International Journal of TESOL Studies (2022)
Vol. 4 (3) 50-65 https://doi.org/10.46451/ijts.2022.03.05

Article

The Affordances and Challenges of Virtual Reality for Language Teaching

Neil Cowie*
Okayama University, Japan

Mehrasa Alizadeh
International Professional University of Technology, Osaka, Japan

Received: 15 November 2021/Accepted: 30 May 2022/Published: 30 July 2022

Abstract

There is relatively little research on how teachers can prepare to teach languages using Virtual Reality (VR) applications. There is also little longitudinal research on student self-directed learning using VR. In response to this lack of reported research, this study explores the educational affordances of VR with a small group of four university students and one high school student in Japan who met online weekly for an academic year starting in April 2021. In the first stage of research, the seven participants used Oculus Quest 2 Head Mounted Displays (HMDs) in the Engage collaborative VR space. The five students were asked to investigate and review VR apps that were connected to their academic disciplines. Initial results showed a large number of positive effects of working in VR but almost all participants suffered some kind of cybersickness. For this reason, in the second stage of research, it was decided to move from HMDs to a web-based browser (Mozilla Hubs) in which participants created their own VR rooms to teach each other about one aspect of their own academic field. Finally, in the third phase of the project, the students created their own 360-degree virtual tours using ThingLink. This paper shows how university students can learn in a self-directed VR environment. It also describes the challenges facing teachers who wish to use VR in their teaching, including technical issues of wifi and computer processing power, training in the VR environment, ethical and health concerns, and, most importantly, the pedagogical knowledge needed to best support students.

Keywords

Virtual Reality (VR), self-directed learning, teacher development, VR apps, immersive VR

1 Introduction

Teacher training in using digital technology for language learning has developed rapidly since the turn of the century and there are many language teacher preparation courses that now include mainstream

Email: ncowie2012@gmail.com

technology courses. However, it is also the case that many teachers still have had no training or have relied on various informal opportunities to keep up to date with new technology and the opportunities it can create for teaching and learning. In a review of language teaching and technology, Kessler and Hubbard (2017) concluded that initial teacher preparation is necessary and that it should be carried out in alliance with situated practice to keep such training relevant to teachers' needs. New trends in educational technology are happening all the time and it can be extremely difficult to know whether such trends will be useful or not, and even more difficult to decide whether to invest time and energy in learning about such technology. The advent of Virtual Reality (VR) is a case in point. For a number of years VR in gaming has promised to herald a massive change in educational methods as it appears to have incredible power to engage students by immersing them in other worlds (Gregory et al., 2016). Students become motivated to learn all that they can about these other worlds, including the jargon and terminology associated with these virtual spaces (Gee, 2003). This shows enormous potential for language learning opportunities. Unfortunately, the educational applications of VR for language learning have not been fully realised yet and there are a number of challenges that need to be overcome, including the need for appropriate training in how to use VR pedagogically. This paper uses a case study approach of student and teacher learning about VR to describe what it is currently possible to do in this important area.

2 Background

Digital technology that can be used for teaching languages takes many forms including learner management systems such as Moodle and Blackboard, automated feedback for writing and speaking, and conversations with chatbots (Shadiev & Yang, 2020). There are also now many free or reasonably priced web-based applications that individual students can access to study in their own time. Examples include Duolingo and Babbel (Bajorek, 2017). Many of these applications include AI-based speech recognition software for pronunciation practice or spaced repetition practice for vocabulary development. These are particularly good for novices in a language and take some of the tedium out of memorization and basic fluency practice that any language student needs to go through. Language teachers can also use these applications as supplementary activities for face to face lessons. More recently, VR has emerged as an even more sophisticated digital tool that can be used for basic language practices and for higher order thinking and 21st century skills such as team building, creativity and collaboration.

VR is a 3D virtual world in which participants are immersed and can feel separated from boundaries of time and space. How realistic and immersive the world is depends on the sophistication of the equipment and applications that are used. These can vary from the most recent kinds of headsets and controllers to simpler 360-degree videos that are available on YouTube. VR games can have Hollywood levels of quality or be student-created: both are effective if designed well. Using a headset is the most immersive form of VR as the user is physically separated from their immediate environment, whilst viewing 3D videos on a computer is much less immersive but can still transport viewers to another time and space. Southgate (2020) lists six different kinds of VR depending on the degree of learner embodied interaction and degree of autonomy (see Table 1). The degree of autonomy increases as the degree of learner embodied interaction increases across the different types of VR.

Table 1

Typology of VR Environments (after Southgate, 2020, pp. 33-35)

Type of VR	Description	Example
Swivel	The learner rotates their head or body to experience the surrounding virtual world.	The seated learner can look around and understand about life in a rainforest.

Explore	The learner can access 360-degree photos or videos with various features embedded in them.	The class and teacher tour a museum together to learn about various artefacts.
Discover	A virtual environment with interactive tools and activities.	Learners can work in a virtual laboratory and do experiments in safety.
No code create	Learners can make their own 3D materials without needing to code.	Learners can recreate a historical battlefield.
Code create	Learners use game engines to create virtual worlds.	Learners use code to create a virtual world, such as a World War 1 trench.
Social VR	Learners join a permanent social world to socialise, play and learn.	Learners meet up to present as avatars at a virtual conference.

Of these six types of VR, three would appear to be particularly suited for language learning: explore, discover and social. Exploring and discovering other worlds, especially their languages and culture, is an intrinsic part of language learning; whilst interacting socially with others using the target foreign or second language is a fundamental goal for most language learners. We will return to these three types of VR in the discussion section below.

3 Affordances and Challenges in Adopting VR for Language Learning

Having briefly described the various types of VR, in the following section we identify the affordances that VR has for learning languages and some of the challenges that teachers may face when trying to fully realise its educational potential.

3.1 Affordances

The Immersive Learning Research Network produces an annual report scoping the possible direction of immersive technologies including VR. The 2021 report (Lee et al., 2021) identifies a number of educational opportunities that VR provides. These include authentic learning activities that are embedded in real world contexts; encouraging learners to be creative designers and makers which will lead to deeper understanding; and, chances for social interaction and collaborative learning in emerging VR applications such as Engage (https://engagevr.io/) and Mozilla Hubs (https://hubs.mozilla.com/). More specifically, VR can uniquely contextualise learning in simulated or imagined settings which has both cognitive, social and affective benefits (Mystakidis et al., 2021). A number of recent studies provide evidence that this kind of immersion can aid both the process and product of learning. For example, reading in a VR environment increased knowledge transfer (Baceviciute et al., 2021); learning about historical events in a VR environment can increase engagement, empathy, presence and knowledge mastery (Calvert & Abadia, 2020); Petersen et al. (2022) show that interactivity in VR can decrease cognitive load (Sweller et al., 2011) and that immersion leads to increased situational interest of learners. In the foreign language field, Lai and Chen (2021) claimed that learning vocabulary in a VR gaming environment increased vocabulary knowledge in translation and recognition tests and learners reported that they wished to continue to use the VR tool for their vocabulary development. Similarly, Tai et al. (2020) reported that the use of the Mondly VR application significantly increased vocabulary learning and retention. Finally, there is some data that shows the use of avatars in VR can decrease foreign

language anxiety (Horwitz, 2001) and encourage learners to communicate more successfully (Melchor-Couto, 2017; York et al., 2021).

3.2 Challenges and shortcomings

Conversely, there are a number of barriers to the adoption of VR including limited access to the equipment and networks that are needed, and whether VR is affordable or not. In addition, two key limits to VR take up are the need for teacher training in the technical and pedagogical aspects of using VR and the lack of educational content that is available for teachers to use or adapt (Lee et al., 2021).

Further evidence from the research literature about the limits of VR comes from Radianti et al. (2020, p. 22) who conducted a systematic review of VR in higher education. These authors concluded that VR was "mature enough to be used for teaching procedural, practical knowledge and declarative knowledge" as has been used in various fields such as fire safety, surgery and nursing. However, it was acknowledged that more broadly VR is not mature yet and that "researchers need a comprehensive market overview of existing VR apps that support education". Parmaxi (2020) reviewed the use of VR in language learning. It was revealed that of the 26 studies that eventually were chosen to be included in the review 15 were about Second Life and five were connected to a similar virtual world called Open Simulator. This review covered studies from 2015 to 2018, and even in this relatively recent survey there was almost no mention of social spaces such as Engage or Mozilla Hubs that have been recently marketed, nor of immersive VR using headsets such as the Oculus series. As a result, one recommendation from this meta-analysis was that more research on affordable and fully immersive VR still needs to be undertaken.

Southgate (2020) has carried out one of the relatively few longitudinal qualitative studies. She engaged in participatory research (Vaughn & Jacquez, 2020) with teachers and students from two high schools in Australia. In the first school students and teachers used the networked VR application Minecraft to create virtual tours of the human brain. In the second school a drama class used the 3D drawing program, Tilt Brush, to design costumes and sets for a play. As a result of these experiences, Southgate outlined several suggestions for how teachers can use VR in education including the need for teachers to know about different types of VR and to develop clear protocols and procedures, and that "signature pedagogies" (Southgate, 2020, p.29) can be used to leverage the affordances of VR. That is, a subject teacher should maintain their existing teaching approaches that work best and use VR as a tool that fits into those approaches. The implications of this suggestion in terms of language teaching are to identify common signature pedagogies and develop specific examples for using VR.

In sum, the above literature on VR shows that it has great potential for education in general and language learning in particular, but how this potential can best be realised is not so clear, especially in terms of pedagogical approaches. This leads us to the following research questions:

1. What free educational VR applications are available that students can use with minimum direction from a teacher?
2. What VR applications are specific for language learning?
3. What training or development is necessary to help teachers implement VR?

Underlying these questions is the overarching one of how mature VR is for language learning. It is probably suited for direct teaching of basic practical knowledge about language such as vocabulary but it is not clear yet whether it can be used for higher order communication skills such as collaboration and negotiation. And, if it can, what do language teachers need to know in order to successfully teach a course with a VR component in it?

In order to try to answer these questions the authors underwent a joint research journey of discovery with a small number of students who were partners in the task of finding out the potential and pitfalls of VR for language learning. Two theoretical frameworks are used for this paper. The first is that of

exploratory practice (Allwright, 2003; Hanks, 2019) in which data collected from both students and teachers in one lesson cycle is analysed and then used to inform the next. It is an iterative process in which the direction of both lessons and research is frequently adjusted as the research context is jointly explored. The second theoretical framework is that of self-directed learning (Aguayo et al., 2020; Knowles, 1990; Loeng, 2020; Loyens et al., 2008), which is used in a very basic sense where learners are classified on a continuum from teacher-directed to self-directed. In this study, the authors have tried to create tasks and activities that give learners the most amount of freedom to carry out in their own way; be that, for example, choosing content or using their own strategies to solve issues. However, there are times when what the learners are asked to do is very directive.

4 The Study

4.1 Participants and setting

The first author works at Okayama University in western Japan. As well as teaching EFL he works in the Centre for Teaching Excellence (CTE) which employs student workers on education-related projects. Four of these student workers were eager to join a VR project when it was suggested to them. A fifth participant was not a student worker for the CTE but was the son of a staff member. He was of high school age but as he was being home-schooled he could join with the university students for this project. It was, therefore, an opportunistic sample (McLeod, 2021) of students that could participate in the project.

The students had a variety of prior VR experience and knowledge. One of the student participants had experienced immersive VR before as he owned an Oculus Quest headset, but the others had no experience of a VR environment beyond brief "amusement park" rides. Two of the participants had created an avatar before but none of them had been in a multi-user environment. As can be seen in Table 2 below, the L1 for two of the students was English, Japanese for two and Thai for one student. All students had adequate levels of English and so English was used for all communications within the VR environment.

In addition to the five students and two researcher-teachers, a third EFL teacher colleague joined the online meetings as an observer and gave valuable feedback from the perspective of a keen but novice user of VR.

Table 2
Participant Details

Participant	Age	First language	Major
C	29	English	Politics
R	20	Japanese	Social Studies
S	20	Thai	Engineering
T	23	Japanese	Economics
D	16	English	Social Studies

The project began at the start of the academic year in Japan, in April 2021, and lasted until January 2022. This period was divided into three distinct phases reflecting three different kinds of VR software that the students used: (1) Engage; (2) Mozilla Hubs; and, (3) ThingLink. The results from these three phases are

shown in the next section. In addition to recording the students' experience throughout the term of the project, the two teacher-researchers also collected information on VR applications that could be used for language learning. These are briefly profiled in the discussion section below where research question two is examined.

4.2 Phase 1: Using head mounted displays in Engage

Initially, the seven participants were all equipped with Oculus Quest 2 Head Mounted Displays (HMDs) and controllers. In the first lesson the students worked together in a classroom to carry out the orientation training that Oculus provides. The two teachers took part remotely using Zoom. This training involves a series of game-like activities in which a user gradually understands how the headset and controllers work. After this first lesson, all the participants met online each week using the Engage collaborative VR application. This is a virtual communications platform in which participants can meet in a variety of spaces such as a lecture theatre or coffee shop. Each participant creates an avatar to represent them which can move freely around the space and if the avatars are close enough the participants can talk with each other. Engage allows participants to share various media such as texts, images, videos and websites. As a result, it is possible to use it to communicate and present information to each other.

After the initial headset training, the five students were asked to investigate and review free VR applications that were, if possible, connected to their academic disciplines or that they had a personal interest in. They were asked to complete an online survey for each application that they used. The questions included ones on how to access the application; what kind of learning experiences it offered; were there any problems in using it; and, how could the application be used for educational purposes. From April to June 2021 the five students logged reports on 18 applications which included games (N=7), immersive documentaries (N=5), subject-specific applications (N=4) and social applications (N=2). The screenshots in Figure 1 show examples of each type.

Figure 1

Screenshots of Free VR Applications That Can Be Used in Oculus Quest

In addition to answering the online survey, whilst meeting in Engage the students presented their findings about the applications that they had used. The teachers would facilitate these meetings and take notes as part of participant observation (Patton, 2014). The surveys, the meeting notes and a final focus group interview in June 2021 were the data that was collected and analysed by the authors. From this data the following conclusions can be drawn. Overall, the students were very positive about their VR lessons describing the experience as fun, exciting and stimulating, similar to what Bower et al. (2020, p. 2221) describe as "hedonic motivation". They felt that the experiences were very engaging, especially the

more physical game activities that they tried out. The students also felt that the use of avatars had the potential to improve their communication skills as it decreased their anxiety (backing up the findings of Melchor-Couto, 2017 and York et al., 2021). In addition, wearing a headset meant that students could not be distracted by other actions such as checking their phones so they felt that they were more "on task". The following are some comments from the students explaining why they thought the applications that they found had educational affordances: Student C said "I think that this is a very good app for people who find it difficult to connect and empathise with historic/current world events". Student D said that the applications could be used for "team bonding and collaboration". Student S believed that they can be good for content knowledge acquisition: "It's a good medium to teach students about (the) ecosystem and environment".

On the negative side, the students felt less presence (Garrison, 2011) in environments where they moved less or were in a simulated real environment such as a lecture hall. All participants suffered to some degree from cybersickness (Rebenitsch & Owen, 2016) as they sometimes felt dizzy and nauseous or had a headache after using the VR applications. For some of the participants this was the result of being so enthusiastic about VR that they wanted to stay in the environment for as long as possible; showing that it can be a very powerful tool to engage students. Two further issues were the difficulty of wearing glasses with the HMDs and the weight of the devices becoming uncomfortable after prolonged use. For these health reasons it was decided to move from HMDs to a web-based browser (Mozilla Hubs) for the next phase of the project. A web-based VR platform can still have a virtual effect but is not as immersive as using a headset and so is less likely to cause cybersickness. From the perspective of teacher development, it was also an opportunity to gain experience in another form of VR.

4.3 Phase 2: Presentations in Mozilla Hubs

In the second phase of research the student participants were asked to create their own rooms in the Mozilla Hubs application. Mozilla Hubs is an open source, free virtual meeting application which is similar to Engage in that there are a variety of different spaces in which participants can meet. Here, the participants can use basic templates to create their own room and then repurpose them in any way that they like. They can do this within Mozilla Hubs using the "assets" that are available or use an associated application called Spoke (https://hubs.mozilla.com/spoke). The second author has experience of using Mozilla Hubs and could guide the students as to how to use it. However, as is common with recently developed digital technology, there were still a number of questions and issues that arose. One particular problem was that Mozilla Hubs can create quite a heavy processor load for individual computers so sometimes students did have trouble accessing the space and sharing audio.

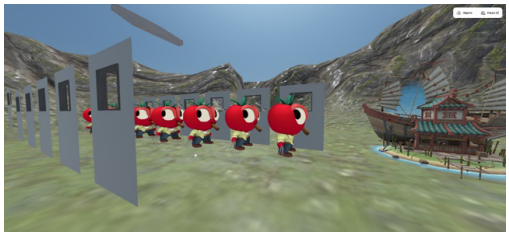
Once the students could create their own rooms they were then asked to teach each other about one aspect of their academic field or interest. As with phase one, the five students and two teachers met each week for an hourly lesson during which the students would present their work and reflect upon the use of VR to do so. From the end of June to the beginning of August 2021 the five students each created a different presentation (see Figure 2).

The participation observation notes, surveys and focus group interview revealed that Mozilla Hubs was preferred to Engage and the Oculus headsets as the participants did not become sick and it was less effort and less complex to participate in the meetings. On the other hand, some students did have some problems uploading objects and assets and were somewhat frustrated as they could not successfully implement all their ideas. They enjoyed the creativity that Mozilla Hubs allows but the process of making complex scenes was difficult and building a room from scratch was not very efficient. Simple, visual effects were relatively easy to achieve and visually effective but more complex rooms were challenging to create and not so visually effective if not done to a high standard (for example, it can be very hard to align images correctly). Spoke is an advanced application that takes time to understand and get used to. It was concluded that it may be worthwhile to use this for a big project and it is probably

better to use simple effects for a basic class. In fact, at this stage, one of the students stopped attending the online meetings because he was frustrated with the Mozilla Hubs platform not loading properly and not being able to easily access linked materials such as photographs. Unfortunately, it was not possible to determine what exactly was causing the problems.

Figure 2

Mozilla Hubs Presentation Examples and Screenshots of Mozilla Hubs Rooms

Topic	Features
Kazuo Ishiguro  	R presented his room about Kazuo Ishiguro, Nobel-prize winning author of novels such as "A Pale View of the Hills" and "Artist of the Floating World". R explained in an in-room presentation about the themes in these works such as the reliability of memory. We were then invited to enter another space where R had posted examples of propaganda art by Yoko Ono.
SNS marketing 	T presented his room making a connection between SNS marketing and the real-world example of the Ohara museum in Kurashiki, Japan.
Infinity 	S's two rooms were the most ambitious of the presentations. In his first room he presented an abstract concept of infinity using a hotel with many doors and walls, and in the second he uploaded many floating walls with mathematical formulas representing hexagons, pentagons and squares. Each participant's avatar could fly above the floating walls and see them from different perspectives.
Art propaganda 	C presented her room which she described as a prototype project in which she wanted feedback on different objects in the space. The theme was about how art can become controversial and she illustrated it with the satirical 'The Spear' by Brett Murray (2012) depicting the South African president.

Musical pitch 	D presented his room which illustrated how sound travels and included a video which explained how pitch works.

In sum, the use of Mozilla Hubs was preferred to Engage and Oculus Quest because it did not cause cybersickness and it was a stimulating way to use VR to present ideas to other participants. However, as it was challenging for the students to create materials, it was decided to continue with a browser-based interface but to investigate other ways for students to create their own VR materials. This was phase three of the study which took place from September 2021 to January 2022.

4.4 Phase 3: Virtual tours using 360-degree cameras and ThingLink

In stage three of the project the student participants were asked to take their own 360-degree photos and videos in order to create a virtual tour of a location of their own choice. 360-degree photos and videos were chosen as these are becoming increasingly commonplace and easy to use tools which have potentially wide applications for education (Lampropoulos et al., 2021). Each participant was provided with a 360-degree camera, a selfie stick and a tripod and given an orientation about how to use them. In addition, they were taught how to use the ThingLink application (https://www.thinglink.com/) to edit videos and photos, and to populate them with various VR features such as web links, audio files, animations, and pop up information tabs. ThingLink was also used as the means to share these virtual tours.

Figure 3

Screenshots of ThingLink 360-degree Tours

A South African horse ranch↵

A university campus↵

A walk in the park↵

The student participants made three virtual tours: of a South African horse ranch; a university campus; and, a walk in the park (see Figure 3). Each one had embedded information that provided extra details for the viewer, such as close up photos, extra textual information, and quizzes. Three of the students reflected on their experience in the following ways. Student R stated that he enjoyed taking photos and editing them on ThingLink as he found the application easy to use and very intuitive. The only negative point that he felt about the experience was the large size of the selfie stick which sometimes appeared in the visual images. One unexpected result that Student C reported was that she felt very conspicuous taking photos with a selfie stick and did not feel very comfortable doing that. However, she "enjoyed working with Thinglink itself… (as) it was intuitive, enjoyable editing". Student T felt that using the 360-degree cameras and ThingLink could be used to create links with the real world and he enjoyed taking photos, especially with one particular camera that could be swung around to create some very stimulating effects (this is called "bullet time" and is one feature of the Insta360 camera). Overall, Student T felt that ThingLink was the easiest application to use although it was less immersive than Engage or Mozilla Hubs.

5 Discussion

In this discussion section of the paper we will return to our initial research questions in order to reflect on the lessons of the year-long project and help guide other language teachers who are interested in using VR in their classrooms but are not quite sure which approach to take.

5.1 What free educational VR applications are available that students can use with minimum direction from a teacher?

As Jensen and Konradsen (2018) and Lee et al. (2021) point out, the lack of educational content is a major barrier to the uptake of VR by educational institutions. However, there is a gradual increase in availability and we will briefly list some of the most common educational VR applications and categorise them in terms of three of Southgate's (2020) pedagogical types: discover, explore, and interact socially.

The student participants found a small number of free content-based educational apps which can be used to discover and explore other worlds in time and space. These include immersive documentaries such as Travelling While Black, Home After War, Anne Frank House and Ecosphere. National Geographic VR is gradually adding more content in order to visit places such as Antarctica and Machu Picchu. There are a range of museums which have created VR tours such as the British Museum and the National Museum of Contemporary Art in Seoul, South Korea. Perhaps the application with the greatest number of possibilities for teaching is Google Earth VR. This can be used on a web browser or headset and allows students to create virtual tours of almost anywhere on the planet.

With regards to language learning, social VR applications provide great opportunities for students to interact, collaborate on projects, and present their ideas. For some students the opportunity to have an alternative identity through the use of an avatar can decrease anxiety (Melchor-Couto, 2017). For this project Mozilla Hubs and Engage were used, but there are a number of other applications such as Spatial (https://spatial.io/), RecRoom (https://recroom.com/), VR Chat (https://hello.vrchat.com/), and AltspaceVR (https://altvr.com/).

5.2 What VR applications are specific for language learning?

Throughout the life of the project the two teacher-researchers tried to find VR applications that were specifically developed for language learning. In this section, we will briefly describe four of the most prominent ones.

5.2.1 Mondly VR

This application (https://www.mondly.com/vr) is a VR complement to the widely used Mondly language learning platform. At the time of writing 30 languages are supported. The VR application is situation based; that is, learners have to carry out tasks in various VR environments such as check in to a hotel or take a taxi and so on. The VR environment uses animations with voice recognition and feedback from a chatbot included in the software. As mentioned previously Tai et al. (2020) found that Mondly VR could significantly increase vocabulary learning and retention.

5.2.2 ImmerseMe

ImmerseMe (https://immerseme.co/) has a large number of 360-degree video scenes in nine languages which a learner watches and can interact with to a limited extent: the learner can talk to the person featured in the VR through automatic speech recognition which enables learners to receive instant feedback. As Berti (2020, p. 327) points out in a review of ImmerseMe, although there are a number of limitations to the tool, "Compared to traditional pedagogical materials (e.g., textbooks), this platform has the advantage of immersing language learners in culturally authentic contexts that may produce a sense of 'being there'".

5.2.3 Virtual Speech

This is a business-oriented set of courses on various soft skills such as leadership and presentations (https://virtualspeech.com/). Students have access to over 40 VR 360-degree video scenarios in which they can practice what they have learned and receive feedback on their performance including indicators such as their use of filler language, amount of eye contact, and word speed.

5.2.4 McGraw Hill Spanish Practice Study Abroad

This application (https://www.mhpractice.com/products/Practice_Spanish) is an animated avatar, game-based study abroad experience. Students can earn points after completing various tasks and practical activities on a study abroad trip to Colombia. Students have to solve various mysteries in a series of quests, and in order to help carry out the quests students must do various vocabulary and grammar related activities.

The above applications are probably best used as supplemental options for a class or the basis of some kind of flipped learning; that is students do the activities before a lesson and then follow up with the teacher and their classmates. The ones that are cited all have free demonstration options but the full versions are not free, reflecting the current high cost of creating high quality VR applications. It is expected, however, that the number of VR applications will only continue to increase and that costs will come down (Alexander et al., 2019; McGee & Jacka, 2021).

5.3 What training or development is necessary to help teachers implement VR?

Teacher training in the use of VR is important. Teachers need to be aware of the following four areas: signature pedagogies; training in the VR environment; technical issues; and, ethical and health concerns.

5.3.1 Signature pedagogies

Southgate (2020) suggests that one approach to the successful use of VR in education is for teachers to align their "signature pedagogies", or most successful teaching methods, with the type of VR use they

want to use. For this paper we will assume that there are two main kinds of pedagogical approaches associated with language teaching, and for the sake of simplicity we will focus on speaking. Firstly, language students need to build their vocabulary, become familiar with the most common grammar patterns, and develop automaticity in speaking skills. Secondly, once language students have a basic knowledge and some command of the target language they need to develop fluency and higher order communicative skills.

For basic language development, signature pedagogies include such methods as direct translation, dictation, and various kinds of language drills and pattern practice. These can be very satisfying and fun in the hands of a skilled teacher but they can also be boring and repetitive and are not very engaging for students. This is where language learning applications designed for individual use, such as Mondly VR or McGraw Hill Study Abroad, could be very helpful in maintaining student interest and preparing them for more challenging authentic classroom interaction. Students can use these applications in their own time and at their own pace. They can use them to develop a basis for more communicative tasks with other students, either online or in a classroom.

Signature pedagogies based on higher order communication and fluency development include various kinds of real-time interactions such as role plays, simulations, presentations, conversation, debate and so on. Students need to be able to use their language skills in a range of circumstances from a prepared presentation script to spontaneous interaction. These are challenging to many learners who may suffer from some kind of foreign language anxiety (Horwitz, 2003) and are not able to fully realise their potential. The types of VR applications that can help with these kinds of issues include the ones used in this research project (virtual tours; web-based collaborative spaces; and, fully immersive headsets). They can be used for individual and class use, are interactive, and can be used for presentations and discussions.

We would encourage teachers to view VR as another potential tool or approach to be used when designing a curriculum and syllabus. It offers the opportunity to virtually visit other places and times that may be impossible in any other way. As a result, the chances for increased student engagement, motivation and subsequent learning are high.

5.3.2 Training in the VR environment

Given that VR in education is not yet a fully-fledged field of practice and research, training and support programs for teachers are scarce or unavailable at most institutions (Lee et al., 2021). A key factor in teacher development of the use of VR is the necessity for teachers to experience for themselves VR environments (Blaschke & Hase, 2019). The degree to which teachers can do this will depend on their context and budget but we would like to offer some possibilities.

In our research project we started with fully immersive headsets as these are the most obvious and attractive VR tool, and we wanted to really have an impact on the students. However, these are the most expensive options and we found that they are the most likely to cause health issues such as cybersickness (Rebenitsch & Owen, 2016). On reflection, we would reverse the order in which we used the various VR tools and options. We suggest teachers start with language learning applications such as Mondly VR and then try out virtual tour creation using a 360-degree camera or smartphone with simple tools such as ThingLink. If teachers do not have access to such equipment Google Earth VR can be used to make virtual tours. There are also many 360-degree videos on YouTube which can be very helpful to get used to this kind of environment. Once teachers have gained some insights and familiarity with VR they can then move on to web-based collaborative spaces. At first, we suggest opening their own accounts and experimenting by creating a room and being able to navigate around it. Finally, if it is possible it would be logical to then move on to fully immersive headsets and controllers. These have their own in-built training programs to get used to the equipment and teachers can then experiment using the headsets to

visit the other VR environments that they have found or created. In all these different VR environments it is advantageous to work with colleagues or friends to gain joint insights and to experience the interactive and collaborative potential of VR.

5.3.3 Technical issues

When using VR there are a number of potential pitfalls for teachers to be aware of and to anticipate. Firstly, there are currently few models of standalone non-tethered VR headsets available on the market such as the Oculus Quest, Pico Neo, and HTC Vive Focus. These HMDs can deliver a fully immersive experience in high-resolution 3D environments with 6 degrees of freedom in movement and room-scale tracking. However, the initial setup and management of a large number of these devices can be a labour-intensive task in the absence of a device management platform. Secondly, although the consumer edition of HMDs designed for personal use can be purchased at lower cost, an issue that is often raised in their use in educational contexts is that they require designated accounts to complete the initial setup. For example, the Oculus Quest 2 requires a Facebook account to start the device and get it ready for use. This problem can be resolved by purchasing the enterprise edition of HMDs that do not require social media accounts for setup and that can be managed in bulk using a device management tool. The downside with the enterprise edition of HMDs is that they cost much more and are unaffordable for many schools and universities. Thirdly, VR applications do take up a lot of wifi broadband width and computer processing power. Again, teachers need to check on the equipment and environment that they teach in to make sure that it can support appropriate use of VR. Finally, when using headsets there needs to be enough classroom space to allow students to use them safely without hitting objects and they need to be cleaned correctly after use (Southgate, 2020).

5.3.4 Ethical and health concerns

There are a number of ethical and health concerns that teachers need to be aware of when using VR (Steele et al., 2020). The most important ethical issue is that by using VR applications teachers and students will be sharing data with the companies that supply these VR applications. It is clear that learners' privacy can be violated to a certain extent when using any Web 2.0 tool that requires login information and collects user data in the form of GPS location, images, videos, and so on. However, the ethical problems associated with the use of wearable devices and VR applications are far more complicated since, in addition to general personal data, user biometric data such as head and hand motions and eye tracking data (in the case of HMDs with built-in eye trackers) can be accumulated into big data and accessed without user knowledge or consent to serve the benefit of tech companies.

As was apparent in the description of the research project an important issue when using VR, especially in fully immersive environments, is the potential for participants to suffer from cybersickness. We suggest that students need to be closely monitored when using headsets and, as recommended by the UK government (Department for Business, Energy & Industrial Strategy, 2020, p. 20), limited to 15 minutes use before taking a break. An additional potential problem with headsets is that participants are so immersed that they can be unaware of the environment they are in and can fall over or trip into obstacles. Teachers need to be very careful in setting up the class use of headsets and make sure that students use the "guardian" feature inbuilt in the devices to prevent moving out of the safe area.

6 Conclusion

This paper described a research project carried out over one academic year in which two teacher researchers worked with five students in order to explore the affordances of VR in a student self-directed

setting and uncover potential implications for teacher training and development. Through the use of immersive headsets, web-based browsers and the creation of virtual tours the students could explore for themselves both the fun and learning opportunities that VR provides. And in collaborating with the students, we as teachers discovered the limits and challenges that organising VR lessons involves. The limitations of the case study are that there were only five students involved and all self-declared themselves enthusiastic about being involved in a VR project. The findings would be more robust if there had been more participants and that not all were positive about VR. Nevertheless, in view of the paucity of longitudinal research into self-directed learning and VR we feel that our study has merit in terms of a number of recommendations for other teachers wishing to use VR in their practice. These include training in terms of VR applications, technical knowledge, and ethical and health issues. But most of all we would urge other teachers to not be overly anxious about these challenges but use their "signature pedagogies," or preferred teaching approaches, to access the affordances that VR has to increase student engagement and learning.

References

Aguayo, C., Eames, C., & Cochrane, T. (2020). A framework for mixed reality free-choice, self-determined learning. *Research in Learning Technology*, *28*, 1–19. https://doi.org/10.25304/rlt.v28.2347

Alexander, B., Ashford-Rowe, K., Barajas-Murphy, N., Dobbin, G., Knott, J., McCormack, M., Pomerantz, J., Seilhamer, R., & Weber, N. (2019). EDUCAUSE Horizon report: 2019 Higher Education Edition. EDUCAUSE. https://library.educause.edu/-/media/files/library/2019/4/2019horizonreport

Allwright, D. (2003). Exploratory practice: Rethinking practitioner research in language teaching. *Language Teaching Research, 7*(2), 113-141. https://doi.org/10.1191/1362168803lr118oa

Baceviciute, S., Terkildsen,T., & Makransky, G. (2021). Remediating learning from non-immersive to immersive media: Using EEG to investigate the effects of environmental embeddedness on reading in Virtual Reality. *Computers & Education*, *164*, 104122. https://doi.org/10.1016/j.compedu.2020.104122

Bajorek, J. P. (2017). L2 pronunciation tools: The unrealized potential of prominent computer-assisted language learning software. *Issues and Trends in Learning Technologies*, *5*(1), 24-51. https://doi.org/10.2458/azu_itet_v5i1_bajorek

Berti, M. (2020). ImmerseMe. *CALICO Journal*, *37*(3), 321-330. https://doi.org/10.1558/cj.39714

Blaschke, L. M., & Hase, S. (2019). Heutagogy and digital media networks: Setting students on the path to lifelong learning. *Pacific Journal of Technology Enhanced Learning*, *1*(1), 1-14. https://doi.org/10.24135/pjtel.v1i1.1

Bower, M., DeWitt D., & Lai, J. W. M. (2020). Reasons associated with preservice teachers' intention to use immersive virtual reality in education. *British Journal of Educational Technology*, *51*(6), 2214–2232. https://doi.org/10.1111/bjet.13009

Calvert, J., & Abadia, R. (2020). Impact of immersing university and high school students in educational linear narratives using virtual reality technology. *Computers & Education*, *159*, 104005. https://doi.org/10.1016/j.compedu.2020.104005

Department for Business, Energy & Industrial Strategy (2020). *The safety of domestic virtual reality systems: A literature review*. https://www.gov.uk/government/publications/safety-of-domestic-virtual-reality-systems

Garrison, D. R. (2011). *E-learning in the 21st century: A framework for research and practice* (2nd ed.). Routledge. http://dx.doi.org/10.4324/9780203166093

Gee, J. P. (2003). *What video games have to teach us about learning and literacy.* Palgrave Macmillan.

Gregory, S., Lee, M. J., Dalgarno, B., & Tynan, B. (Eds.). (2016). *Learning in virtual worlds: Research and applications*. Athabasca University Press.

Hanks, J. (2017). *Exploratory practice in language teaching: Puzzling about principles and practices.* Palgrave Macmillan.

Horwitz, E. (2001). Language anxiety and achievement. *Annual Review of Applied Linguistics, 21*, 112-126. https://doi.org/10.1017/S0267190501000071

Jensen, L., & Konradsen, F. (2018). A review of the use of virtual reality head-mounted displays in education and training. *Education and Information Technologies*, 23, 1515–1529. https://doi.org/10.1007/s10639-017-9676-0

Kessler, G., & Hubbard, P. (2017). Language teacher education and technology. In C. A. Chapelle & S. Sauro (Eds.) *The handbook of technology and second language teaching and learning* (pp. 278-292). Wiley-Blackwell. https://doi.org/10.1002/9781118914069.ch19

Knowles, M. S. (1990). *The adult learner: A neglected species* (4th ed.). Gulf Publishing.

Lai, K.-W. K., & Chen, H.-J. H. (2021). A comparative study on the effects of a VR and PC visual novel game on vocabulary learning. *Computer Assisted Language Learning*. https://doi.org/10.1080/09588221.2021.1928226

Lampropoulos, G., Barkoukis, V., Burden, K., & Anastasiadis, T. (2021). 360-degree video in education: An overview and a comparative social media data analysis of the last decade. *Smart Learning Environments*, *8*, 20. https://doi.org/10.1186/s40561-021-00165-8

Lee, M. J. W., Georgieva, M., Alexander, B., Craig, E., & Richter, J. (2021). *State of XR & immersive learning outlook report 2021*. Immersive Learning Research Network.

Loeng, S. (2020). Self-directed learning: A core concept in adult education. *Education Research International*. https://doi.org/10.1155/2020/3816132

Loyens, S.M.M., Magda, J. & Rikers, R.M.J.P. (2008). Self-directed learning in problem-based learning and its relationships with self-regulated learning. *Educ Psychol Rev* 20, 411–427. https://doi.org/10.1007/s10648-008-9082-7

McGee, B. L., & Jacka, L. (2021). Virtual reality in Education. Broken promises or new hope? In Gregory, S., Warburton, S., & Schier, M. (Eds.), *Back to the Future – ASCILITE '21. Proceedings ASCILITE 2021 in Armidale* (pp. 74–80). https://2021conference.ascilite.org/wp-content/uploads/2021/11/ASCILITE-2021-Proceedings-McGee-Jacka.pdf

McLeod, S. (2021). Sampling methods: Types and techniques explained. *Simply Psychology*. https://www.simplypsychology.org/sampling.html

Melchor-Couto, S. (2017). Foreign language anxiety levels in Second Life oral interaction. *ReCALL, 29*(1), 99-119. https://doi.org/10.1017/S0958344016000185

Mystakidis, S., Berki, E., & Valtanen, J.-P. (2021). Deep and meaningful e-learning with social virtual reality environments in higher education: A systematic literature review. *Applied Sciences, 11*, 2412. https://doi.org/10.3390/app11052412

Parmaxi, A. (2020). Virtual reality in language learning: A systematic review and implications for research and practice, *Interactive Learning Environments*. https://doi.org/10.1080/10494820.2020.1765392

Patton, M. Q. (2014). *Qualitative research and evaluation methods: Integrating theory and practice.* Sage Publications.

Petersen, G. B., Petkakis G., & Makransky G. (2022). A study of how immersion and interactivity drive VR learning. *Computers & Education*, *179*, 104429. https://doi.org/10.1016/j.compedu.2021.104429

Radianti, J., Majchrzak, T., Fromm, J, & Wohlgenannt, I. (2020). A systematic review of immersive

virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & Education,147*, 103778. https://doi.org/10.1016/j.compedu.2019.103778

Rebenitsch, L., & Owen, C. (2016). Review on cybersickness in applications and visual displays. *Virtual Reality, 20*(2), 101-125. https://doi.org/10.1007/s10055-016-0285-9

Shadiev, R., & Yang, M. (2020). Review of studies on technology-enhanced language learning and teaching. *Sustainability, 12*(2), 524. https://doi.org/10.3390/su12020524

Southgate, E. (2020). *Virtual reality in curriculum and pedagogy: Evidence from secondary classrooms.* Routledge. https://doi.org/10.4324/9780429291982

Steele, P. B., Burleigh, C. & Young, E. A. (2020). Considering educators' perceptions of ethics and safety in virtual learning environments (VLEs). *Journal of Educational Research and Practice, 10*, 404–419. https://doi.org/10.5590/JERAP.2020.10.1.26

Sweller, J., Ayres, P., & Kalyuga, S. (2011). *Cognitive load theory*. Springer.

Tai, T.-Y, Chen, H. H.-J., & Todd, G. (2020). The impact of a virtual reality app on adolescent EFL learners' vocabulary learning. *Computer Assisted Language Learning*. https://doi.org/10.1080/09588221.2020.1752735

Vaughn, L. M., & Jacquez, F. (2020). Participatory research methods – Choice points in the research process. *Journal of Participatory Research Methods*, *1*(1). https://doi.org/10.35844/001c.13244

York, J., Shibata, K., Tokutake, H., & Nakayama, H. (2021). Effect of SCMC on foreign language anxiety and learning experience: A comparison of voice, video, and VR-based oral interaction. *ReCALL*, *33*(1), 49-70. https://doi.org/10.1017/S0958344020000154

Neil Cowie is an English teacher in the Centre for Language Education, Okayama University, Japan. His interests include teacher development, e-learning and making engaging online courses.

Mehrasa Alizadeh is an assistant professor at the International Professional University of Technology in Osaka, Japan where she teaches EFL courses. She holds a PhD degree from the Graduate School of Information Science and Technology, Osaka University with a focus on technology-enhanced language learning. Mehrasa's research interests include blended learning, mobile learning and immersive learning in second language education.