progression of learning experiences from concrete to abstract, corresponding to three modes: enactive (i.e., learning by doing), iconic (i.e., learning through observation), and symbolic experience (i.e., learning through abstraction) (see Fig. 7.1) (Lee & Reeves, 2007). According to Lee and Reeves (2007), Dale's Cone of Experience has been misinterpreted by claiming that learners will remember 10% from reading, 20% from hearing, 30% from seeing, 50% from hearing and seeing, 70% from speaking, and 90% from speaking and doing. It has also been implied that realistic learning experiences are better than abstract learning experiences. It is very common for AVR learning researchers to adopt a concept like Dale's Cone of Experience to support AVR learning, such as Class VR (2020) and BT from the UK. Although misused literature was applied, Dale suggested that teachers be aware that learning involves the combination of concrete and abstract learning experiences (Lee & Reeves, 2007), which is a great indicator for AVR technology integration.

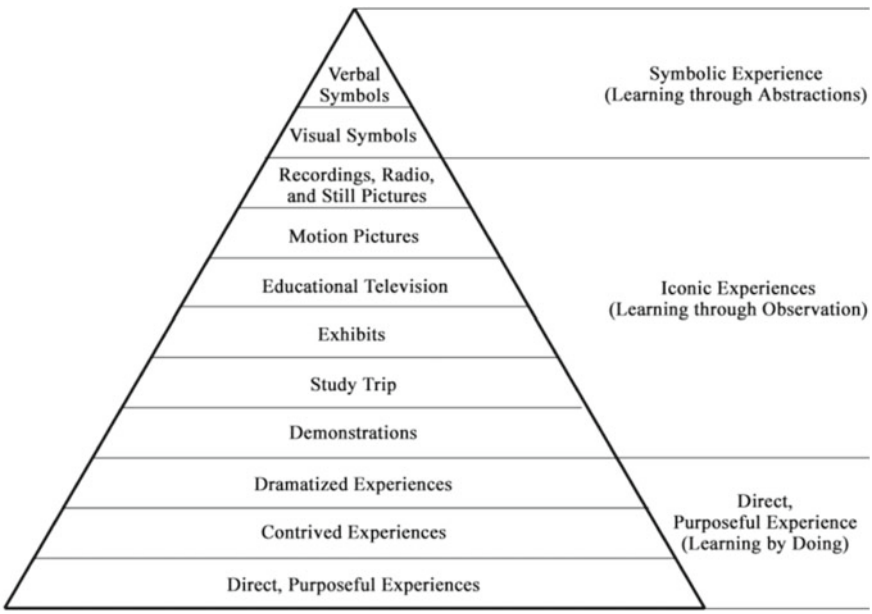

Fig. 7.1 Dale's Cone of Experience

Constructivism. Constructivists propose that learning becomes more effective when students are actively constructing knowledge through learning-by-doing situations involving active, interactive, authentic, meaningful, cooperative, and reflective learning activities (Abdoli-Sejzi, 2015; Chen, 2009). Many scholars propose that virtual reality supports constructive learning. Huang and Liaw (2018) concluded that perceived ease of use, perceived usefulness, and learning motivation are three important factors affecting learner intention to use a virtual reality learning environment that supports constructive learning. Winterbottom and Blake (2008) applied constructive learning theory in designing the interface of a virtual environment tool and the content of the VR tool for novice designers. Abdoli-Sejzi (2015) claimed that AR offers rich contextual learning settings and materials which concentrate on how virtual information and real environments mix together to satisfy learning objectives.

Cognitive Learning theory (Boyles, 2017; Christou, 2010). Scholars (Boyles, 2017) defined traditional class strategies as "language-based, conceptual, and abstract" (p. 5). In a VR learning environment, students can actively learn and understand abstract knowledge. Jensen and Konradsen's (2017) review paper concluded that a user's cognitive learning skills could be enhanced through virtual reality head-mounted displays, but mostly related to lower-level skills, such as remembering and understanding according to Bloom's taxonomy. This implies that educators should begin to design VR lessons focusing on how virtual reality technology enhances higher-level cognitive learning skills.

7.2.3 AVR Technology in Language Education

Within the past two years, numerous virtual reality technology applications and platforms have emerged, such as ClassVR, Mondly, ImmerseMe, VirtualSpeech, and Nearpod, which can be applied for language education. ClassVR was launched by Avantis Systems in 2017, and provides comprehensive solutions, including AVR lessons, AVR devices, and AVR contents of different subjects for educators of different levels; Mondly launched Mondly VR in 2017 offering foreign language teachers authentic and situated language communication through VR to enhance immersive language (Douglas, 2017); HundrED launched ImmerseMe in 2020 offering a VR platform with a 360-degree immersive language learning environment where students can communicate with virtual native speakers of one of nine supported languages. VirtualSpeech launched in 2016 as a platform offering a variety of online courses, developing users' communication skills for public speaking, sales, and leadership. An online instructor leads the course, supported by VR scenarios where students can practice their speech skills accordingly. Nearpod launched Nearpod VR in 2016, where teachers can create interactive lessons engaging students' participation with multiple interactive tools, including 360-degree VR videos and images, within its online platform.

The aforementioned VR applications and platforms all seem to promote immersion and interactions for learning upon further observations. Table 7.1 shows that

Table 7.1 The comparisons of the AVR resources

Name	ClassVR	Mondly AR/VR	ImmerseMe VR	Virtual Speech	Nearpod
Company	Avantis Systems	Mondly	HundrED	Virtual Speech	Nearpod
Launched year	2017	2017	2020	2016	2012 2016 (VR)
LMS	V	V	V	V	V
Mobile support		V	V	V	V
AR technology	V	V			
VR technology	V	V	V	V	V
Learning content support	V	V	V	V	V
Teacher training support	V				V
Language learning	Language art	30 Foreign language	9 Foreign language	Communication skills	Culture

they all developed their own online learning management system (LMS) to support learning and teaching with virtual technology, and two of them (ClassVR and Nearpod) even provided teacher training support. Among five companies, Mondly and ImmerseMe aim to promote foreign language learning specifically, and the rest were for general education. In conclusion, an online learning management system, the support of 360-degree VR video, and learning content resources are the top three components for virtual language learning at present.

From an academic point of view, previous research has proven VR technology as a great tool for conveying cultural information, such as in Japanese gestures (Cheng et al., 2018), or to practice intercultural communication skills in a VR open space with native speakers around the world (Liaw, 2019). In addition, the technology promotes memorization and retention (Cowans, 2018), while reducing learning anxiety (Liaw, 2019). Regarding AR technology, it has been widely applied in English education, such as in kindergarten English learning (Hsieh & Lee, 2008; Hsu, 2017), children learning animal names in English (Barreira et al., 2012), college students in EFL English composition (Liu & Tsai, 2013), and adult learners in English listening and speaking learning (Ho et al., 2017). AR technology promotes learning proficiency (Barreira et al., 2012; Hsu, 2017; Liu & Tsai, 2013; Solak & Cakir, 2015) and language learning motivation (Solak & Cakir, 2015). Overall, VR technology can resolve the issue of lacking authentic language practices by providing simulated learning environment for learners and reduce learners' learning anxiety,

while AR technology provides opportunities for learners to interact with the technology, learning materials (e.g., books, cards, and sheets), and learning environments. However, compared to AR technology, VR technology in language education is still in its infancy.

Even though AVR technology has been proven to increase learners' learning motivation, learners may be excited about the new technology only in the beginning phases of learning, and their motivation may decrease toward the end of the study (Li et al., 2014). Therefore, long-term observations of students' learning, pedagogical strategies in conjunction with AVR technology, and other teaching resources like a sound lesson plan are crucial elements for teachers interested in integrating AVR technology into language education.

Very few studies have focused on investigating the effects of AR/VR technology from an instructor's perspective. Lin and Lan (2015) indicated that teachers may play a critical role in terms of continuing to apply virtual reality technology in their instruction, especially for language lessons, but not many other empirical studies have related to in this topic. Thus, there is an urgency for language scholars, educators, and teachers, to not only understanding the effects of AR/VR technology on learning but also understanding teachers' reactions to it.

7.3 Research Methodology

The researcher of this current study applied a content analysis method to find out (1) the affordance of AR /VR technology in Chinese education and (2) the challenges that Chinese teachers may encounter during implementation.

7.3.1 Research Context

The researcher of this study offered a teacher training course entitled *Studies in Technology Learning and Chinese Education* during the spring semester of 2018 and 2019. A training model was implemented in five phases: *discussion, hands-on activities, lesson planning, research experimentation,* and *reflection*—aimed at determining answers to the research questions. The first three phases—*discussion, hands-on activities, and lesson planning*—were administered repeatedly as a circular process according to the quantity of the themes until the classroom-based experiment phase was reached. Two themes, AR and VR, were selected in this training course, so the first three phases were each conducted twice accordingly. Then the participants conducted a classroom-based research experiment through their practicum lessons and reflected on what they did in terms of pedagogical approaches, technical issues, and students' reactions.

In the first phase, *discussion*, all participants built upon their existing VR and AR technology knowledge by collecting the latest information and news, and reviewing

literature from journal articles and books before attending the training sessions. Participants discussed and shared the knowledge they gathered and clarified questions in class. Certain topics discussed in class included AVR technology development in the market, the latest devices and applications, the cases of educational applications, the latest research studies, and its future development.

In the second phase, *hands-on activities*, once the participants had acquired basic AVR knowledge, accessible technical resources were introduced to the class and teachers were encouraged to develop their own AVR pedagogical techniques through creating hands-on AVR artefacts or directly manipulating the hardware and software. Hands-on activities such as interacting with the AVR storybooks, creating their own AR activities and VR 360-degree tours, using Google Cardboard for associated mobile-based VR apps, experiencing VR goggles (e.g., HTV Vive) and their immersive games/applications, and testing AVR learning platforms. Through these activities, the teachers developed AVR techniques for specific levels, and became aware of the integration potential of such AVR tools into Chinese lessons.

In the third phase, *lesson planning*, the teachers had experienced a variety of AVR applications and devices, and tried to create a lesson integrating them into their Chinese language classrooms. Based on their students' learning needs and their teaching objectives, teachers were encouraged to plan Chinese lessons blended with AR materials, VR instructional platforms, and 360-degree videos, respectively, or to mix them accordingly. In this phase, teachers were asked to present their lesson planning proposals to the class. Peers and the researcher of this study provided constructive criticism and suggestions for teachers to modify their lesson plans.

In the fourth phase, *experimentation*, the teachers implemented classroom research based on their lesson plans from their Chinese language classrooms. All were working on their practicum and role-played in their AVR classrooms as both intern teachers and researchers. At this stage, the participants conducted preliminary research based on their research objectives and methodologies. Several group or focus group discussions were during class sessions and the teachers designed research instruments, and collected and analyzed data to determine the answers to their research questions. At the end of the training sessions, all participants shared their findings.

In the fifth phase, *reflections*, the teachers first presented their findings as a formal research report with support from a one-and-half minute video presenting their teaching process, AVR materials, students' reactions, and research findings. Participants reflected on their experiences in terms of their research and teaching roles within their learning journals.

7.3.2 Data Collection

The researcher of this study collected documents, artefacts, lesson plans, video clips, and final reflections, as well as a questionnaire to answer the research questions. A survey was distributed to collect teachers' demographic information and teachers' learning reflections on their instructional challenges and achievements.

7.3.3 Research Subjects

This training was implemented twice in the spring semester of 2018 and 2019. In total, 19 Chinese teachers (9 from 2018 and 10 from 2019), who were master-level students, participated in this study. They were organized into groups of two or three working as a team for this five-phase training course. As shown in Table 7.2, the teachers were all pre-service and novice teachers with less than 3-years of Chinese teaching experiences in online or onsite settings.

In 2018, there were 4 groups of intern teachers. Group 1 (W and L) and 2 (Z and R) were teaching 5 children and 1 adolescent at school settings. Group 3 (F and Y) was teaching 1 adult learner online and 1 onsite, and Group 4 (K, H, G) was teaching 1 adult learner. Overall, three adult learners, five children, and one adolescent participated. In total, there was 1 online case, 2 onsite cases, and 1 comparative case (Table 7.3).

In 2019, there were five groups of intern teachers. All of them taught adult learners. 2 out of the five cases were onsite and 3 were online (Table 7.4).

In terms of teaching mode, this study collected four online cases, four onsite cases, and one comparative case over the course of two years. Overall, 10 topics covered in this study aimed to achieve different instructional objectives (see Table 7.5). They aimed to reduce learning anxiety by applying AVR enhanced storybooks (2018 Group1), develop student's Chinese writing strategies (2018 Group 2), help

Table 7.2 Participants' demographic information

Chinese teaching experiences	Number of teachers
Less than 1 year	8
1–2 years	8
3 years and above	2
N/a	1
Total	19

Table 7.3 The information of 2018 cases

Year	Groups	ID	AR/VR research targets	AR/VR settings
2018	Group 1	W	3 elementary students	onsite
		L	3 elementary students	
	Group 2	R	1 teenager	onsite
		Z		
	Group 3	F	1 Adult	online
		Y	1 Adult	onsite
	Group 4	H	1 Adult	online
		K		
		G		

Table 7.4 The information of 2018 cases

Year	Groups	ID	AR/VR research targets	AR/VR settings
2019	Group 1	S	2 adults	online
		X		
	Group 2	YE	1 adult	onsite
		YU		
	Group 3	YA	1 adult	online
		XI		
	Group 4	P	1 adult	onsite
		T		
	Group 5	FU	1 adult	online
		J		

Table 7.5 Topics of each cases

Year	Groups	Topics
2018	Group 1	Children storybook with AVR technology support
	Group 2	Writing strategies developed with AVR technology support
	Group 3	Assisting Chinese adult learners' pronunciation with AR materials
	Group 4	Integrating AR technology into an online cultural lesson
2019	Group 1	Business Chinese lesson with AVR materials
	Group 2	AR Story-based material for grammar learning
	Group 3	Using AR to support Chinese character learning
	Group 4	Using AR materials to support beginning learners' oral communication
	Group 5	AR learning materials for advanced less of Chinese culture

students overcome difficult pronunciation (2018 Group 3), learn Chinese grammar with story-based AR materials (2019 Group 2), develop students' communication skills (2019 Group 4), design cultural lessons with AVR materials (2018 Group 4 and 2019 Group 5), and create immersive online business Chinese lessons (2019 Group 1). Surprisingly, there were few overlapping topics, which demonstrated a potential for more variety and possibilities that can be achieved by incorporating this technology. This training mode potentially leads teachers to fully implement well-connected lessons in terms of their practicum and innovative technology instead of replicating previous studies.

7.4 Cases

To closely observe the applications of AVR technology in Chinese lessons, this section provides brief descriptions of 9 cases based on data from documents, lessons, videos, and final reports from the 19 intern teachers.

7.4.1 Case 1: Elementary Students' Chinese Lessons

Teachers W and L taught three 3rd graders and one 4th grader in a mainstream school in Taiwan who were all transnational students. According to the intern teachers, most students were not confident with their Chinese abilities when they were in Chinese language-oriented classes. Teachers W and L used a penguin animal book to create a relaxing learning environment with AR technology and 360-degree VR videos, and conducted a two-circle action research study for 8 sessions of Chinese lessons.

In the first session, students read a storybook about penguins, then viewed 360-degree penguin videos. As a final assessment, students talked about what they learned and wrote down sentences in Chinese. For the second session, in order for students to be able to self-read the content of the book, the teachers created AR videos to support the audio form of the content, so that students could read and hear each page of the book while scanning corresponding photos.

7.4.2 Case 2: Teenager's Writing Lesson

Group 2 was also a case from a transnational student. Teacher Z from group 2 taught a 15-year-old student who was afraid of Chinese composition writing. This group of teachers (Z and R) planned to develop a 4-step strategy to develop the student's writing and reading competence. They also sought to apply AVR technology to the lesson to create a relaxing learning environment and reduce the anxiety of the learner.

First, the teacher gave the student a sample narrative to read written by the teacher about a field trip to a zoo. Then they worked on the unknown words and determined the structure of the narrative. Second, the teacher applied an AR worksheet to develop the student's writing skills in modification, such as using adjectives to describe animals, and using conjunctions correctly in sentences. After watching the AR videos, the student was encouraged to describe the animal she saw. Third, 360-degree VR technology was blended with the writing lesson. The student used Google Cardboard to visit a 360-degree virtual zoo in Beijing aimed at providing an immersive and realistic field trip experience. Fourth, the student was encouraged to write down her virtual experiences based on what she had learned about how to write a Chinese narrative.

7.4.3 Case 3: Online and Onsite Adult Learners' Pronunciation Issues

Teacher F and Teacher Y found that their students, whose native languages were English and Spanish, respectively, had encountered pronunciation difficulties with the Chinese phonetic sounds of *j* and *q*. In order to help the individual learners identify and self-correct their errors, the teachers conducted an experiment to see if they could help their students improve upon those two sounds. With AR technology support, they created self-learning materials that showed the positions of speech organs and the placement of articulators for the two sounds.

They first had the students read a short narration with many words containing the sounds of *j* and *q*. Then, students used the AR-enhanced learning materials to practice *j* and *q* sounds for 15–20 minutes. At the end of the experiment, the students revisited the narrations and read them aloud again.

This experiment was implemented with one online learner first and another one onsite learner second. The teachers and students encountered some technical issues during the onsite session. To resolve these issues, the teachers created a pre-training tutorial showing how to trigger the images for the online session, so that the online student did not encounter similar technical issues. The teachers distributed a questionnaire and recorded the students' learning experiences to determine out whether the AR material was helpful.

7.4.4 Case 4: Online Cultural Lessons

The teachers from Group 4 were all online teachers. They designed a cultural lesson about the Dragon Boat Festival with AR-enhanced activities. The lesson was aimed at introducing learners to the Dragon Boat Festival, including what Chinese people do and eat during that time. The teachers first explained vocabulary along with cultural information, including the activities and food for the festival. Some vocabulary needed multimedia support when explained, so the students were asked to scan AR-enhanced materials displayed on the screen through their smartphones while the teachers introduced the respective vocabulary. Then, the teachers worked on sentences and text associated with the festival. Last, online interactive activities, such as a dragon boat puzzle, matching, and pairing activities were arranged to assess students' understanding. The teachers used AR technology to enhance assessment activities for reviewing content and reinforcing students' learning.

7.4.5 Case 1: Online Business Chinese Lessons

Two teachers (S and X) from Group 1 taught two adult learners online business Chinese. They designed AVR immersive business activities to enhance students' learning. The theme of the lesson was *Attending an Exhibition.* The teachers first worked on the vocabulary and dialogue of the lesson and then provided AR interactive materials that students could access on their mobile phones to interact with the virtual characters by recording or typing their responses. As a formative assessment tool, the teachers tried to create an immersive activity close to real-life dialogue and interactions by offering non-linear selections for students to practice their Chinese with the virtual characters. Additionally, 360-degree exhibition photos and videos enabled the students to virtually experience authentic business exhibitions while practicing their business Chinese.

7.4.6 Case 2: Situated Learning for Adult Learners

One adult learner from Teacher YE's class was selected in this case. The objectives of the lessons were to help the student learn new Chinese sentence structures effectively. The teacher designed AR-enhanced story-based learning materials for this class and implemented three lessons. The student received AR flipped material before each class to preview the learning content. During the class, the teacher used the AR materials to reinforce the grammar she had just taught. With this material, the student practiced the grammar in the story. In lessons 2 and 3, the student was given AR material for homework. In this case, the AR materials were created for previewing, practicing, and reviewing the learning content.

7.4.7 Case 3: Online Chinese Character Lessons

In this case, one adult online learner was selected. The teachers (F and Y) designed an online lesson for Chinese character learning by applying AR learning materials. The teachers used radicals to teach learners to recognize Chinese words. With the support of radical learning sheets embedded within AR scanning codes showing words with the same radicals, students were able to interact with the learning materials to reinforce their learning. The teachers first used HP Reveal for their learning sheets but encountered an issue when the company terminated the app. Therefore, they switched to Metaverse. Additionally, the content of their learning sheets was not challenging enough for the learner, so it was treated as review material.

7.4.8 Case 4: Training Adult learner's Oral Skills

Teachers (P and T) from Group 4 selected one adult learner as their target learner. They aimed to design a survival Chinese class covering the following topics: sports, shopping, dining, and traveling. With the applications of Metaverse AR and Google Tour Creator with 360-degree images, the teachers conducted a 2-week experiment. The student had an exam at the end of each AVR lesson and the teacher interviewed the student at the end of the experiment to investigate the student's learning outcomes and perceptions toward the innovative lessons.

7.4.9 Case 5: Online Culture Lesson

Teachers (FU and J) from Group 5 selected an adult learner as their target learner. They designed an AR material for an online cross-cultural course aimed at informing students of cultural differences by introducing Chinese family culture, dining culture, and school culture. The teachers also conducted an action research and applied the AR materials in two lessons to determine their impact on the student's learning outcome and motivations. In the first lesson, the teacher did not apply the AR materials. In the second lesson, AR material was used as a formative assessment tool for the student to have more interactive exercises. Due to the limitations of the class time, the teachers decided to use the AR materials as take-home exercises in the third lesson, so the student could have sufficient time to practice.

7.5 Findings

This section discusses the researcher's findings on the affordance of AVR technology in Chinese lessons, and the challenges that intern teachers encountered during implementation.

7.5.1 The Affordance of AR/VR Technology in Learning and Teaching Chinese

From teachers' final reports, lesson plans, and documents, data were analyzed qualitatively and quantitatively to conclude the affordance of AVR technology in Chinese lessons. These findings are stated from five perspectives.

1. Learners' learning motivation: 7 out of 9 cases were designed for adult learners. 1 case was for children (case 1 in 2018) and another was for a teenager (case 2 in 2018). Even though this study did not collect sufficient data on cases for

Table 7.6 Learning objectives of the nine cases

Learning objectives	Frequency	Percentages (%)
Vocabulary	4	44
Culture	2	22
Oral Lesson	2	22
Grammar	1	11
Writing	1	11
Reading	1	11
Chinese Characters	1	11

children and teenagers, it proved that AVR technology can be applied in Chinese lessons regardless of learner ages. Compared with adult learners, children and teenagers' learning excitements in the lessons with AVR technology were much easily triggered than adult learners. Teachers from case 1 in 2018 reported that their students were looking forward to next AVR class after having their first AVR activities. A nervous adult learner from case 4 in 2019 was happy about using the innovative materials when learning Chinese. It was found that there was a different excitement level of reactions toward AVR lessons, and learners could spend their own time and pace to explore or review the learning content. This created less stressful and more enjoyable learning environments for learners who were nervous and had less motivation for Chinese language learning.

2. Lower-level and Higher-level Cognitive Learning Objectives: Teachers from 9 cases set 7 different learning objectives for their AVR lessons. Table 7.6 shows that, overall, close to half of the cases (44%) were about learning vocabulary. Two cases (22%) were for learning culture and engaging in oral practice. Four distinct cases (11%) covered the following objectives: learning grammar, learning how to write Chinese compositions, reading a storybook, and recognizing Chinese characters.

   According to Bloom's *Taxonomy of Educational Objectives,* 9 cases were associated with lower-level cognition learning, such as understanding the content of a storybook (2018 case 1), memorizing vocabulary (2018 cases 2 and 4, 2019 cases 1 and 5), recognizing students' own learning weaknesses (2018 case 3), understanding Chinese grammar (2019 case 2), recognizing Chinese characters (2019 case 3), and learning factual knowledge associated with Chinese culture (2018 case 4 and 2019 case 5). The lower-level learning objectives seemed easy to achieve using AVR tools in Chinese lessons. These results correspond with the conclusion of Jensen and Konradsen's (2017) review paper. In addition, this model was also applied to higher-level cognitive lessons. There were 3 cases that set higher-level learning objectives, such as producing a Chinese essay (2018 case 2), applying grammar knowledge in different situations (2019 case 2), and comparing the differences of Chinese and American culture (2019 case 5). Teachers from those cases implemented their AVR enhanced activities with action research to gradually review and modify their learning activities based on

students' learning cognition developments. When integrating innovative technology for language learning, teachers should consider designing lessons for higher-level cognitive skills to produce a much more solid performance in terms of language instruction.

3. Use of AVR Technology Applications: Language teachers are not technicians, so they strongly rely on commercial applications to integrate technology into their lessons, especially with easy-to-use applications that provide creative content. Compared with VR technology, AR applications in this study, HP Reveal[1] and Metaverse, were used by all the intern teachers due to their ease of use. AR applications like HP Reveal, build the experiences based on triggering images of users' choice, and it is "a pre-supplied trigger (Callum & Parsons, 2019)." It was easily applied into the storybook (2018 case 1), vocabulary worksheet (2018 case 2 and case 4). Metaverse allows learners to import their own contents and answers, such as their artefacts, photos, texts, and answers from multiple choices. Metaverse provides nonlinear navigation features that allow teachers to create various interactive learning activities, such as learning scenarios for business Chinese in 2019 case 1 and survival language in 2019 case 4, and take-home language learning tasks in 2019 case 2. Language instructors can create more activities to construct learners' learning cognition, which makes AR-enhanced learning more interesting, and also corresponds to Callum and Parsons' (2019) paper.

   For VR applications or devices, although high-end VR devices, like HTC goggle and its platforms, were introduced during the training, the intern teachers still selected lower-cost and easy to access devices like 360-degree videos in YouTube, Google Tour Creator, and Metaverse's built-in 360-degree videos, as well as Google Cardboard. Chinese teaching involves many instructional preparations, so it is reasonable that the teachers of this study selected tools with easy use and accessibility in mind. As Table 7.7 shows, none of the cases purely used VR technology for their lessons. However, 4 cases applied a blended mode, combining AR and VR technology in their lessons.

   Overall, the intern teachers preferred AR over VR. In the current market, it is easier to find more AR applications. Aside from Google VR hardware and software, it is still not easy to locate more VR resources for Chinese lessons. Teachers were most concerned with the technology's ability to support user-created learning content. Thus, promoting full integration of AVR technology relies heavily on resource diversity and availability in the commercial market.
4. Students' positive perceptions and attitudes toward AVR technology lessons: Students from all cases, in this study, positively perceived a Chinese lesson supported with AVR technology and believed it to be a helpful learning tool. Five more elements summarizing students' perceptions and attitudes can be found in Table 7.8 and are discussed below.

First, students' feedback from three cases (33%) (2018 case 1 and case 2, 2019 case 2) proved a reduction in learning anxiety. Two of those three cases were onsite young

[1] HP Reveal company terminated their studio and smartphone versions at the end of 2019.

Table 7.7 The technology and instructional modes of the nine cases

2018	Mode	Technology		
Case		AR	VR	AVR
1*	F2F	1	1	1
2*	F2F	1	1	1
3		1		
4	Online	1		
2019				
1*	Online	1	1	1
2	F2F	1		
3	Online	1		
4*	F2F	1		1
5	Online	1		
Frequency		9	3	4
Percentage (%)		100	33	44

Table 7.8 Learners' feedback

	Learning anxiety reduced	Excitement	Interest	Engagement
Frequency	3	5	7	7
Percentage (%)	33	56	78	78

learners not confident in learning Chinese. But, with the offering AVR-enhanced materials, the lessons provided them with a typical learning materials like a live storybook and a virtual field trip. Younger Chinese learners with blended virtual and real materials escaped from their stressful lives and their language teachers were akin to classroom magicians. Reducing learning anxiety for language learning definitely promotes learning efficiency, as proven by much research. AVR technology can address this problem and teachers should take the advantage of it, especially novice teachers who may not have matured skills for inspiring their learners to succeed. Second, students became excited for future AVR lessons. Students from more than half of the cases, 5 cases (56%) (2018 case1, 3, 4, and 2019 case 1 and 4), were excited about using AVR materials for learning regardless of their learning modes. Third, students from more than half of the cases, 7 cases (78%), agreed that AVR technology was interesting. Some students (e.g., 2019 case 4) preferred to use it in the classroom, while others (e.g., 2019 case 2 and case 5) preferred to use it as take-home material, and some even used it as flipped learning material (e.g., 2019 case 2). Fourth, students from more than half of the cases, 7 cases (78%), became fully engaged in the activities. Most teachers were happy to see these lessons bring about their students' best and positive reactions toward Chinese learning. For teachers who encounter student's engagement issues, AVR technology integration is a great solution to implement.

7.5.2 The Challenges that Teachers May Encounter

During the process of implementing the AVR lessons, the intern teachers encountered different obstacles. This section identifies those obstacles from four perspectives.

1. Insufficient apps/resources on the market for Chinese learning and teaching. A lot of AVR applications were created for English learners, so their contents and resources are mostly in English. Chinese teachers spend considerable amounts of time searching for suitable content in Chinese. The AVR applications such as HP Reveal, Metaverse, and Google Tour Creator used in this study allowed teachers to create custom content for their lessons. This is probably the best alternative to resolve the lack of pre-existing content issue. Until the market offers sufficient resources for Chinese learners, applications providing certain amounts of editable content and facilitating users' sharing of custom-created content are what educators need.
2. Time management is the biggest obstacle for teachers. Even though creating custom content is currently the best way to design Chinese lessons, teachers still need to spend considerable amounts of time searching for or creating proper multimedia resources. However, teachers who are driven away or given up on this task miss out on the chance to build their own technological knowledge base and development valuable skills in content creation and pedagogical integration of technology in the classroom.
3. Technical issues. Teachers from 5 cases (2018 cases 1, 3, 4, and 2019 cases 2 and 4) reported that they encountered technical issues during class. These issues are classified into the three parts below.
   First is the issue of application stability, e.g., disconnected networks on the learner's end (2018 case 4) and non-guaranteed connections of AR videos (2018 case 3 and 4), as in the case that used HP Reveal in 2018. Metaverse was much more stable in the 2019 cases, so these issues did not occur again. However, a student from case 3 in 2019 encountered recording issues, and another student from case 2 thought that the Metaverse learning material was not user-friendly enough. This may have been due to unclear instructions provided by the instructor.
   Second is the issue of device accessibility. For those cases (2018 case 1 and case 3) planning to implement an AR lesson with more than one learner, they needed more smartphones for each learner. However, not all learners or institutions have access to such devices. Insufficient mobile devices or Google Cardboards for learners can be a recurring issue.
   Third is the issue of device compatibility. Learners' devices may not be able to run AR materials. From case 4 in 2018, a student's mobile device did not support the AR materials created with HP Reveal. However, in 2019, no such issue occurred. In cases where students own older devices, teachers planning to implement innovative technologies should double-check the compatibility limitations of such devices. The rapid modernization and regular development of common technologies may render this issue obsolete in the near future.

Teachers should embrace their failures for offering valuable information for professional development.

4. Pre-training. Teachers in 2018 cases 3 and 4, and 2019 case 5 encountered technical issues that compelled students to spend a lot of time figuring out how to download and use the app, and learning how to use the materials. Language students conducting activities associated with technology need clear instructions and a decent amount of practice time. If these two critical elements are lacking, all the lesson plans may be severely impacted and thrown off schedule. Therefore, a pre-training lesson should be provided to confirm users' understanding of how to activate the AR videos, use the VR devices, and check all hardware, software, and network connections. Teachers should prepare tutorials and guiding manuals for both online and onsite learners.

7.6 Conclusion

In the field of teaching and learning Chinese as second/foreign language, AVR technology is still new for many language teachers. The researcher of this study conducted two years of teacher training courses in 5 phases associated with integrating AR/VR technology into Chinese lessons to not only train Chinese teachers to develop their technical and pedagogical knowledge of innovative technology integration but also investigate their teaching cases on a wider base.

It was found that AVR technology can be applied to learners of any age, as well as with a variety of learning objectives. Learners' perceived AVR lessons positively as an interesting and relaxing lessons. For learners who are anxious and nervous about learning Chinese, especially young learners, such lessons created self-learning moments for them to explore, find, and review learning content at their own pace, and also provided secure moments to disengage from overwhelming teacher-centered learning time. Therefore, many learners in this study liked the AVR technology.

Regarding learning objectives from the nine cases. Most of the teachers in this study applied AVR activities to practice lower-level learning cognition, such as remembering vocabulary, understanding dialogue, and applying knowledge to other scenarios. Such results also corresponded with Jensen and Konradsen's (2017) study. Only 3 learning activities were involved in higher-level cognitive learning activities associated with analyzing, evaluation, and creation. Lower-level cognitive exercises seemed to be easier to implement when planning a Chinese lesson with AVR technology. For teachers seeking to work with AVR technology for higher-level learning activities, they must first gain experience with AVR technology integration and become familiar with those techniques from lower-level activities, then work on designing their own higher-level cognitive activities. Therefore, the suggestion for teacher trainers is to encourage teachers unfamiliar with the technology to begin with lower-level cognitive exercises and work up to higher-level cognitive exercises over time.

The challenges the teachers of this study encountered included a lack of Chinese learning content on the market, time-consuming course preparation, technical issues, and a lack of pre-training guidelines. It is not surprising that Chinese teachers are unable to find sufficient Chinese content and resources for AVR applications, since Chinese language education does not dominate the digital learning world. Globally, English learners are the biggest group in terms of second/foreign language acquisition. Thus, AVR applications providing certain levels of resources and allowing users to create their own content are the best choices for Chinese teachers at the present time. Creating digital content is indeed time-consuming, especially for innovative technology, so teachers need to develop skills in recycling AVR materials created by themselves for different instructional objectives. For instance, using AR flash cards to help students review vocabulary and adapting the same to create story building activities. In this way, teachers will not spend as much time in creating content from scratch and can instead brainstorm how to apply their digital materials toward different learning tasks and objectives.

Due to the rapid development of AVR technology, factors like users' devices, internet environments, and learners' digital skills may affect the implementation of AVR lessons. It is important for teachers of first-time AVR technology learners to provide clear instructions to guide users in navigating the digital materials in advance of the integrated lessons, so that teachers can mitigate technical issues ahead of time and prepare a backup lesson plan. For online AVR lessons, learners may need multiple devices, including a laptop and mobile device for AVR exercises. Providing guidelines or pre-training sessions is crucial. However, once learners become familiar with the technology tools, pre-training sessions and instructions are only suggested for learners with weak digital literacy.

In terms of instructional design, the AVR activities in this study were implemented for the following purposes: flipped learning materials, supporting in-class activities, after-class assignments, self-learning resources, cultural lessons, and business Chinese scenarios. With the five-phase training process, the teachers of the study were able to develop their own AVR activities for their Chinese lessons at the end of training. Through literature discussions, lesson plan sharing, and frequent hands-on exercises, most of the teachers were not only able to have a better understanding of how to design AVR lessons for Chinese courses but also shared their own AVR technology lessons with teachers who were working on similar goals, and raised awareness of how to execute innovative lessons. Particularly, blending research with teacher training compelled intern teachers to investigate their teaching ideology fully, construct innovative lessons based on their research, and thoroughly understand learners' reactions to their approaches. More classroom-based research and applications geared toward younger learners or adolescents is not only encouraged for future intern teachers in future training sessions, but is also necessary to close the literature gap.

For suggestions of further research and courses on AVR technology, there is no doubt that a well-developed teacher training course guiding those teachers, as an instructor and a researcher, in planning a lesson and executing their plan is

important. Training teachers to become life-long learners who are willing to challenge themselves to use innovative tools and continue trying new technologies is crucial. Regarding applications of different learners, this study did not have sufficient young learners or adolescent learner cases. In addition, in-service teacher training or combined two groups training is also suggested. Future research and teacher training educators should encourage teachers to implement more lessons targeting these participants.

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Chapter 8
A Systematic Literature Review of Augmented Reality Used in Language Learning

Sin Yee Lau and Yun Wen

Abstract Augmented Reality has great potentials in education, as this technology may help increase students' learning motivation and engage them in deep learning. Nevertheless, teachers have concerns about how to integrate the technology into their daily teaching. Moreover, the studies on AR in language learning are relatively immature compared to in other subjects. The present review study aimed to investigate how AR has been used in practical language learning. Instead of learning outcomes, this study focused on exploring the various AR-supported activities, the pedagogy theories and strategies that enabled language learning, and the constraints of teachers' enactment. A total of 17 published studies with empirical data were analyzed. The findings unpacked Augmented Reality's affordances and enactment constraints in language teaching and learning. Suggestions and implications were provided for researchers, designers, and educational practitioners in the field.

Keywords Augmented reality · Technology-enhanced learning · Language learning · Teacher's enactment · Place-based learning

8.1 Introduction

We live in an amazing age with multiple communication tools that provide us with compelling linguistically and culturally contextualized environments for conversations. The technologies have empowered language educators to seek more robust and individualized learner-centered teaching approaches to enhance individual experiences, social engagements, and accessibility to learning data (Kessler, 2018).

Augmented Reality (AR) technologies have been featured for their enormous potentials in learning and are recognized as one of the key emergent technologies for education (Chen et al., 2017; Safar et al., 2016). Diegmann et al. (2015, p. 1544) define AR as "a situation in which a real-world context is dynamically overlaid with coherent location or context-sensitive virtual information." As compared to other

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mixed reality technologies, such as Virtual Reality (VR), AR supplements reality rather than completely substituting it (Azuma, 1997). These added realities can be in the form of 3D models, 2D graphics, audio, GPS, and so on. In addition, AR is versatile yet powerful as it is available on a variety of technological devices such as mobile devices, desktop computers, head-mounted displays, and many more.

AR is initially used for visualization and training purposes in commercial enterprises or the military, but as technology advances, it has become more affordable and easier to execute (Diegmann et al., 2015). In recent years, the number of educational AR studies has steadily increased (Akçayır & Akçayır, 2017). Findings have shown that AR can increase students' learning motivation, gains, interaction, and collaboration levels (Chen et al., 2017; Diegmann et al., 2015; Wen, 2018, 2020). In the context of language learning, an AR-supported learning environment may help to increase learner's willingness to communicate as it has the potential of reducing anxiety in speaking, therefore encouraging social interaction and collaboration (Liu, 2009). AR has been applied to education in a variety of subjects, and the importance of disciplinary integration has been highlighted. However, compared to AR in science education, the integration of the pedagogical design with AR in language learning seems to be less mature (Wen & Looi, 2019).

In this study, a systematic review was conducted to understand AR-enabled language learning practices and potentials. The study systematically reviewed and synthesized the relevant literature on AR-supported language learning research to unpack AR's pedagogical affordances and constraints in language teaching and learning. The review targets researchers and practitioners who are interested in empirical studies in technology-enhanced language learning, especially for those concerned about design and enactment issues in AR-supported language learning practices.

8.2 Literature Review

8.2.1 AR in Education

AR helps to create a rich, sensory experience by adding another dimension to the actuality (Richardson, 2016). Unlike other ICT tools where users only receive information, AR prevents unilateral learning (Pegrum, 2014). It can create immersive hybrid learning environments that facilitate process skills development such as critical thinking, problem-solving, and communication through independent collaborative exercises (Richardson, 2016). Perez-Lopez and Contero (2013) investigated the use of AR in teaching digestive and circulatory systems to elementary school students and its role in knowledge retention. The results of the study suggested that using AR technology in the classroom helped learners retain more concepts than using the traditional teaching approach. Diegmann et al. (2015) revealed that AR technology was a useful means to improve learners' motivation, engagement, and

learners' performance in a learning environment. Some other advantages of using AR technology in education include the following points: (1) providing a simple yet attractive way of presenting interactive learning contents that also incorporates fun and entertainment (Kuo et al., 2016); (2) allowing learners to direct their self-paced learning with their desire learning experiences (Hsu, 2016); (3) enriching learning processes with modern expertise and technological capabilities (Ogata et al., 2014); (4) providing learners with better and clearer access to information (Teng et al., 2018); (5) being cost-effective and the ability to expand easily (Kuo et al., 2016); (6) providing practical room to quickly gain experience; (7) offers the possibility of innovation (Parton, 2016); (8) supporting creativity learning (Diegmann et al., 2015); and (9) improving the development of spatial abilities.

However, each AR application, editor, or feature has its unique characteristics. Therefore, the identified benefits may not apply to every context (Diegmann et al., 2015). Designers who seek to provide proper scaffoldings to the technological adaptation should consider a relevant educational framework that allows effective teaching and learning use (Giasiranis & Sofos, 2017). Besides technical issues, other non-technological obstacles such as the lack of support from the institutions or schools (Kuo et al., 2016) and AR-related pedagogical knowledge (Lee, 2012) may lead to the failure of using AR for learning and teaching as well.

8.2.2 AR-Enabled Language Learning

AR technology can offer various innovative approaches in the field of language teaching and learning by supporting learning through various immersive channels with sound, picture, writing, video, and animation. It has been evidenced that AR technology has a positive impact on learners' emotional states such as higher motivation and engagement level (Taskiran, 2019). This may lead to the development of basic language domain knowledge such as vocabulary learning (Solak & Cakır, 2015); grammar learning (Taskiran, 2019); listening and speaking skills (Liu, 2009); and reading comprehension skills (Hellermann et al., 2017). Moreover, Özcan et al. (2017) also revealed that using AR in the language classroom can reduce insecurities and fears toward Ottoman Turkish lessons, making learning more enjoyable and less complex. Likewise, Shea (2014) has shown that AR can reduce second language anxiety, promote personalized learning, and extend learning out of the classroom.

Furthermore, there have been studies that concentrate on AR-enabled language learning processes. The use of AR can help to create an effective learning environment for richer interactions in oral courses (Solak & Cakır, 2015). It may enable more robust and learner-centered learning that enhanced individualized learning experiences and collaborative activities to occur during language learning (Kessler, 2018). Besides that, the effectiveness of AR-enhanced collaborative learning in language learning contexts has been evidenced in Wen's (2018, 2020) studies on whether and how augmented papers enhance lower primary students' collaborative learning.

However, most of the studies on AR-supported language learning paid attention to the positive effects of using AR and overlooked its constraints (Chien, 2019). Therefore, this review focuses on unpacking both pedagogical affordances and constraints of AR in empirical language learning studies. Implications for the activity design and enactment of AR-enhanced language learning will be discussed as well.

8.3 Review Methodology

This study surveyed multiple publications on AR in language learning. A systematic literature review was conducted following the guideline by Kitchenham and Charters (2007). The first phase was framing the research questions. That was followed by a thorough search of relevant literatures and a check on the criteria in selecting articles that met the review purpose.

Although the number of published studies about AR in education had drastically increased every year since 2011 (Akçayır & Akçayır, 2017; Garzón et al., 2019), studies regarding AR in language learning are still limited (Bonner & Reinders, 2018). Despite the great potential of using AR in language learning, there is a need to clear up obstructions for its classroom integration. Many studies have shown that AR can help students in various manners by facilitating positive learning attitudes or positive learning outcomes. They are not the focus of this study. Instead, this study concentrates on examining the various AR-supported activities and pedagogical approaches that enable language learning. Rather than measure the intervention effects, we seek to understand how students and teachers could use AR to achieve their extant goals of enhancing language learning. The concrete research questions are as follow:

How are AR technologies adopted in language learning studies?
What are the pedagogical approaches implemented in AR-supported language learning?
What are the constraints of using AR in language learning?

8.3.1 Identification of Eligible Studies

The first literature search was conducted in January 2020 using a well-known online research database, ERIC via EBSCOhost. Since this systematic review focused on the empirical evidence of AR-enhanced language learning studies, refereed journals without empirical studies or about computer programming languages were excluded. Details were summarized in Table 8.1. We used the search keywords “augmented reality AND language learning.” The search parameters were set as follows: Publication date: “since 2010.” Language: “English.” Document type: “Article.”. A total of 53 search results were obtained.

Table 8.1 The inclusion and exclusion criteria for review

Inclusion criteria	Exclusion criteria
Peer-reviewed journal article	Full text not available
With empirical data	Studies that mentioned the term "augmented reality" but were about "virtual reality"
Related to language learning with augmented reality	Focus on computer languages instead of human languages

A data extraction spreadsheet form was created to screen the 53 articles with the following elements: article's name, year of publication, journal of publication, author, sample size, target group, field of education, theory or theoretical framework used, reported advantages, reported disadvantages, and main findings. Two of the researchers proceeded to read each paper individually and to extract the relevant data. Among the 53 publications, 15 articles were identified as relevant to the purpose of this review. Two more articles were then added after reviewing the references of the first 15 selected publications. Finally, a total of 17 articles were selected for this review.

8.3.2 Analysis of Studies

To answer the three research questions, the analyses of this study include three main areas, respectively. They are (1) the context of studies; (2) learning activity designs; and (3) the enactments of the activities. The context of studies was identified by concentrating on the participants, learning domain knowledge, and the learning settings where the AR-supported learning activities took place. Concerning learning activity designs, we focused on what pedagogical frameworks were applied to guide the learning design and their learning effectiveness. As for the activity enactment, we coded the teachers' role and constraints of the AR implementation discussed in the articles.

8.4 Review Results

8.4.1 Context of Studies

We examined the education level or the role of the participants participated in the research studies and discovered that the majority of the studies, 11 studies (64.7%) among the 17 studies, were college students. Other participants ranged from the pre-schoolers (1 study) to elementary-school students (2 study) and to middle-school students (1 study). One study involved only the university professors and another

Table 8.2 Summary of AR used in language learning

Learning setting	Total no. of studies	Domain knowledge and skills				
		V	G2	L&S	R&W	WL
Classroom	9	8	2	5	4	7
Out of classroom	5	1	0	5	4	5
Blended	1	0	0	1	1	1
Lab-based	2	2	0	1	0	2

Legend: V = Vocabulary; G = Grammar; L&S = Listening and Speaking; R&W = Reading and Writing; WL = Whole language.

study by Parton (2016), who made used of virtual reality and QR code to enhance deaf children's American Sign Language (ASL).

Table 8.2 shows that among the 17 studies, 9 studies took place in classrooms; 5 studies outside the classroom; 2 studies in a lab-based setting; and one study in the blended learning environment where participants completed their tasks online remotely and then presented their works in class (Alizadeh et al., 2017).

We also examined the domain knowledge these studies focused on. A total of 5 different domains were identified, (a) vocabulary; (b) grammar; (c) listening and speaking; (d) reading and writing; and (e) whole language. In our coding, whole language refers to the pedagogical awareness such as cultural awareness or to promote and life-long learning that would lead to language improvement (Ogata et al., 2014). Findings from Table 8.2 also reflected that multiple domains might be evident in a single study.

The results showed that the most explored area of the domain was whole language. This indicated that AR in language learning was widely used to facilitate positive emotions and behavior in any learning environment. However, results showed that when AR-enabled activities were conducted outside of the classroom, the ratio of enhancing learners' listening, speaking, reading, and writing skills to vocabulary skills was higher compared to when the activities were conducted in class. This might be because the environment outside was less controlled, creating more opportunities and freedom for more authentic use of language to occur. On the other hand, grammar learning was an area least explored with only 2 studies focusing on it in a classroom environment.

8.4.2 Learning Activity Design

To examine the learning activity designs, we focused on investigating the pedagogical approaches that were used to guide the learning activities. Similarly, findings from Table 8.3 indicated that multiple pedagogical approaches may be used in a single study.

Table 8.3 Pedagogical approaches adopted in the 17 studies

Pedagogical approaches	No	Pedagogical approaches	No
Place-based learning	8	Task-based learning	4
Game-based learning	4	Experiential learning	1
Self-directed learning	1	Ubiquitous learning	2
Collaborative learning	2	Not specify	4

Table 8.3 showed the pedagogical approaches used in the 17 studies. The most used pedagogical approach was the place-based learning approach with 8 implementations. Perhaps due to its ability to augment the surroundings with the outside environments and scenarios. Following behind were game-based learning and task-based learning approaches with 4 studies each. AR has become one notable technology as it has the capability to incorporate elements of play and fun into learning and can facilitate positive emotions and reduce cognitive loads (Safar et al., 2016). Task-based learning has also been introduced into AR activities as it can enable promote role-playing. Thus, students can experience working on tasks meaningfully which may lead to significant learning gains, higher levels of engagement, and more positive learning attitudes (Hsu, 2016). Two studies applied the collaborative learning approaches, of which one study used the concept of social constructivism (Liu, 2009) which focused on the individual's learning that occurs during his or her conversation in a group while another with social constructionism (Wen, 2018) which focused more on the artifacts created through social interactions. One study applied the experiential learning approach (Alizadeh et al., 2017). Another study applied the self-directed learning approach (Hsu, 2016) while comparing it with the task-based learning approach to investigate if the two learning approaches matter in regard to AR-enabled language learning which yields similar results. Ogata et al.'s (2014) studies applied the ubiquitous learning approach as a scaffolding for the learning activity design for vocabulary learning. Whereas a handful of these studies (4 studies) did not specify the pedagogy approach that was applied in their study. These 4 studies were mainly staged by the affordances and benefits of AR technology.

Based on the findings of these studies, we identified 4 critical impacts of using AR on language learning. As shown in Table 8.4, they are the ability to (a) reduce anxiety; (b) enhance language usage opportunities; (c) create a sense of belonging to the community; and (d) increase cultural competence. The publications are organized based on their research focus(es), hence not every study that may have the following impacts was included.

The impacts of using AR in language learning were mainly measured by self-reported data, followed by learning progress data and participants' performance and product data with 12 cases and 11 cases, respectively. This supports that most of exiting studies focused on the affordances of AR that facilitate positive attitudes and beliefs of learners. Furthermore, nearly all the cases used self-reported instruments to measure its effectiveness, suggesting that the researchers were interested

Table 8.4 Learning effectiveness

Main findings	Studies Instruments			No
	S-R	P&P	LP	
Reducing anxiety	Richardson (2016)		Richardson (2016)	6
		Safar et al. (2016)		
	Özcan et al. (2017)			
	Hsu (2016)			
	Kuo et al. (2016)			
	Yang and Liao (2014)			
Enhancing language usage opportunities	Richardson (2016)		Richardson (2016)	7
	Yang and Liao (2014)			
	Chien (2019)			
	Alizadeh et al. (2017)		Alizadeh et al. (2017)	
	Holden and Sykes (2011)		Holden and Sykes (2011)	
	Liu (2009)			
			Hellermann et al. (2017)	
Creating a sense of belonging to the community	Richardson (2016)		Richardson (2016)	7
	Yang and Liao (2014)			
	Holden and Sykes (2011)		Holden and Sykes (2011)	
	Liu (2009)			
			Hellermann et al. (2017)	
	Solak and Cakır (2015)			
	Wen (2018)			
Increasing cultural competence	Yang and Liao (2014)			5
	Chien (2019)			
	Alizadeh et al. (2017)		Alizadeh et al. (2017)	
	Holden and Sykes (2011)		Holden and Sykes (2011)	
	Sahin and Ozcan (2019)			
Total	22	11	12	

Legend: S-R = Self-Report; P&P = Performance & Products; LP = Learning Process data.

in examining the individual's perception of emotional state rather than their cognition processes. More details of these benefits will be discussed in the following paragraphs.

8.4.2.1 AR Reduces Anxiety

Willingness to Communicate (WTC) enables language learners to learn the target language with less anxiety and frustration (Shea, 2014). WTC also indicates the possibility of a person initiating conversation in a less familiar language with others. AR can help learners to be more comfortable in their voice to create their monologues without feeling judged (Shea, 2014). When being fully immersed deeply in experiencing the environment around us, the activities or events happening may then be authentic and meaningful. Immersed language learners also showed higher willingness to communicate, lower communication anxiety, higher perceived communicative competence, and more frequent communication (Yang & Liao, 2014).

8.4.2.2 AR Creates Language Usage Opportunities

Liu (2009) stated that students often lack sufficient opportunities to practice conversation with their teachers, classmates, or native speakers. AR can create opportunities for language use beyond what is available in the language classroom (Richardson, 2016) by augmenting the novelties into reality. It can encourage spontaneous and unplanned use of the language under some pressure of time which may push them out of their linguistic comfort zone and stretch their language skills (Richardson, 2016). In addition, as learners are given more opportunity to converse in a language, it helps them to see the true purpose of language learning and overcome the challenges (Yang & Liao, 2014) to practice the language (Richardson, 2016).

8.4.2.3 AR Creates a Sense of Belonging to the Community

AR also creates situations where language learners can gather and reflect as a community (Holden & Sykes, 2011) This may result to the enhancement of collaborative skills (Wen, 2018). As highlighted in Vygotsky's sociocultural theory, collaborative learning provides the foundation where learning is built upon social situations (Stahl et al., 2006). Y. F. Yang (2011) also stressed that spending a longer time in the community where the target language is used and spoken is one of the most effective ways to pick up and improve a language. However, this may not be feasible for all language learners due to time and financial limitations. In this respect, AR offers, yet another, opportunity by bringing authentic objects into the language classroom and creates a feeling of authenticity (Solak & Cakır, 2015). Furthermore, language

usage in a real-life situation can do more than just improving the learners' learning but can also facilitate creativity (Liu, 2009).

8.4.2.4 AR Can Help Increase Cultural Competence

Cultural learning is a process of acquiring knowledge, skills, and fostering positive attitudes required for effective interaction with people of unique culture (Yang & Liao, 2014). Cultural learning is tightly intertwined with language learning as language is the key component of cultural contexts, and learners cannot master the target language until they have managed to master the cultural context (Yang & Liao, 2014). Furthermore, intercultural competence can create more productive and multilingual members of society (Holden & Sykes, 2011).

8.4.3 Enactments

We examined the difficulties or obstacles faced among our 17 studies regarding the use of AR technology for language learning and classified them into four categories based on the four barriers suggested by Safar et al. (2016):

1. Physical barriers: These refer to the infrastructure, the technological advancement and stability of the digital devices, tools, applications, services, and even internet connection (Holden & Sykes, 2011);
2. Technical barriers: These are related to the digital content, user interface (UI), and user experience (UX) design (Kuo et al., 2016);
3. Individual barriers: These are related to the knowledge of the users, the specialized roles of teacher and student (Sahin & Ozcan, 2019) or the class enactment and;
4. Social barriers: These refer to the community's receptiveness towards using AR for learning (Kuo et al., 2016). Community members include the institution, teachers, students, and parents.

8.4.3.1 Physical Barrier

Technology advancement has narrowed the gap between state-of-the-art technologies and our daily lives. We no longer require fancy devices to operate such technologies. We create new problems leading to system instability and complexity reported when using AR. Perhaps the devices used were not strong enough, in technical specifications (Network bearer, processors, etc.), to power and operate the system or software used. Although not many cases, 4 reported cases among the 17 studies had to deal with technical glitches or occasional miss-detections of markers or the lack of Wi-Fi connection, etc. These issues resulted in the decrease of learners' satisfaction and diversion of their attention and concentration which disengaged them from

the learning tasks (Alizadeh et al., 2017; Yang & Liao, 2014). There were also 4 other cases reporting that the systems were too complex for the students to operate. Students' unfamiliarity and inability to handle the software operations can cause negative emotions or even failures (Chien, 2019). Nevertheless, this might also be due to the lack of explicit explanation of instructions before the activity.

8.4.3.2 Technical Barrier

As mentioned, thanks to technological advancement everyone with or without computer languages' knowledge can develop their own AR activities. Notwithstanding, the available open-source AR editor is very limited. The majority of the studies (6 out of 9 studies made use of open-source AR editor) developed their activities using an open-source AR platform named Aurasma for their studies. Aurasma is an AR platform that is free and developed for simple and easy implementation. Aurasma does not, however, provide a full or immersive AR experience. It is a versatile tool to overlay physical spaces or prints with digital information. The overlays can be images or videos with or without audios. Perhaps because of the inability to provide an immersive experience, these studies using Aurasma may not be able to leverage the full potentials of AR in learning. On the other hand, learning contents were required to be pre-loaded into the editor to finalize the class. These editors were not dynamic enough to support non-linear, open-ended, nor multiple selections of options or answers, and hence it may lead to a superficial curriculum design (Garzón et al., 2019). As such, despite its claims, the inflexibility might restrict authentic and personalized learning to occur (Kuo et al., 2016).

8.4.3.3 Individual Barrier

Among all the 17 studies, none placed emphasis on teacher's enactment. Six studies did not mention the role of the teachers in their study. The rest of the 11 studies merely stated their tasks to manage the learning contents and students. While in some studies, teachers were equipped with a good comprehension of the pedagogical principles and the technological affordances as well as the learning objectives to conduct effective activities. Nevertheless, none of the 17 studies focused on investigating how they enacted or orchestrate the AR-supported activities.

8.4.3.4 Social Barrier

Intertwined with all other factors, Hellermanna et al. (2017) mentioned that AR-enabled classes might not be beneficial for all. This was because some students and teachers were not ready for it while they were the most important components of teaching and learning. In addition, the communities and politics also contributed to the delay of implementation (Sahin & Ozcan, 2019). Sahin and Ozcan (2019)

revealed budget was also an issue especially when programs need to be scaled up. Kuo et al. (2016) suggested promoting the technology to the officials in the ministry of education to raise their awareness of its affordances. However, AR in language learning was still in its infancy stage. Most of the studies were still in the stage to understand the technology and exploring ways to integrate it into the classroom. This may explain the lack of supports from the macro sector.

8.5 Discussions

In this review study, an observed trend is that most of the participants were college students. That is perhaps because adult learners are more independent and more responsible for their own learning and generally better in handling technology and taking care of themselves, and thus the effect of AR implementation may be more obvious. Additionally, about half of the studies involved out-of-classroom AR-supported language learning activities. However, teachers are not easy to monitor students' learning process in the out-of-classroom environment, or even when teachers and students were in the same room, but dealing with different devices. The lack of monitoring and communicating functions may be one of the concerns when teachers use AR in their teaching. Embedding learning analytics tools may be helpful for teachers to monitor their students' learning processes and provide instant feedback. It will be also beneficial for students' self-reflection.

There is also a lack of studies that explore grammar learning using AR technology despite its capability to support the notion of time manipulation. AR can potentially alter time, in an abstract manner, by augmenting the environment into past, present, and future or a human performing certain actions to illustrate the rules of grammar into action in the authentic environment. These studies, in general, paid less attention to enhancing the main domains of language proficiency, reading, writing, speaking, and listening. While facilitating positive learning attitude and behavior are important, perhaps investigation related to enhancing a specific domain of language proficiency can make better contributions since these are the knowledge pertain particularly to language learning.

Teachers can make use of AR technology to broaden or enhance the spectrum of language learning experiences for their students, such as providing feedback to engage learners in extensive language practice or providing opportunities for students to participate in social communication, those learning processes which are associated with meaningful and authentic language practices. According to the results of this review, the majority of the studies focused mainly on leveraging the technical affordances of AR and neglected the key value of the pedagogical and social affordances of AR in language learning. Teachers were trained to, based on their knowledge and experiences, decide on the best suited pedagogical approaches to conducting them in class, yet the teachers played a very small part in these studies.

In addition to learning design, the necessity of investigating teachers' enactment in AR-supported language learning activities is underscored in this study. Teachers'

enactments of ICT lessons are still under-explored and under-recognized (Sun et al., 2014) and the high demands for language teacher preparation often leads to technology use sacrificed although it is becoming increasingly important across the spectrum of language teacher (Sun et al., 2014). Their enactment of the technological lessons in the classrooms has been regarded as a critical indicator for evaluating teacher performance on technology integration (Kessler, 2018). Ertmer et al. (2012) distinguished two types of barriers that hinder ICT integration and well implementation. First-order barriers include resources, training, and support, and second-order barriers include teacher confidence, beliefs, and their perception of the technology (Ertmer et al., 2012). With ample support for the teachers, we can expect technology to be integrated in a more desirable way (Sun et al., 2014).

In light of this, teachers' familiarity and confidence with the technology are important. More studies need to be conducted to explore and understand the relationship between teachers' enactment and other underlying pedagogical theories relevant to the AR-supported language learning activity design. In regard to the consideration for the suitable pedagogical approaches or framework to structure the AR-supported activities, developers and teachers are suggested to work together. While working together, the software can be designed to cover the shortcomings of the teachers' teaching and, on the other hand, teachers can learn about the limitations of the software and adjust their enactment accordingly.

8.6 Conclusion

AR can help to improve cognitive, behavioral, and emotional aspects of language learning, while the analysis of the 17 related studies suggested that most studies focused mainly on the technology itself, and studies on teachers' pedagogical contributions and enactments of the AR learning activities are still lacking. We identified 4 barriers that may hinder the penetration of the integration of AR into language: (1) physical; (2) technical; (3) individual; and (4) social barriers. While physical and technical barriers may be resolved as technology advances, people and social barriers are the obstacles that require our actions to overcome. The findings suggest that more studies are needed to investigate the effect of teacher's enactment on AR-enabled language learning activity. Researchers could examine how language teachers teach and enhance learners' language with different domain areas and explore ways to integrate AR technology accordingly into the class.

Three main suggestions are proposed to help integrating AR in language learning. Firstly, system designers, teachers, and stakeholders can work together to boost teachers' confidence to use the AR technology in class, by increasing teachers' awareness and knowledge as well as the institution's authorities about it, to eliminate misconception such as the technical complexity, budget, or curriculum changes issues. Secondly, researchers and teachers can work together, by providing teachers with feedback or external perspectives and allowing them to reflect on their practice in integrating the technology that may or may not lead to the change of pedagogical

approach (Mills et al., 2019; Urbina & Polly, 2017). Lastly, learning analytics tools can be embedded in the AR learning system, allowing teachers to monitor and assess students' learning progress, such as presenting the number of target vocabulary items learned or analyzing the grammatical features that the students struggled with. This can prepare teachers to work independently with AR by cultivating their data literacy in interpreting results of learning analytics even if their students are scattered around different areas.

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Chapter 9
One-On-One Foreign Language Speaking Practice in High-Immersion Virtual Reality

Regina Kaplan-Rakowski and Alice Gruber

Abstract This autoethnographic study investigated the dynamics of five one-on-one tutoring sessions conducted in high-immersion virtual reality (VR). A lower-intermediate, adult learner of German practiced her foreign language speaking skills in VR with a tutor guiding and assisting her. Both the learner and the tutor visited various VR locations, which offered opportunities for situated learning. A qualitative analysis of the tutor-learner interactions confirmed that social VR applications can offer pedagogically valuable settings for the development of foreign language speaking skills. With a pedagogical mindset, we address affordances of social VR applications, including the authenticity of the settings, and practical implications of using VR as a medium for one-on-one instruction. We also discuss the limitations and technical impediments of using VR, including the lack of facial expression tracking and other nonvocal paralinguistic cues for foreign language instruction.

Keywords Virtual reality · Tutoring · Immersion · Foreign language speaking skills · Situated learning

9.1 Introduction

Speaking practice plays an important role in foreign language development (Gass, 2018), however, face-to-face opportunities to practice speaking skills in class are often limited. One way to solve this problem is using technology and involving students in telecollaboration projects (i.e., collaborative projects that use digital technologies to link students in geographically distant classes) or in one-on-one conversations with expert speakers on dedicated platforms.

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The COVID-19 pandemic restricted face-to-face learning interactions (Ferdig et al., 2020; Hartshorne et al., 2020) and imposed travel restrictions. Consequently, foreign language speaking practice was largely redirected to online communication (Gruber & Bauer, 2020). Online platforms for language speaking practice allow learners to converse in the target language with expert speakers, either in groups or on a one-on-one basis.

Humphry and Hampden-Thompson (2019) describe one-on-one online speaking practice as part of an expansion of online technologies given its potential to offer low-cost individualized teaching, compared with face-to-face teaching. White et al. (2020) argue that a one-on-one speaking practice via videoconferencing offers learners the opportunity to shape their learning interaction and therefore provides more learner agency. Consequently, instructors need to be more flexible in their interactions with learners (White et al., 2020). One-on-one speaking practice in VR offers a similar potential because of the use of avatars, which can lower learners' speaking anxiety (Gruber & Kaplan-Rakowski, 2020, 2021), and can give learners a sense of security (Liaw, 2019), thus encouraging increased learner agency. This development can be extended to one-on-one tutoring in VR, which can have similar benefits and additional affordances, such as authenticity.

Foreign language learners have the opportunity to practice their language skills in increasingly more authentic, realistic-looking, and pedagogically sound language learning spaces. One such space, the virtual world called Second Life, gained popularity in the early 2000s. Since that time, language scholars have explored and researched the potential and pitfalls of learning in this virtual environment (see, for example, Grant et al., 2014, 2018; Kaplan-Rakowski, 2011a, 2011b; Lan, 2014; Lan et al., 2016; Sadler, 2017). Second Life and several other virtual worlds (e.g., Active Worlds, ViRbela) were designed to be experienced on a desktop computer and thus are classified as low-immersion VR as opposed to high-immersion VR (Kaplan-Rakowski & Gruber, 2019).

High-immersion VR is defined as "a computer-generated 360° virtual space that can be perceived as being spatially realistic, due to the high immersion afforded by a head-mounted device" (Kaplan-Rakowski & Gruber, 2019, p. 552). Such an environment can provide a sense of presence, plausibility illusion, and perceived usefulness for practicing public speaking (Gruber & Kaplan-Rakowski, 2020). From the user experience standpoint, the main difference between low-immersion and high-immersion VR is the level of immersion. The ability to be immersed in 360° environments using a VR headset, as opposed to seeing the environment on a flat monitor, is a major factor that increases the authenticity of the experience. We, therefore, make a conscious effort to distinguish between the two types of VR and narrow the scope of our study to only high-immersion VR.

Following a surge in the availability of high-immersion VR headsets in 2016, language scholars have explored ways that VR can assist language learners. Subsequently, the use of high-immersion VR to develop foreign language skills, including oral competency, as well as other language aspects, has been studied (see, for example, Berns et al., 2019; Gruber & Kaplan-Rakowski, 2020, 2021; Hartfill et al.,

2020; Jauregi Ondarra et al., 2020; Kaplan-Rakowski & Wojdynski, 2018; Legault et al., 2019; Papin & Kaplan-Rakowski, 2021; Xie et al., 2019; Yang et al., 2020).

One-on-one foreign language interaction has been studied in online settings (e.g., Stenbom et al., 2016). The results show that the conceptualization of online one-on-one education, as a reliable relationship of inquiry, is possible. Thus, while VR could be a valuable medium for communication between a tutor and a learner, a lack of research exists that investigates the dynamics of one-on-one instruction in high-immersion VR. A systematic review of studies on language learning in high-immersion VR confirms this research gap (Dhimolea et al., 2021).

The gap in the literature led us to pursue three main objectives in this study:

1. To explore the affordances of high-immersion VR for one-on-one tutoring sessions.
2. To present the most relevant observations from the tutor's and the learner's reflective journals regarding the authenticity of settings for language learning.
3. To discuss pedagogical implications and address limitations of using the high-immersion VR application vTime for language learning.

9.1.1 Background

The theoretical foundation of this study derives from several VR research-related topics that explore situated learning and sense of presence, together with the interaction hypothesis and the concept of negotiation. This study is based on the general theoretical framework of situated learning theory, which claims that knowledge is connected to the culture, context, and activity in which it was learned (Brown et al., 1989).

High-immersion VR enables situated learning, which can be defined as "the notion of learning knowledge and skills in contexts that reflect the way the knowledge will be useful in real life" (Collins, 1988, p. 2). Those learning contexts can closely mirror real-life settings. Alternatively, the contexts can be conveyed with the use of video or other multimedia (McLellan, 1996). Herrington and Oliver (2000) maintain that instructional materials based on situated learning need to provide environments that enable each participant to contribute a unique role. Situated learning elements include authentic context, coaching, and scaffolding (Herrington & Oliver, 2000).

The concept of presence plays a pivotal role in high-immersion VR. Sense of presence refers to the feeling of "being there." That is, users behave and feel as if they were in the real world, while knowing that they are not. The sense of being there is enhanced by the realistic environment created in VR (Gruber & Kaplan-Rakowski, 2020; Slater, 2009) and is influenced by factors such as interactions with VR characters (Servotte et al., 2020) and the environment (Slater & Usoh, 1993). Personality traits can also influence the level of sense of presence (Weibel et al., 2010).

The concept of immersion is related to presence but is a separate construct and refers to the VR system's objective level of sensory fidelity (Slater, 2003). Studies

have shown a positive correlation between immersion propensity and sense of presence (e.g., Servotte et al., 2020). With regard to virtual bodies in VR, the concept of sense of embodiment, i.e., the sense of ownership of a virtual body in VR (Slater et al., 2010), can also contribute to making the experience in VR feel real (Slater & Sanchez-Vives, 2016). Such immersion and presence have been shown to engage learners, thus fostering better learning (Webster, 2016).

In terms of second language pedagogy, this study deals with conversational interaction in VR. The most pertinent hypothesis underlying conversational interaction is the interaction hypothesis (Castaneda, 2019), which relates to language production and language reception (Gass, 2018). Conversational interactions carried out in computer-mediated communication have led to improvements in, for instance, students' lexical performance, communication skills (Al-Mutairy & Shukri, 2017), grammar (Gass, 2018), negotiation of meaning, and interaction in real-life activities (Jauregi Ondarra et al., 2011).

One benefit of conversational interaction is negotiation, i.e., "communication in which participants' attention is focused on resolving a communication problem as opposed to communication in which there is a free-flowing exchange of information" (Gass, 2018, p. 159). Negotiation helps not only to draw the learner's attention to linguistic form but also to increase saliency to receive feedback on learners' spoken production and may thereby facilitate learning (Gass, 2018).

Instructors need to offer learning environments (in and out of class) which might enhance and facilitate learner agency (Mercer, 2012). Foreign language speaking practice in VR has the potential of being one of those environments because it can require active participation, depending on the task. Foreign language speaking practice in VR is a task-based activity. Task-based learning focuses on the learner as an active person and is action-based in that it puts human agency at the center (van Lier, 2007).

9.2 Study Design

For the purposes of this study, we opted for an autoethnographic approach where authors act as subjects. Autoethnographic studies allow for the collection of data that is unique, reliable, and based on subject-level information that is difficult to obtain through traditional research methods (Bolger et al., 2003). Indeed, in the case of this study, the involvement of the authors allowed for the gathering of in-depth information from the tutor's and the learner's reflective journals.

9.2.1 The Participants: The Tutor and the Learner

The tutor was an adult female and a qualified teacher of German, working in an academic environment. She was highly experienced in teaching all levels in K-12

and adult education in different countries. Her teaching experience of over 15 years included online one-on-one and small-group online tutoring, using standard video-conferencing tools. In terms of familiarity, the tutor knew the learner very well. They had conversed only in English before the sessions started.

The learner was an adult female with an educational background in language learning and pedagogy. She was a polyglot, having studied eleven languages throughout her life. She took formal German classes on four occasions in school. After over 14 years of only informal contact with German, the learner reached out to the tutor to refresh her German speaking skills. The completion of the German standardized test (Klett Einstufungstest DaF) resulted in a score of 101, which classified the learner's level of German as lower-intermediate (B1).

The participant's scores on the VARK (visual, aural, read/write, and kinesthetic sensory modalities) questionnaire (https://vark-learn.com/the-vark-questionnaire/) of learning preferences were eleven (11) for kinesthetic, three (3) for visual, two (2) for aural, and null (0) for read/write learning preferences. That result classified the learner as strongly kinesthetic. According to the VARK interpretation of the scores, strongly kinesthetic learners "like practical exercises, experiences, examples, study cases, trial and error, things that are real" (https://vark-learn.com/the-vark-questionnaire/).

The learner also completed a "Willingness to Communicate outside the Classroom" inventory (MacIntyre et al., 2001). The objective of the inventory is to establish subjects' level of deliberate initiation of conversing with others, that is, "the intention to initiate communication, given a choice" (MacIntyre et al., 2001, p. 369). The participant scored 32 points out of 40, placing her as "usually willing to communicate."

9.2.2 Instruments, Study Setting, and Content

This autoethnographic report is a part of a study with a wider scope. As a result, we employed multiple instruments to collect information about the learner. Here, we report only the most relevant data derived from the following instruments: a standardized entrance test, the learner's reflective journal, the tutor's reflective journal, the learner's demographic survey, and the tutor's demographic survey.

Five tutoring sessions took place over the span of three weeks. Each session lasted between 30 and 50 min. The first two sessions followed a lesson plan with materials from the tutor. The other three sessions consisted of free-style conversations and were mostly dependent on the learner's agenda. The tutor steered the conversation on occasion. The tasks performed in these three encounters were therefore more open-ended, which allowed for increased ecological validity of the study.

The tutor tried to recycle vocabulary throughout the VR speaking practice sessions to support the learner's lexical development. For instance, in one setting, the tutor and the learner were sitting over a precipice (see Fig. 9.1), which naturally felt dangerous. The tutor took advantage of this setting to revisit words that pertained to the scenario.

Fig. 9.1 Conversing on the edge of the rock while a hawk is flying by

One of those words was "gefährlich" (meaning, "dangerous"), which was linked to the previous VR session when the learner encountered the word for the first time. During all the sessions, the tutor gave oral feedback in the form of recasts, explicit correction, clarification requests, translation into English, metalinguistic feedback, and elicitation. The learner also instigated self-corrections.

9.2.3 Description of the VR Application

vTime (vtime.net) is a social network platform that uses VR as the main medium of interaction between the users. The social encounters can be experienced using a wide range of VR headsets, for example, Oculus Go, Oculus Quest, and even the low-priced ($10) Google Cardboard. While vTime is mainly used for entertainment, it can also be used for educational purposes.

One of the pedagogically useful tools that vTime offers is a notice board that allows for the display of textual information. Tutors can convert Microsoft Word documents to images and upload them to their vTime accounts. When needed, the uploaded documents can be projected onto the notice board, allowing learners to rely

on the textual information. This feature can be particularly useful when the focus of a tutoring session is on specific vocabulary or grammar concepts.

9.2.4 Location Descriptions

The social VR platform vTime offers over twenty locations to choose from. The five tutoring sessions took place in four VR locations were an office, a beach, a rock edge (for a video clip, visit https://www.youtube.com/watch?v=_aZHMmSt13g), and a cave (https://www.youtube.com/watch?v=2at51EqQX7g). The first two sessions were in an office on the top floor of a skyscraper with a view over the city landscape. The place looked like a modern executive office and had a corporate feel. The positive aspect of the location was the possibility of projecting text-based handouts on a VR projector.

The beach setting highly contrasted with the office, allowing for a calming effect. The sound of waves, the animation of the ocean, and slightly dimmed levels of brightness provided relevant opportunities for easygoing conversations. The rock edge overlooked a large, realistic landscape. Pre-programmed hawks were flying in the sky, making the location feel more dramatic and authentic (see Fig. 9.1 for a depiction of the rock edge setting). The cave featured flying bats and a fire pit (Fig. 9.2), together with paleolithic cave drawings. It also had a tiny pond and water dripping from the ceiling.

9.3 Evaluative Report and Pedagogical Implications

The analysis of the tutor's and the learner's reflective journals, along with their discourse throughout the five VR sessions, allowed for a few distinctive themes to emerge. The authenticity of the experience surfaced as the most frequently noted VR affordance. In addition, relevant issues arose regarding paralinguistic cues, scaffolding, distractions, and cognitive load. Project limitations and technical impediments came to light, along with special concerns that need to be kept in mind when learning or teaching in VR.

9.3.1 Authenticity of the Experience

The authenticity of the experience was deepened by several technical affordances of VR. The pre-programmed VR animations (e.g., helicopter flying outside of the office) and the sound effects (e.g., phone ringing, hawks screeching) usually made the experiences feel more real. Both the tutor and the learner were impacted by these VR features, as noted in the reflective journals.

Fig. 9.2 Conversing in the cave at a fire pit

Some examples of authentic experiences could be experienced in the cave (Fig. 9.2). Just like in a real-life cave, the VR cave echoed the interlocutors' voices. Also, steam was coming out of the mouths of their avatars when they were speaking. Another authentic aspect was seeing flying bats, which created a fear that they would fly into one's hair. In addition, the animation of the fire pit at one's feet gave an impression of some warmth being generated from it.

Authentic features included ocean waves hitting the shores of the beach and pieces of stone falling off a rock edge. The tutor's reflective journal reported that sitting over the precipice triggered her fear of heights. Such a scenario could ignite interlocutors to discuss the subject of phobias, which is a possible real-life topic.

Some of the settings in vTime offer contextual vocabulary learning opportunities. For example, when the conversation takes place on the beach, talking about activities typically related to the beach, such as watersports, relaxation, summertime, or vacation, is easier and more natural than it would be in the classroom. Some locations could be beneficial, especially for practicing and recycling high-frequency vocabulary.

VR affordances also could be useful for practicing certain grammar points in an authentic context. In her reflective journal, the tutor noted that VR settings are conducive to practicing, for example, local deictics and dual prepositions (e.g., *dort*,

there; *hinter dem/das Haus*, behind the house). The setting facilitated the practice of these grammatical concepts, which are challenging to many learners of German.

9.3.2 Paralinguistic Cues

In addition to VR providing authenticity of setting, foreign language learners can benefit from paralinguistic cues that applications such as vTime offer. Paralinguistic cues assist interlocutors to facilitate communication by including nonvocal signals or vocal signals, or both. Body language, gestures (e.g., shrugging, clapping, raising hands), and facial expressions are examples of nonvocal signals. They are typically used through avatar embodiment. To offer vocal cues, users rely on their own real-life voice.

The learner commented in her reflective journal on the lack of lip-reading opportunities. In this case, the learner was unable to read the tutor's lips to assist German language listening comprehension. When users talk, the avatars are programmed to move their lips along. The issue is that the avatar's lip movement is random and unnatural; that is, it does not correspond with what the user expects to see while hearing the real person's voice. Consequently, a discrepancy between the avatar's lips and the real-life person's lip movements may be confusing to language learners. This is especially the case for learners with a hearing deficiency or for lower-level language learners, who heavily rely on supporting their listening comprehension with paralinguistic cues.

Schwartz et al. (2004) point out that "lip reading, that is, the visual identification of speech gestures from the moving face, improves the intelligibility of speech in noise when audio-visual perception is compared with audio-only perception" (p. 70). Research with second language learners shows that audio-visual presentation facilitates foreign language learners' perception and recognition of foreign sounds (Davis & Kim, 2001).

9.3.3 VR Versus Videoconferencing

Because both the tutor and the learner were daily users of videoconferencing platforms, such as Zoom, Skype, and WebEx, they naturally noted and commented on the differences in interactions between VR and videoconferencing tools. While comparing the reflective journals of the tutor and the learner, we detected a different preference regarding VR and videoconferencing tools such as Zoom.

The tutor said that she felt more relaxed in the VR setting because, unlike when using teleconferencing tools, no camera was involved. The tutor remarked that, while videoconferencing, she feels that looking into the camera is appropriate when working with a learner, for monitoring and offering support with gestures and

mimicry. Doing so was unnecessary in the VR setting, which made her feel more relaxed.

Meanwhile, the learner's reflective journal revealed that she would have preferred to rely on some paralinguistic cues that are typically possible in a traditional video-conference. The learner wanted to see the tutor's real face or her real lips to help her with German language comprehension. Such an option was not available in VR and the learner could see only the avatar's synthetic image, which is limited in paralinguistic cues.

9.3.4 Scaffolding

To better facilitate the communication in VR, it could be useful for the tutor and the learner to agree on the topic of discussion in advance; this way, they can anticipate the vocabulary that is likely to feature in the discussion. The tutor could provide students with preparatory work based on a flipped classroom concept. Offering written scaffolding before the meeting can then support aural scaffolding during the tutoring session in VR. This reliance on support is especially important for lower-level language learners.

Receiving auditory input without support from the text input in the foreign language makes discussing specific grammar points challenging. Therefore, the tutor could find strategies to direct learners' attention to certain grammar points. One way is to provide the learners with metalinguistic feedback, for instance, by clarifying certain grammar concepts in their first language.

An advantage of relying mostly on spoken communication without any visual cues from the interlocutors is that such a limited communication might trigger more negotiation, e.g., clarification, which is important for foreign language acquisition (Gass, 2018). The recording function in VR would help students, after the sessions, to revisit those parts of the conversation when communication breakdown, clarifications, and form-focused instruction occurred.

9.3.5 Distractions and Cognitive Overload

Wearing a VR headset blocks out the outside world, consequently dimishing real-world distractions and allowing for increased focus on VR tasks and experiences. On the other hand, previous research shows that rich, multimedia spaces such as VR can overwhelm learners with multisensory stimuli (Kaplan-Rakowski et al., 2021; Makransky et al., 2019; Papin & Kaplan-Rakowski, 2021). Especially, for learners who get easily distracted, such as in the case of the learner in this study, VR can cause cognitive overload and, consequently, impede the learning process.

The learner reported being highly distracted in the first two sessions, when the interlocutors met in the virtual office. Even though the office location felt authentic,

the space had pre-programmed helicopters repeatedly hovering behind the office window. In addition, a phone made ringing noises. As evidenced by the tutor's and the learner's reflective journals, at the initial stage, the helicopters and the phone increased the sense of presence. During the second session, they started distracting the learner and disturbing the tutor.

A similar experience took place in the rock-edge setting, with pre-programmed hawks circling in the sky. Likewise, for the cave location, the pre-programmed bats were flying over the interlocutors' heads. The learner found those VR animations distracting as she was challenged to focus on formulating sentences in German. Given that the learner self-reported that her levels of attention are low and that she gets distracted easily, these pre-programmed animations negatively impacted her linguistic processing. The tutor did not perceive the animations as distracting. Being an expert speaker, the tutor likely had sufficient room to process both the conversation and the accompanying VR animations.

In sum, as much as the VR animations (i.e., the helicopters, the bats, the hawks, the ringing phones) increased the perceived sense of presence and the authenticity of the settings, the same elements were making the learner more prone to distraction. Similar observations took place in a study by Gruber and Kaplan-Rakowski (2020), in which students practiced speaking in a foreign language in front of VR classmates. The virtual classmates were pre-programmed to gesture in a way that made the learners feel more immersed. In the meantime, the same looping gestures were increasingly distracting.

9.3.6 Technical Impediments

Currently available high-immersion VR systems can be simple and affordable (e.g., Google Cardboard), relying on their smartphone display to provide a visual VR experience without kinesthetic interactivity. More sophisticated, but more costly, devices (e.g., Oculus Quest) offer better quality VR experiences and are equipped with hand-controllers, allowing for kinesthetic interactivity, if needed.

In this study, we used Oculus Go, which is a portable, standalone device with a wireless, orientation-tracked hand-held controller. This controller enables interactivity, but users must go through a menu to select the gesture they want to perform. Such an action interrupts the natural flow of the conversation and could be considered burdensome. The more advanced Oculus Quest and Oculus Quest 2 offer kinesthetic interactivity through a special haptic system, where gestures can align with natural interaction while speaking.

Even though VR technology is rapidly developing, up-to-date VR systems are still limited with regard to more sophisticated facial expression tracking. This limitation is particularly relevant for language learners. Many language learners rely on their interlocutors' body language for comprehension. Therefore, it will be useful if, in the future, VR systems also offer the ability to "read" the other avatar's mimicry and, especially, lips.

9.3.7 Study Limitations and Future Research

The Oculus Go VR system has limited haptic interactivity, making the VR activities relatively static. Follow-up studies should expand the tutor-to-learner interaction with more dynamic interactivity, allowing users to interact with the VR components and creating opportunities for substantive learning. One idea is to have a tutor and a learner perform some hands-on tasks in VR. For Spanish language learning, a tutor and a learner could, for example, talk about the process of making paella, while cooking it in VR using a haptic system, or learn flamenco, while discussing the dance moves in Spanish.

Based on the findings of this study, certain pre-programmed VR animations increased the sense of presence, but they were distracting for the learner. Future studies could examine how to calibrate the intensity of VR animations to accommodate optimal immersion and learning outcomes with minimal distraction and cognitive overload.

Further studies could implement an alternative to our autoethnographic approach. This study explored the interaction between two interlocutors only: a tutor and her learner. While we purposefully focused solely on the context of one-on-one language interaction between two language experts, future research should consider exploring interactions of a larger number of interlocutors as the dynamics of conversations (e.g., engagement, anxiety, and willingness to communicate) differ depending on the number of speakers involved (Cao & Philp, 2006).

9.4 Conclusions

The main objective of this study was to explore the affordances of high-immersion VR for one-on-one tutoring sessions, with a special focus on authenticity of VR settings for foreign language learners. The analysis of the tutor's and learner's reflective journals and their discourse through the sessions confirmed that social VR applications such as vTime can be valuable tools for foreign language teaching and learning.

The study revealed that tutoring in VR can foster relevant and personalized conversations. The authentic VR settings can also enable role play and task-based learning. The VR scenarios may further spark students' creativity with regard to what they could discuss, thus giving them more agency. Moreover, we found that scaffolding is of utmost importance in VR, almost more important than in other teaching settings.

From the language educators' perspective, certain aspects of social VR applications such as vTime could be improved. Lower-level language learners rely on paralinguistic cues (e.g., lip reading) to decode the interlocutors' speech. The VR technology today is still limited in that it does not offer a large variety of paralinguistic cues.

Blyth (2018) states that "as language technologies grow more immersive, educators increasingly view language learning in terms of a complex social activity—heavily contextualized, thoroughly embodied, and largely experiential" (p. 226). As this study showed, novel social VR applications such as vTime have the potential to provide a setting for such social activities.

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