Reflections on the design and development of language educational resources in the three-dimensional virtual reality environment High Fidelity.

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Abstract

The emergences of freely accessible 2D virtual worlds on the web have brought new opportunities for language education, resulting in the proliferation of virtual language schools and language learning spaces. Studies examining these sites and their users have consistently shown benefits to learners. In late 2016, a number of virtual reality wearables, such as Oculus Rift, were commercially released, facilitating a major shift in the nature of virtual worlds towards three dimensional, totally immersive, virtual reality environments. While these new environments have further extended opportunities for virtual worlds-based language education, they nevertheless involve more complex design and user functionality. Using the virtual world High Fidelity and Oculus Rift, this project explores and reflects on the potential for teacher-led design and development of virtual reality language educational learning resources in a three dimensional, totally immersive, virtual reality environment.

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Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person except that which appears in the reference, attestation of authorship and acknowledgements. Nor does it contain material which to a substantial extent I have submitted for the qualification for any other degree of another university or other institution of higher learning.

Andi Chen

Acknowledgments

I would like to express my gratitude to all those who helped me during the development of this thesis. A special acknowledgment should be shown to my supervisor Dr Darryl Hocking, who gave me kind encouragement and useful instructions throughout the writing of the exegesis, as well as for help and support in the practice-based component of the thesis. Furthermore, thank you to my classmate, Meng Xie who I contributed with on this project. Finally, I want to thank my parents for their long support and encouragement.

Chapter 1: Introduction

In recent years, developments on the internet have influenced the manner in which people communicate, share their ideas, interact with each other and express themselves (Ata, 2016). One development in particular, freely accessible 2D virtual worlds, such as Linden Lab's *Second Life*, have brought new opportunities for learning (Davis, Roblye, Charania, Ferdig, Harms, Compton, & Cho, 2007). These online platforms, which often resemble games, provide an increased flexibility for both educators and learners, and appeal to the increasing number of students who prefer to study online (Thompson, 2012). Importantly, the environments of Virtual Worlds are particularly suitable for foreign language learning and acquisition (Garrido-Iñigo & Rodríguez-Moreno, 2015). Sarac (2014), for example, found that they easily facilitate interaction and the development of conversational skills between native speakers and language learners, and that learners can experience a wider range of conversational settings and cultural experiences than in a traditional language classroom. Furthermore, Lin, Wang, Grant, Chien and Lan (2014) have stated that Virtual Worlds provide an English language environment with greater opportunities for varied language input, production, and feedback.

In the latter half of 2016, with the commercial release of three dimensional virtual reality wearables, such as *Oculus Rift* and *HTC Vive*, online virtual reality platforms underwent a major change. New virtual world platforms such as *High Fidelity* and Linden Lab's *Project Sansar,* have begun to incorporate these emerging technologies and are now providing users with a total immersion, three-dimensional virtual reality experience. However, due to the novelty of these innovations (High Fidelity is still in its Beta stage), there are no studies to date that have begun to explore the possibilities of language education in these emergent three-dimensional virtual worlds, including the ability for language educator/designers to develop learning resources.

Using the beta version of the new virtual world *High Fidelity* and *Oculus Rift* three-dimensional wearables and hand controllers, this thesis examined the development and student use of language learning resources in a three-dimensional virtual world called KiwiLearningSpace, which was designed and built by the researcher. As primarily a practice-based research project, the focus was on the explorative creation of language education resources, however this process included a user experience-based approach to provide ongoing evaluation of and help enhance the development of these resources. The results of this process, along with reflections on the demands and success of engaging in the development of virtual education resources for language learning, is contained in this exegesis. Due to the size of the undertaking and the need to situate language educational resources within a suitably built virtual environment, the development of the three-dimensional language educational space is, in part, a collaborative project with another MENMS candidate, Meng (Simona) Xie, who focused on the design of the educational space. This exegesis, however, which contextualises the practical work, provides the results of the user experience evaluation, and reflects on the process of using the *High Fidelity* platform to develop language learning materials will be presented for examination separately. Overall, the thesis (the development of the learning resources in High Fidelity, and exegesis) sets out to answer the following questions:

What type of suitable language learning resources can be designed and developed in the three dimensional, totally immersive, virtual reality environments of High Fidelity? How will potential learners respond to these resources and their use within the virtual reality environment High Fidelity? What demands and challenges do the design of these resources present?

The exegesis is divided into 7 chapters. Following this introduction, Chapter 2 will provide an overview of literature on language educational spaces in virtual worlds. This will be followed by an exemplification of language learning resources in Second Life to provide examples of existing practice. Chapter 3 will discuss the methods and

resources employed throughout this research. These include a discussion of the notion of reflective practice, that is, the notion of reflecting on the development of a practice. Chapter 3 will also discuss the process and tools of the user evaluation approach employed to assist the ongoing development of the *High Fidelity* virtual education resources, including the observation protocol, and the accompanying interviews used to evaluate the users' experience of the resources. The user evaluation took place in two separate phases. Chapter 4 will first briefly provide a description of the new online platform *High Fidelity* and its affordances, followed by a description of the initial virtual language educational resources of KiwiLearningSpace built in *High Fidelity* for this research. Chapter 5 and Chapter 6 will provide the results of the two phases of user evaluation, and the changes made to the design of the virtual language education resources in KiwiLearningSpace after each evaluation process. The final chapter 7 will provide a reflection on the issues, problems and benefits of designing and developing resources for a virtual language education space in the *High Fidelity* platform and provide implications for future language educators thinking of attempting a similar project.

Chapter 2: Review

Virtual Worlds, such as Second Life, are three-dimensional shared platforms or environments which allowed people simultaneously communicate and interact with others via avatars (Han, 2015; Mawer, 2016). There are many studies which have discussed the value of using Virtual Worlds as teaching platforms. They can provide students' with great opportunities to experience different cultures or enable them to carry out activities that might be difficult in reality (Keskitalo, Pyykkö and Ruokamo, 2011; Han, 2015). Virtual Worlds can provide students with opportunities for experiential, explorative, and authentic learning, and can help them develop interactive and conversational skills (Keskitalo, Pyykkö and Ruokamo,2011; Honey, Connor, Veltman, Bodily, & Diener, 2012). Virtual Worlds also enable students to work in groups, which through feedback and support, enable them to exploit such knowledge and skills (Keskitalo, Pyykkö and Ruokamo, 2011).

Benefits of using virtual worlds for education

i) Gaming and interactivity

The game-like nature of educational practices in virtual worlds maintains students' ongoing interest and motivation (Monahan, McArdle and Bertolotto, 2008), particularly in the context of foreign language learning (Berns, Gonzalez-Pardo and Camacho, 2013). It also provides educators with the ability to easily construct learning resources and activities as games, making the learning process a more enjoyable and entertaining experience (Berns, et al, 2013; Gallego, Bueno, & Noyes, 2016). This is often due to the emphasis on interactivity associated with gaming practices in virtual worlds. Bronack, Sanders, Cheney, Riedl, Tashner and Matzen (2008), for example, suggest that virtual worlds encourage students to interact purposefully on goal oriented projects involving collaborative procedures, resulting in

successful learning environments.

ii) Absence of physical limitations

Unlike the physical language classroom, teachers in virtual worlds are able to design their classes and resources to suit their particular requirements, perspectives and cases (Sarac, 2014; Schiller, 2009). They can also design, build and deploy virtual realia, objects and teaching tools, which they could not otherwise bring to the physical classroom. Virtual worlds also shift the traditional class into more flexible courses where everyone could be a potential tutor or learner, novice or expert and learn from each other (Calongne & Hiles, 2007). Furthermore, virtual worlds provide an effective environment in which course materials and experiences can be easily shared online (Sarac, 2014; Penfold, 2008; Lee, Gregory, Dalgarno, Carlson, & Tynan, 2013; Jarmon, Traphagan, & Mayrath, 2008).

iii) Focus on the individual development.

Due to their flexibility, including the possibility for the teacher to focus on the individual requirements of each student (Kopp, & Burkle, 2010), virtual worlds can often provide more learning opportunities than the physical classroom for both the teacher and learner (Lin, et al, 2014; Keskitalo, Pyykkö, & Ruokamo, 2011). Brown, Hobbs, and Gordon (2008) also show how virtual worlds provide more chances and possibilities for individual exploration. Students also have more autonomy to decide what they want to learn, and to focus on their particular interests. As Lin, et al. (2014) state, virtual worlds help students to set a clear studying aim to ensure a student-centred learning method and help them develop language skills. For Schiller (2009), Second Life provides contexts for students to easily apply what they have learned in class, making it easier for teachers to evaluate students learning goals and the learning process. Furthermore, Gallego, Bueno and Noyes (2016) found that

people like studying in *Second Life* because it can fulfil their variety of needs, while digital technology, more generally, enables students to gain knowledge more broadly and in greater depth (Penfold, 2008; Lee, et al, 2013; González, Santos, Vargas, Martín-Gutiérrez, & Orihuela, 2013).

iv) Flexible learning environment

Virtual worlds provide more flexibility for learning by not restricting the time or place for learning (Calongne, & Hiles, 2007; Kopp & Burkle, 2010; Sarac, 2014). Thompson (2012), for example, claims that as long as they have access to a computer and an internet connection, students are not prevented from taking part in courses in *Second Life* due to their physical location. Furthermore, because there is no physical face-to-face interaction, virtual worlds also provide a more comfortable and flexible learning environment which helps students to overcome any possible anxiety (Ata, 2016; Lin, et al, 2014). As a result, students feel freer and more comfortable when taking classes. Virtual Worlds appear to maintain positive relationships between teachers and students, and make it easy for students to contact their tutors when necessary (Thompson, 2012; Ata, 2016; González, et al, 2013).

Language learning resources in Second Life

This section of Chapter 2 examines a number of learning resources found in Second Life to provide examples of existing practice. These are divided into three categories; audio-based resources, text-based resources, quizzes and games.

i) Audio-based resources

The use of audio can play an important role in language learning, and audio-based resources are common in Second Life learning spaces. For example, in *Learn It Town*

over 20 boxes are placed throughout the sim. Each of these boxes represent a real life space, such as a supermarket, a beach, a street, and a camp, etc. (Figure 1 and Figure 2). Students can visit the various scenarios find the boxes and click on them to play the audio. Alternatively, a student's avatar can be given a landmark at a central road sign and teleport immediately to a selected audio box to carry out the activity (Figure 3). Students are encouraged to write what they hear in a box that appears in the bottom left hand corner. Unfortunately, there are no scripts in the sim to help students check the answer.

Figure 1: Audio box at the Learn It Town mall

Figure 2: Audio box at the Learn It Town camp

Figure 3: Teleport landmarks to the audio box in Learn It Town

In another learning space, Chinese Island, the use of audio is quite complicated. Every avatar has to attach a script named "Chinese Island HUD". After that, a cell-phone display will appear on the right-hand side of screen. When the user clicks on various objects in the sim, their picture will display on the phone and a related audio guide will show up on the up right corner (Figure 4).

Figure 4: The audio system in Chinese Island
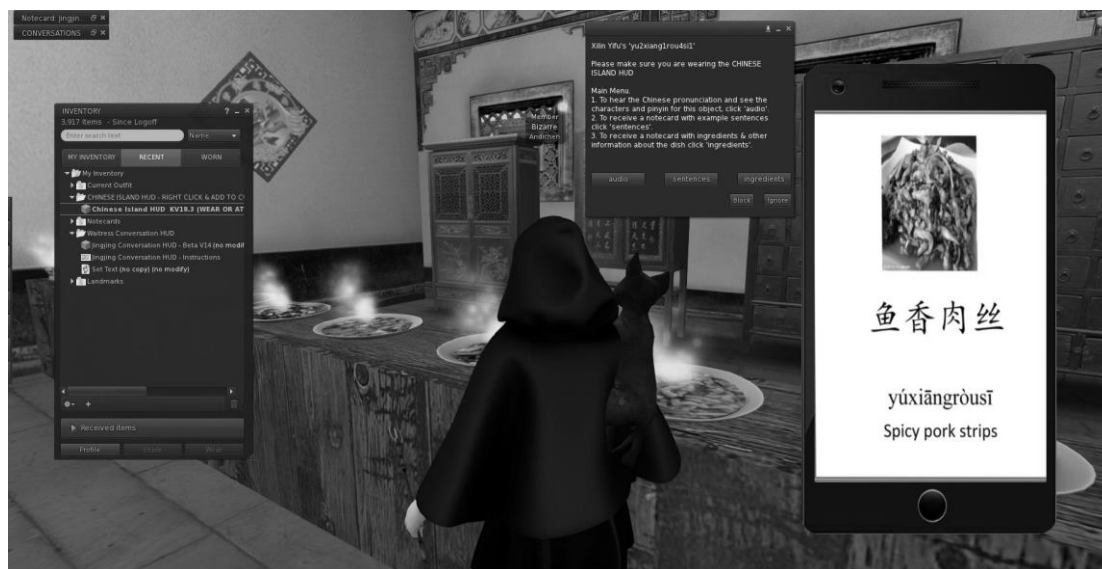
As mentioned, this type of game-like learning resource can improve student learning through motivation. Like the *Learn It Town*, the audio boxes resemble a curiosity or item of interest which students are interested in discovering. As Bronack et al. (2008) suggest, virtual worlds encourage students to interact purposely through goal oriented projects. These create some psychological sense of achievement and keep both students motivated. Furthermore, students, under the guidance of tutors, can contribute to developing their own audio-based teaching materials by recording the audio themselves and embedding it into virtual objects (prims) for later replay. This type of activity supports the views of Calongne and Hiles (2007), who indicate that virtual worlds shift the traditional class into more flexible courses which allow the students be a part of the learning system.

ii) Text-based resources

In Second Life, text-based resources involve PowerPoints, Note Cards and links to WebPages. The use of PowerPoint in *Second Life* involves saving individual slides developed in the PowerPoint programme as JPEG files, then embedding the individual slides with a PowerPoint script into a prim. For example, the Figure 5 and

Figure 6 showed the PowerPoint in Cypris Village and Learn It Town. Avatars could click the right bottom to go to next page.

Figure 5: PowerPoint from Cypris Village
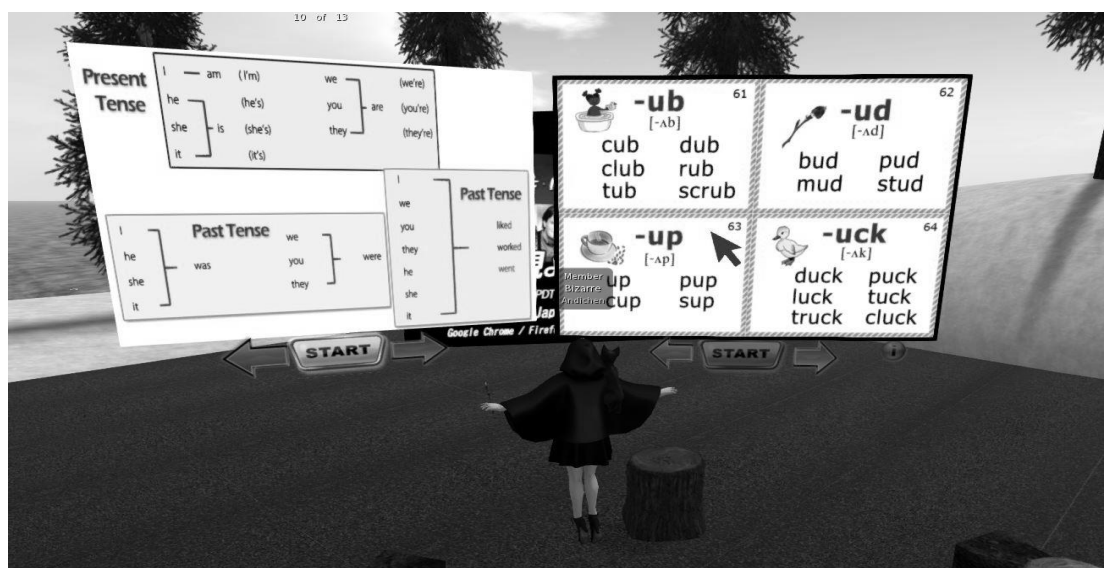
Figure 6: PowerPoint from Learn It Town
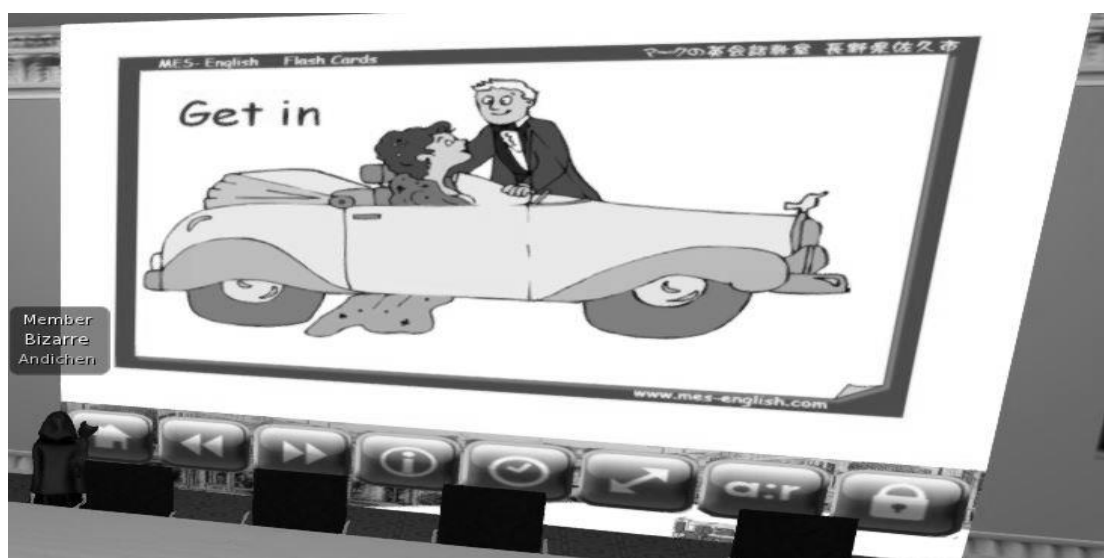
Once a notecard is created in *Second Life* it can also be embedded into a prim using a notecard script that enables it to be given to an interested or targeted avatar (Figure 7). Although Kemp and Livingstone (2006) complained that text-based documents, such as notecards, used in Second Life are overly simple, they are nevertheless easy and

convenient for users to create and avatars to read. Furthermore, audio can be attached into notecards (Figure 8). It is also possible to easily copy and paste the text in notecards to other platforms. Generally all notecards given to avatars are placed into that avatar's inventory, so it can be recalled at a later time by the user.

Figure 7: Notecard from University of New Mexico

Figure 8: Notecard from Chinese Island

Another kind of text which can be embedded into Second Life is the webpage. This can be seen in the Learn it Town sim (Figure 9), where each of the books on the shelves and tables are linked to a webpage (Figure 10). This is the most convenient use of text-based resources. Students could effectively bookmark this page and open it without Second Life. Through the use of embedded text, students can learn by themselves and focus on their unique interests. Brown, Hobbs, and Gordon (2008) claim that learning in Virtual Worlds can provide more chances and possibilities for students' individual exploration.

Figure 9: The books in the Learn It Town library.

Figure 10: The Webpage of a book from Learn It Town
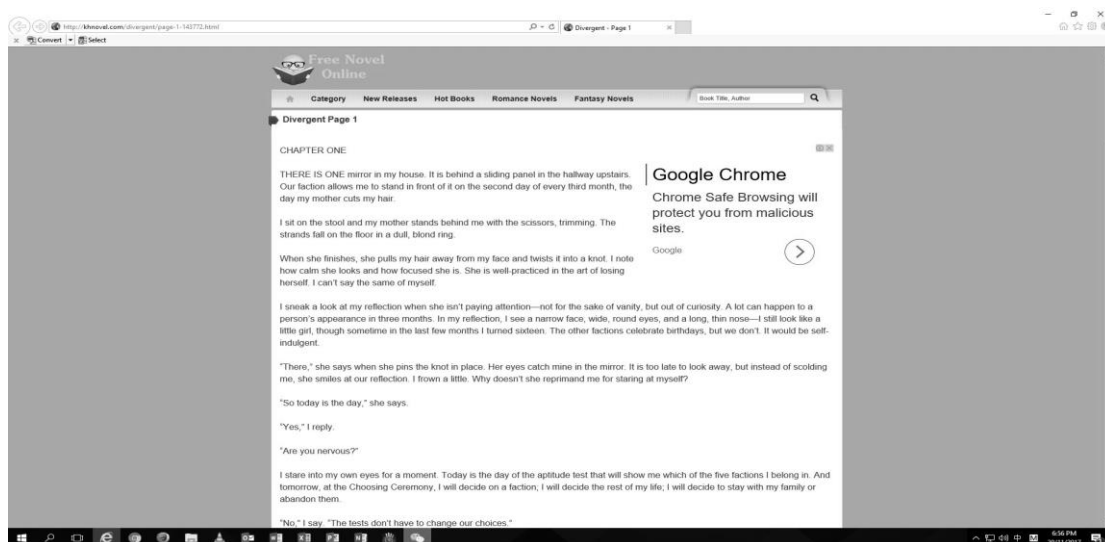
iii) Quizzes

Quizzes can help students check how much they have learned in, and about, a particular sim. The quiz in Learn it Town, for example, is multiple choice where users select one answer for each question. After completing the quiz, the answer and score is shown on the lower left corner (Figure 11 and Figure 12).

Figure 11: A quiz from Learn It Town

Figure 12: Quiz answers from Learn It Town
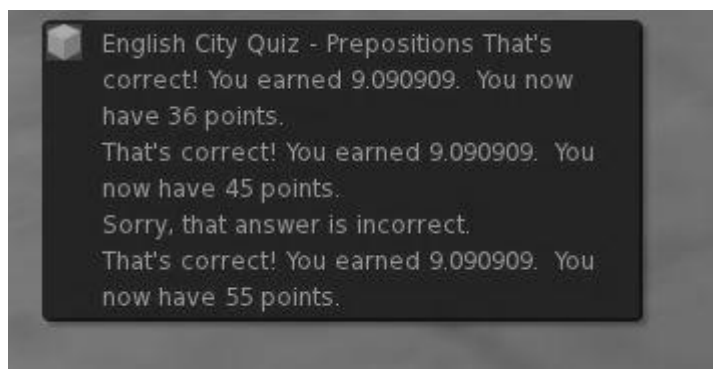
The Cypris Village sim also includes quizzes using a different approach. As seen in Figure 13 and 14, the quiz is presented through an embedded PowerPoint and the answers are provided by notecards.

Figure 13: A quiz from Cypris Village
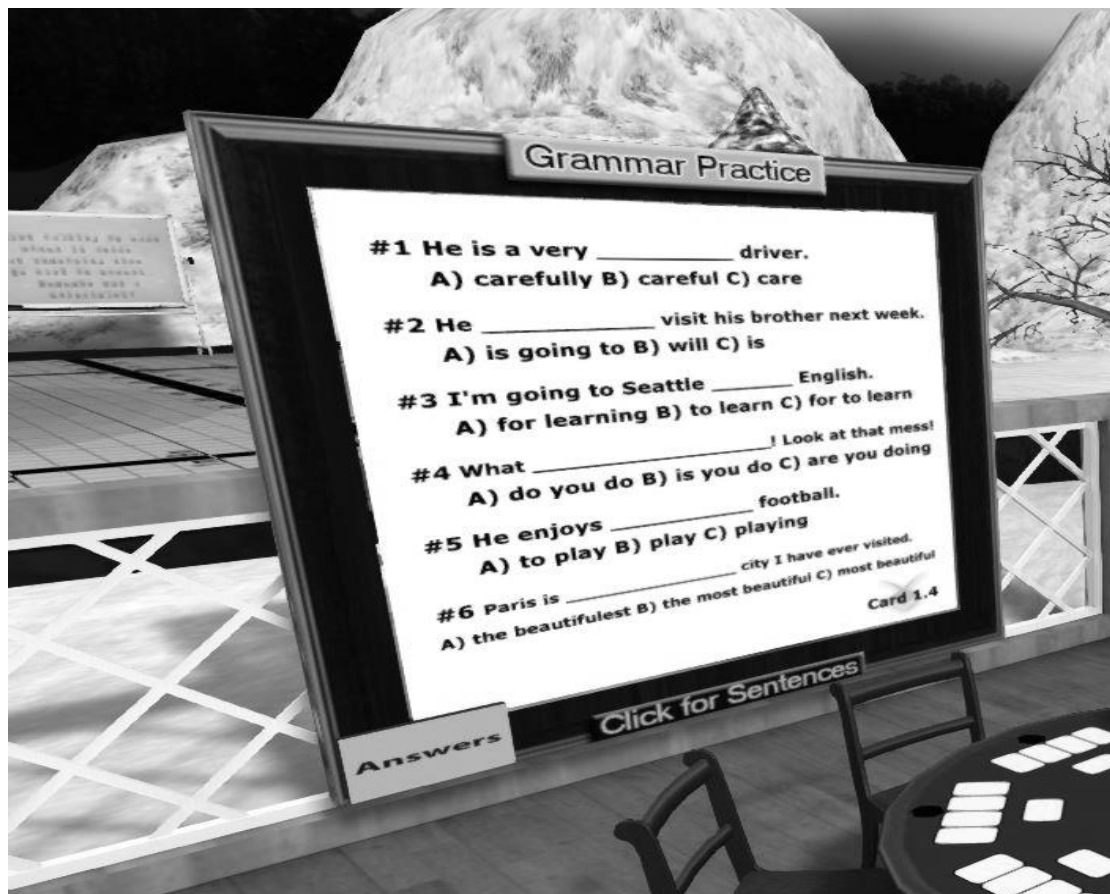
Figure 14: Quiz answers from Cypris Village
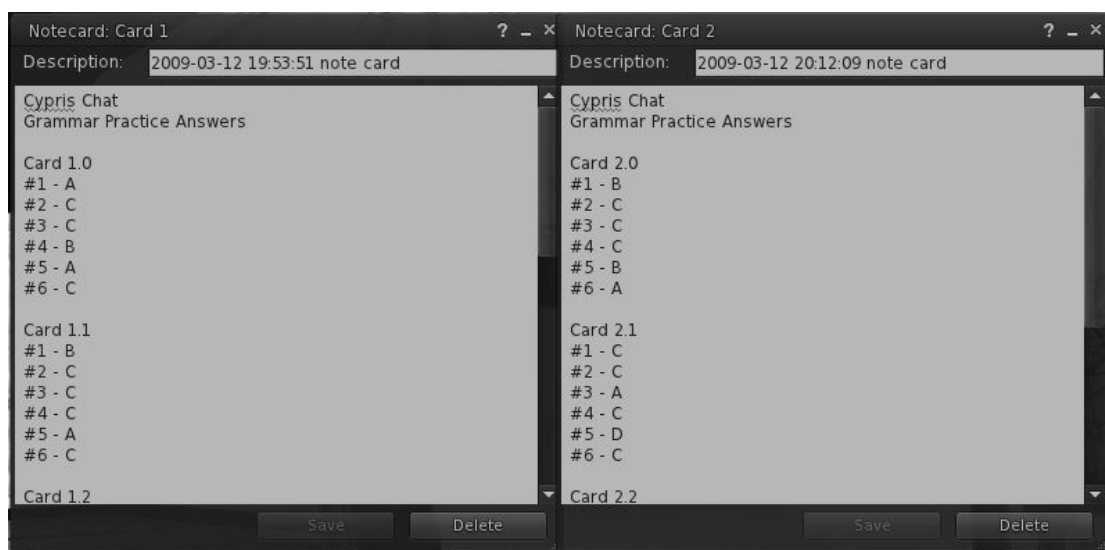
iv) Games

Many of the games in Second Life involve simple interactive models similar to the Whack-a-Mole game in Figure 15 and are typically played by one user. Furthermore, most learning spaces in Second Life have a sim called Sandbox which enables avatars to practise creating their own models (Figure 16).

Figure 15: A game from Cypris Village

Figure 16: A sandbox from Cypris Village

An example of a game that involves multiple players is Learn it Town's, Guess the Words. When the avatar clicks on the box, a card identifies the word that other players/avatars must guess (Figure 17). They must use voice and/or text chat to describe the word to others without using certain forbidden words, also listed on the card. A similar game is found in Cypris Village, where student find the Japanese word which matches the meaning of the provided English word (Figure 18). As Monahan, McArdle and Bertolotto (2008) stated, the game-like nature of educational practices in Second Life is able to maintain the students' interest and motivation to learn.

Figure 17: A game of Guess the Word from Learn It Town

Figure 18: A game of Guess the Word from Cypris Village

The next section examines the methodology for the project. Due to the collaborative nature of certain components of this research, the methods section was developed with my collaborator Meng Xie, in consultation with my supervisor.

Chapter 3: Methodology

Research Framework

The research framework was firstly practice-based, in that "an original investigation is undertaken in order to gain new knowledge partly by means of practice and the outcomes of that practice" (Candy, 2006, p. 3). For Dirkx (2006), practice-based research emphasises meaning arising within practice, and practitioner construction of knowledge. The study's questions regarding the potential of language learning educational spaces in the virtual environment of High Fidelity, and the demands and challenges that this process presented for language educator/designers, were established through an ongoing process of practical experimentation and reflection-in-action (Schön, 1983), which focused on the ongoing queries, challenges, and issues that arise as the virtual spaces and resources are developed by the researchers (Dirkx, 2008).

Secondly, in keeping with contemporary approaches in practice-based research, and drawing from user experience design methods (e.g. Goodman, Kuniavsky, and Moed, 2012, Kuniavsky, 2003), the research also involved the collection of qualitative data through observations of users engagement with the educational space and resources at two different stages of development, followed by interviews to ask about the users' experience of their engagement. This answered the second research question focusing on how potential learners respond to and interact with the virtual educational space. User observations can provide information about a practice, or artefact resulting from a practice, regarding the way it is actually engaged with, in contrast to what the researcher or designer might have expected (Kuniavsky, 2003). Interviews with users often follow observations of user experience (Goodman, Kuniavsky, and Moed, 2012). Information from the user observation and interviews provided the researcher with

insights for the continued development of the educational space resources. Importantly, this ensured that the development of the language learning space, and the subsequent reflection on the challenges and demands involved in carrying out this development, corresponded with the expectations of the intended cohort of users.

Finally, given that High Fidelity is a web 2.0 online platform developed for participatory engagement, the process or research/practice also involved collaborative knowledge creation and production (Yorks, 2007) as the two researchers involved in this project collaborated both online and offline in the development of the educational space and accompanying learning resources in High Fidelity. It is also important to note that within the disciplinary context of digital humanities in which this project is broadly located, it is not the focus of the researcher to produce a flawlessly completed and evocative object (Whitson, 2015). Instead, and according to Ratto (2011), the "shared acts of making" and "practice-based engagement" (p. 253) found in the production of objects in fields such as the digital humanities, function to enable critique, reflection and expression on technology and/or society. According to Whitson (2015), such critically focused making often involves a DIY (do-it-yourself) approach, which he states "encourages the return to a hands-on approach to technology that is often connected to computation" (p. 158). The development of the learning space discussed in this exegesis should be considered as such an artifact.

Gathering and processing of data

Practice-based data

The practice-based data, arose through the process of reflective practice, that is, the ongoing process of experimentation and reflection that occurred as the researcher worked on developing the virtual educational space in the High Fidelity online platform. As indicated by Schön (1983), much of the reflective knowledge gathered

from this data was tacit. However, some aspects of the reflective process was captured in the entries of researchers' personal reflective blogs. Online blogs are recommend for the purposes of reflective thinking and critique (LaBanca, 2011). They also allow the thesis supervisor to easily access the researchers' progress and developments at any time in order to provide support and feedback (LaBanca, 2011). Practice-based data and knowledge (tacit or conscious) was fed back into the development of the virtual educational space and learning resources. The practice-based development of the virtual learning space and resources took place in a room at Auckland University of Technology, where the virtual reality equipment was located.

Observation and interview data

Once the development of the virtual language learning space had advanced to a level that facilitated user engagement, the researcher invited participants to experience the space and its learning resources. This occurred twice, the first time in late August, 2017 and the second time in late October, 2017. It also took place in the room at Auckland University of Technology where the virtual reality equipment is located. Observational data and interview data were collected from these user experiences. This took place in the following way. Before the collection of observational data the participants were introduced to, and shown how to use, the virtual reality hardware, informed about the nature of the virtual educational environment, and what they were required to do. They were also informed about the process of observation. Once the participants were engaged in the virtual educational space, observational data was gathered by the researcher as they watched the screen of the computer, which reproduces the participants' engagement in the virtual educational environment. The researcher took notes about the participants' movements and actions in the space, including the way they approached and used the learning resources. Notes were also taken about the participants' engagement with the virtual reality hardware and their level of comfort. Participants were not able to see or be distracted by the observation process, as they were wearing virtual reality headsets. In this observation process, the

researcher's aim was to play a neutral role, however at times, they needed to guide or assist the participant if they encountered difficulty.

Once the participant finished engaging with the virtual educational space resources, they were asked a number of questions about their experience. The interview questions were semi-structured and asked participants about their use of the space, their comfort when using the space, their likes and dislikes about the design of the space, and their general experiences of engaging in an educational environment through virtual reality. The participants were informed about the interview process during the introduction. They were also told that if they felt any discomfort after their virtual reality experience, the interview could be carried out at another time of their choice. The user experience protocol and the interview questions can be found in Appendix A.

Analysing data

According to Candy (2006) "practice-based research is an original investigation undertaken in order to gain new knowledge partly by means of practice and the outcomes of that practice" (p. 1). She states that claims of originality and contribution to knowledge related to that practice can be shown through outcomes in a number of forms, including digital media. Hence, the reflective process involved in developing the object of the practice, as well as the object of the practice itself (the virtual environment and the language resources collaboratively developed by the researchers), is also a method of analysis (see also Barrett and Bolt, 2007; Nelson, 2013). The use of the personal online blog enhanced the reflective processes by enabling many of the reflections emerging from practice to be noted for later retrieval, analysis and discussion with the co-researchers and supervisor. The qualitative observational notes and interview data were examined for recurring patterns, for example, recurring negative experiences in the participants' use of KiwiLearningSpace. These patterns

are indicated in Chapters 5 and 6. Important findings from the qualitative data were reworked into the ongoing design of the virtual educational space and virtual resources.

This project received ethics approval on 31st July, 2017, by the Auckland University of Technology Ethics Committee (Ethics number 17/188).

Chapter 4: The Teaching Materials in High Fidelity

High Fidelity

High Fidelity is a new open-source Virtual Reality Platform built by the creator of Second Life, Philip Rosedale. It enables users to build a totally immersive 3D VR experience and interact with people from all over the world. High Fidelity is unlike Second Life, where users access a virtual world grid held on external servers owned and operated by the company Linden Lab. Instead the virtual world content in High Fidelity is hosted on the user's own computer. As a result, the platform consists of two components. One is called the *Interface* and the other is called the *Sandbox*.

The *Interface* is a client application which allows users to access and explore the virtual spaces designed and hosted by other users, and interact with these users, through the form of an avatar. The Interface also allows users to import and adjust 3D models (designed using other 3D modelling software, e.g. Blender) for their own virtual space, or buy 3D models from the marketplace. It also provides a number of other functions, for example, enabling users to take photographs of their virtual experiences.

The *Sandbox* application is what enables users to build a virtual space and host this space on their own desktop computer, which acts as a server. It is in the Sandbox space where users can either create objects using the functionality provided by the Interface or upload objects imported to High Fidelity through the asset browser. Features, such as gravity, text, audio, video and scripts can be attached to the models uploaded into the users' virtual space. However, unlike Second Life, which includes relatively accessible building functionality, High Fidelity mostly relies on the import of 3D models. As a result users of High Fidelity need to know about 3D model

building or scripting.

A description of KiwiLearningSpace

KiwiLearningSpace is a totally immersive, three dimensional, virtual educational space, which introduces student users to common New Zealand words and Kiwi culture. Users can learn how New Zealanders speak English, from pronunciation to words and phrases. KiwiLearningSpace space is divided into several components — the Welcome Centre, the Word Corridor, the Fish & Chip Shop, the Clothes Shop, the Classroom, the Reading Rooms, the Test Room and the Playground. The following section provides a brief description of the learnings resources in KiwiLearningSpace.

i) The Instructions in the Welcome Centre

Avatars visiting the space first transport to the Welcome Centre. The Welcome Centre provides visitors with an introduction to the KiwiLearningSpace, including a map, information about the designers, and an indication of what visitors can do in KiwiLearningSpace. Details are also provided about some of the individual spaces in KiwiLearningSpace (Figure 19).

Figure 19: The Welcome Centre of the KiwiLearningSpace
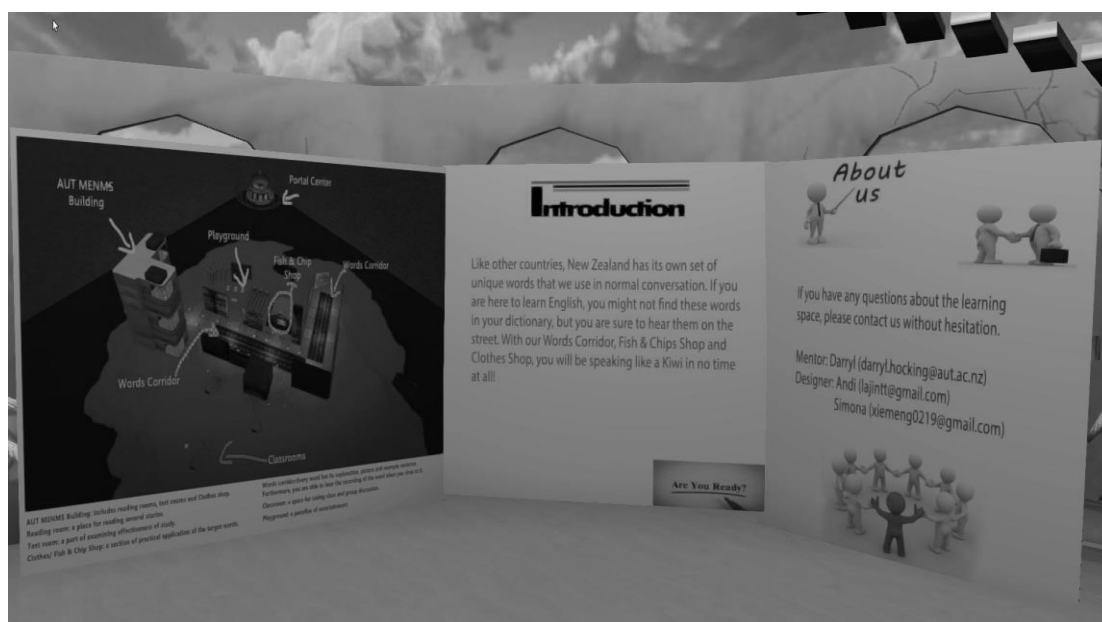
ii) The Word Cards

The Word Corridor is located in the centre of KiwiLearningSpace. The Word Corridor is a stretch of virtual road which contains floating cards introducing visitors to approximately 30 words which most New Zealanders always use in their everyday life. Each word card includes the word, an explanation, an example sentence, a picture representing the word and play and audio of the word (Figure 20 and Figure 21), to provide a multi-modal experience that may contribute to the visitors' acquisition of the target word. As Chen, Hsieh and Kinshuk (2008) state, learning can be more effective by using multiple sensory modes. When the avatars walk near the card, the audio plays until they leave.

Figure 20: A word card from the Word Corridor in KiwiLearningSpace

Figure 21: A word card from the Word Corridor in KiwiLearningSpace

iii) The Whiteboard in the Classrooms

Figure 22 shows a whiteboard placed in Kiwi Learning Space, which was downloaded from the High Fidelity Market Place. It can be useful when taking a class or having a group discussion. When the users' avatar clicks on the bottom of the whiteboard, a pen and eraser appears, which can be used by the avatar to write on the whiteboard. The colour of the pen can be changed by clicking on one of the coloured boxes.

Figure 22: A whiteboard in KiwiLearningSpace

iv) The Quiz

Quizzes were included in Kiwi Learning Space to allow users to test their knowledge of the language they encounter throughout the space. Figures 23, 24 and 25 show a Kiwi Learning Space quiz in the Test Rooms. The Survey Anyplace website was used to develop each of the quizzes and these are accessed in the Kiwi Learning Space through High Fidelity's web browser functionality. By using the hand controllers (Oculus Touch) of the Oculus Rift headsets, avatars can interact with the pages in the same way that they might interact with pages on an iPad or other form of touch screen. All of questions in the quizzes relate to items found in Kiwi Learning Space (for example, the Word Corridor). Answers and feedback are given to the user at the end of each quiz.

Figure 23: A quiz screen in KiwiLearningSpace

Figure 24: A quiz screen in KiwiLearningSpace
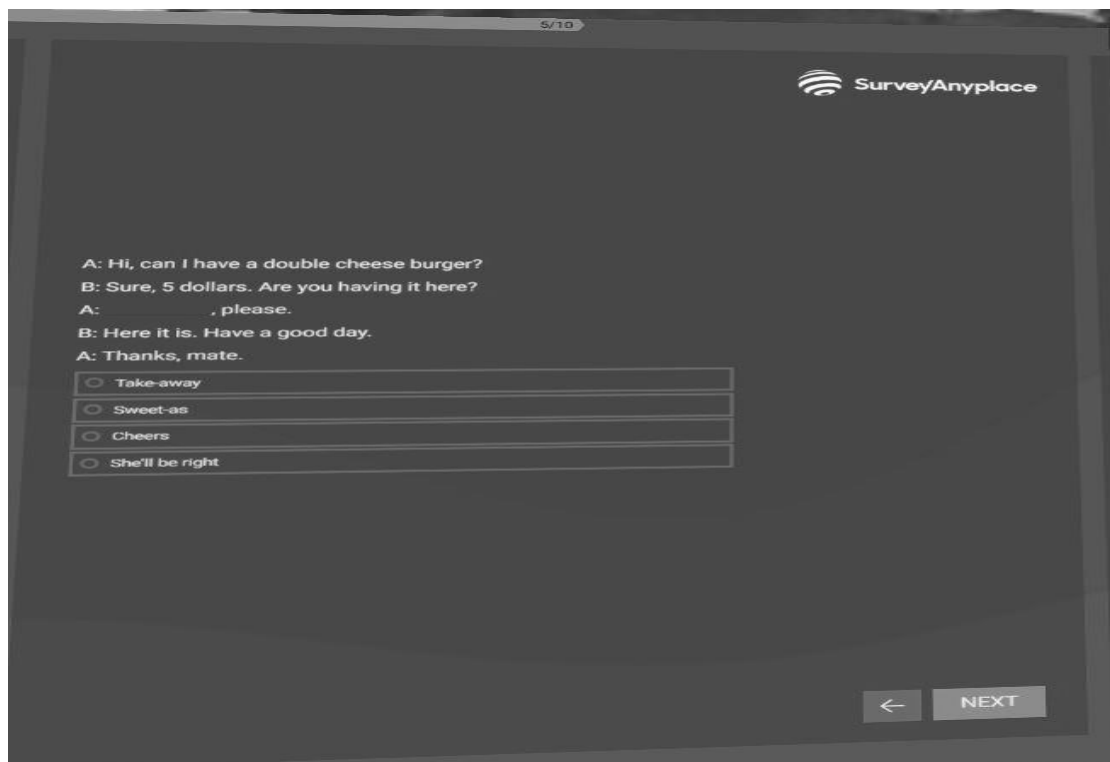
Figure 25: A quiz screen in KiwiLearningSpace
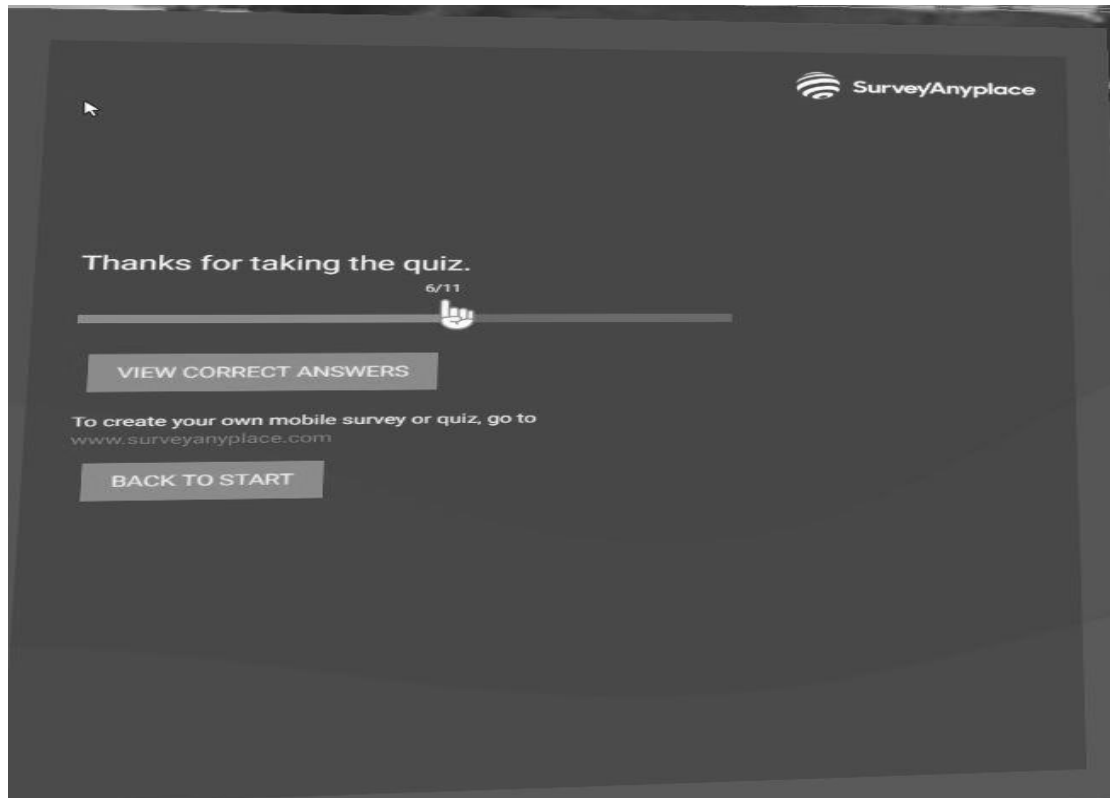
v) The Readings

The Reading Rooms contain five short stories by New Zealand authors. Each of the stories are freely accessed from a website (Figure 26). These stories will enable users to learn more about New Zealand culture and many passages in the stories include words they encounter elsewhere in Kiwi Learning Space (for example, in the Word Corridor).

Figure 26: Readings from KiwiLearningSpace
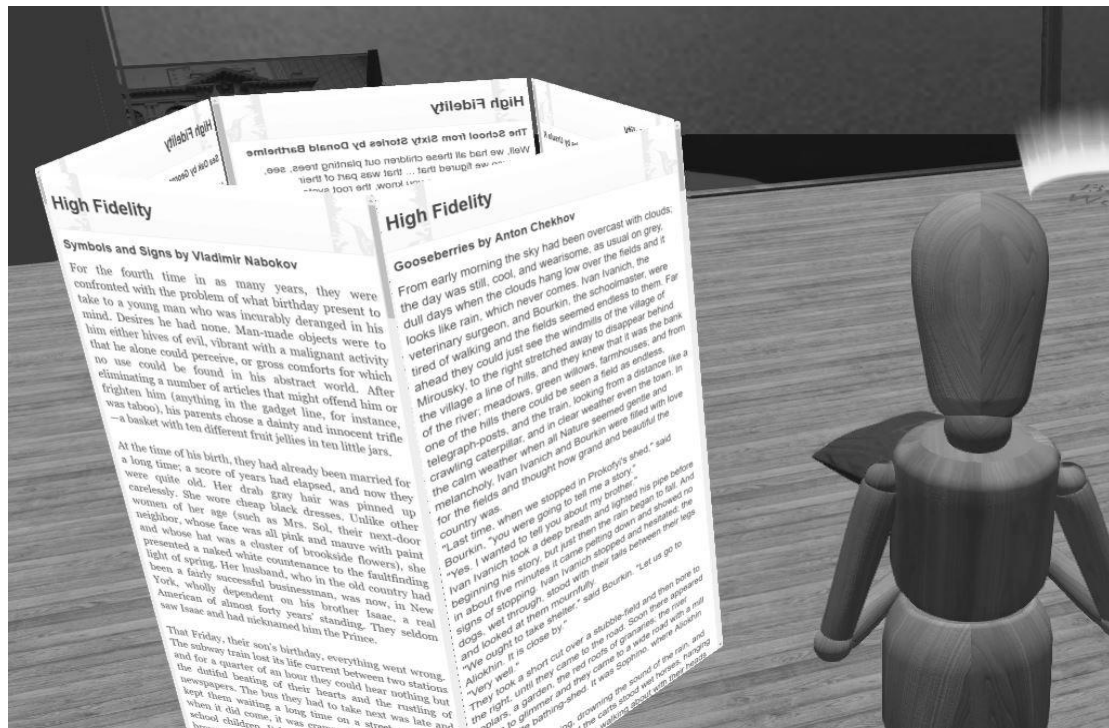
vi) The Games

These include ping pong, bowling, tennis and boxing (Figure 27) and can allow students to relax after the learning components of their experience.

Figure 27: Games from KiwiLearningSpace

Chapter 5: User Evaluation 1

As indicated in the methods section, the user evaluation, which contributed to the ongoing design of the virtual education space and resources, involved two components, an observation of the users as they explored KiwiLearningSpace, and a post-use survey which asked participants questions about their experiences of KiwiLearningSpace and the use of VR in education more generally. The observation and interviews were carried out and written up in collaboration with my collaborator on KiwiLearningSpace, Meng Xie (Simona) and as a result, the findings of the observation of students engaged in using KiwiLearningSpace and post-use interviews are the same as those in Meng Xie's exegesis.

Observation results

The following are the summary results of the user observation, which involved watching the users and taking notes on their ongoing interaction with KiwiLearningSpace, its learning resources and the hardware employed to connect to the virtual space. Any important comments made by the observers were also noted. The protocol for the observation can be found in Appendix A

Observations on participants' initial engagement.

It was observed that most of the participants found it easy and comfortable to wear the Oculus Rift goggles. This was most likely the result of the tutorial provided to participants beforehand. Only one participant found the goggles tight, while two others had to remove their glasses first, with one of these having difficulty viewing the space clearly due to short-sightedness. Oculus rift does suggest that glasses can be worn under the goggles, but it was found that this was not necessarily the case in

practice.

Observations on the participants' movement around the space.

Most participants found it easy to move around and visit the different places in the language educational space. However, as they explored the space, a number complained that their avatars could not walk naturally or fly (flying is a conventional way of moving around in 2D virtual worlds). Instead, they could only teleport from point to point to move through the space. Interestingly, most current 3D totally immersive virtual worlds and games that use virtual reality (VR) headsets, have decided to use the teleport cylinder system as the default method for moving (Figure 28), primarily because walking and flying in VR typically causes dizziness. High Fidelity in fact does include affordances for walking and flying, but for these modes to be included adjustments to the setting are required. These were carried out in preparation for the next evaluation stage.

Figure 28: Teleporting cylinder method of moving in VR
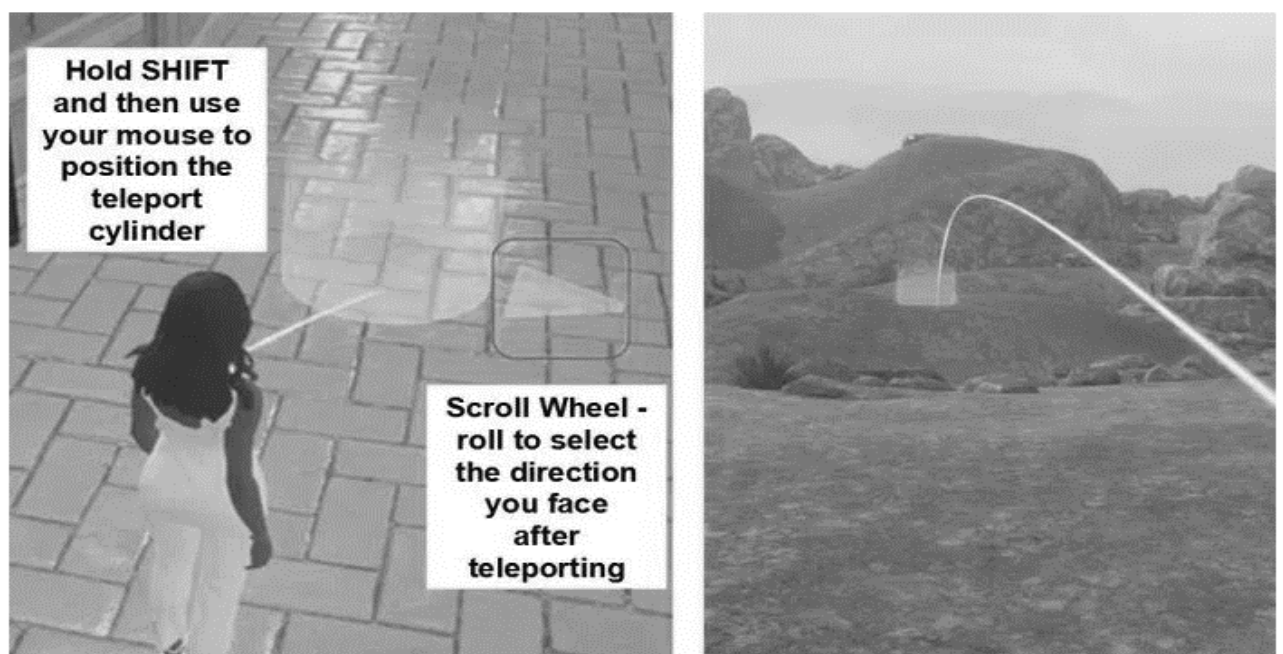
Another way of moving avatars in Virtual Worlds is through pre-established portal points, which allow an avatar to jump immediately from one designated point in the educational space to another. One participant found it difficult to move onto the portals to enable the teleport. Another participant complained that more instructions were required to identify how to move around the space.

Observations on the participants' engagement with learning resources.

All of participants were interested in the learning resources found in the various individual learning spaces. One participant tried on many of the clothes in the *Clothes Shop*, and another explored the games in the *Playground*. Another participant liked the audio component of the Word Corridors and suggested that the continuous audio repetition of the New Zealand words were helpful. This participant also liked the quizzes. While they enjoyed the resources, two participants found the virtual Fish and Chip shop space a little boring, and another wanted more words in the Word Corridor. One participant complained it was difficult to find out where the Reading Rooms and Testing Rooms were located. A number of the participants were expecting to communicate with other avatars in order to practice the words and interactional expressions they learned in the various learning spaces.

Observation of participant difficulties.

It was observed that participants found the lack of instructions regarding where to go and what to do one of the major issues with the learning space. Although a detailed map and general introduction to the different areas and their functions could be found in *The Teleport Centre*, the entry portal for the learning space, further instructions, directions and information were required in the different individual areas. Another area of noticeable difficulty was that participants found it difficult to pick objects up using the Oculus Rift hand controllers. Another participant had problems with the

hand controllers in that they repeatedly called out the menu tablet when it wasn't required.

Other observations

Two of participants complained that they fell dizzy after finishing the evaluation. One participant pointed out that there are some bugs in High Fidelity which made interaction with the space difficult. Only one participants repeatedly went to the wrong places because they had difficulty using the rift. Participants stated that they enjoyed listening to the audio of the words.

Interview feedback

The following are the summary results of the post-use survey which asked participants questions about their experiences of KiwiLearningSpace, as well as the use of VR in education more generally.

1. What did you think about the design of the educational space?
Participants positively described the first design of the High Fidelity learning space as functional, practical and an innovative way to be educated. They also commented positively on the learning focus on New Zealand English, and the ability to receive feedback on knowledge learned from the space through the multi-choice quiz. However, participants also thought that the space was lacking detailed instructions that would guide the user around the space, and that there was a lack of activities or situations that the users could engage with. One participant also suggested that the design of the space could be more attractive.

2. Was it easy for you to move around the space? Why/why not?
All but two participants suggested that it was easy for them to move around the virtual

space. The signage and reaction time of the hardware was said to have assisted their movements. Of those that found it difficult, however, one stated that their difficultly was due to their inexperience with the Oculus Rift. While most participants found the teleport cylinder approach easy to handle, one stated that they preferred to move directly, rather than use the teleport approach.

3. Did you know where to go and what to do in the space? Why/why not?

Most of the participants stated that they easily established where to go and what to do in KiwiLearningSpace. They cited the labelling, signs and instructions as helpful. However, some excellent suggestions were put forward. One participant stated that signs near the teleports would help identify where to go, and another stated that more detailed instructions in the various specific areas, such as the clothes shop, would be useful.

4. Did you feel comfortable when you are in the space? Why/why not?

All but one participant responded positively about the comfort of KiwiLearningSpace. One of those who responded positively added that it was "relaxing" and "just like real life", while another said it made them feel like a "superman". One also liked the familiarity of the Auckland scenery. In contrast, one participant mentioned that the Auckland scenery was not clear enough and needed to be more stereoscopic. The lack of comfort felt by one participant was due to the dizziness they experienced when using the VR goggles.

5. What did you like about the design of this virtual educational space?

When asked about the design of the space, many aspects and areas of KiwiLearningSpace were mentioned by the participants. The responses show that a third of participants liked the design of the Word Corridor, with one stating that it is "useful for the people who come to NZ for a short time". Another participant stated that she liked the clothes store, while another found the playground activities interesting. Two comments positively mentioned the graphic quality of the space.

6. What didn't you like about this space?

Again, when asked about their dislikes of KiwiLearningSpace, there were a variety of different opinions. Two participants suggested that the space could include more shops and that the existing shops could be improved. Another said more examples of English conversation needed to be included in the shops; for example, a dialogue about buying clothes in the clothes shop. Furthermore, one participant suggested that the audio for the definition of the words should be added to the space, and in contrast to the responses in the previous question participants claimed that the graphic quality of the space could be improved.

7. How can the educational space design be improved?

Most participants responded that more and better facilities were required to fill KiwiLearningSpace, and that the design of the street, shops and rooms should be detailed. More entertainment was also required in the playground. Furthermore, one of participants usefully suggested that words in the Word Corridor could be grouped into certain themes or situations.

8. Was it easy to use the learning materials? Why/why not?

All but one participant stated that the learning materials, in particular the Word Corridor, as easy to use. They liked seeing the words in real-life contexts, viewing the clear explanations and accompanying image and hearing how to pronounce the word. They also found it easy to move from word to word.

9. Were the learning materials useful? Why/why not?

All participants positively described the learning materials. Three said the words are useful for everyday communication in a New Zealand context, for example, they are "useful to communicate with Kiwis and shortened the distance between foreigners and native speakers". The materials were also seen as helpful for learning new words and improving reading. However, one participant indicated that the words could have

been displayed in a more interesting way instead of being cards on street.

10. What did you learn from the virtual learning materials?

Almost all participants identified learning new words which they viewed as being helpful for their daily interaction with native speakers of English in a New Zealand context. One participant mentioned that the Quizzes helped them to check what they learned, while another suggested their learning primarily involved Kiwi culture.

11. How can the learning materials be improved?

A quarter of participants suggested that clearer instructions would help improve the learning materials. Suggestions for instructions included the addition of signs, and arrows on the floor, to direct users to their next destination. As above, two participants stated that grouping the words in the Word Corridor thematically would help them to be more easily remembered. The number of the words could also be increased, as could the number of images. One participant stated that it would be necessary to constantly upgrade the materials, and that users' feedback could be collected, to assist with this.

12. Do you like learning in virtual reality?

Almost all of the participants stated that they enjoyed learning in VR (e.g. *I love it, easy and fun, informative, exciting, the images are fancy and dynamic*). The view that it would be accepted by the young was also expressed. Two students suggested it was an important development for students who live some distance away from the institution (*it will help me to save the bus fee*). One participant stated that their preference for learning was in the real world, while another participant worried that the emphasis on play might obscure the purpose of learning.

13. Did you enjoy learning in this virtual educational space? Why/why not?

The participants were very positive about their learning experience in KiwiLearningSpace. One student stated, for example that:

It is useful for foreigners. For example, it can show what Queen St looks like to Chinese when they are in China. It provide realistic teaching and students will be more interested in this mode. It broke the limits of geography.

While another stated that:

Compare to the traditional learning style, the knowledge is easier to be understood and remembered.

As above, others stated that KiwiLearningSpace made the learning process more *enjoyable*, *interesting* and *fun*, and stimulated the brain more. Two participants mentioned liked the novelty of the KiwiLearningSpace method and its promotion of self-study.

14. Do you think this kind of virtual self-learning is useful? Why/why not?

The participants provided a lot of interesting and varied responses for this question. Four explicitly identified it as useful for independent learning, with one participant stating that it is a convenient and dynamic way to self-study. Two pointed out its contemporary significance, for example, *the book is not popular anymore so that VR is easier to learn knowledge* and *this method becomes an essential trend and an increasing amount of people tend to accept virtual education*. However, one participant worried that students may view it more as a game instead of studying. Another stated that while useful, KiwiLearningSpace required clearer instructions. The only participant who did not find this kind of virtual self-learning useful stated it needed more interactive design.

15. Would you like to experience learning in this virtual space again? Why/why not?

All participants stated that they would like to experience learning in KiwiLearningSpace again and provided a variety of reasons. These included the ease

of learning (*It's easy to memorize all the learning material through the fun learning environment*), the ability to experience the culture of somewhere that had never been visited in real-life, the convenience, the ability to combine learning with gaming, that it was the *trend*, and the enjoyment. One participant was keen to receive updates and details about KiwiLearningSpace.

Changes Made after User Evaluation 1.

As a result of this first evaluation, many changes to the design of KiwiLearningSpace were made. Clearer instructions in Welcome area and in each room were added. More Kiwi words in the Word Corridor were added. A Café was developed on the Word Corridor which introduced users to the typical types of coffee orders in New Zealand cafés. Written transcripts of relevant service encounter dialogues were placed on the walls of the Fish and Chip Shop, Clothes Shop and the Café. Each of these had an accompanying audio which was triggered by an avatars proximity to the written transcript. Furthermore, another quiz which tested participants learning, was added to the Test Room. These changes and their motivations are discussed below in more detail.

i) The Instructions

As result of participants' feedback, a clearer indication of the best way that a student user might move through the different places in KiwiLearningSpace was provided next to the map (Figure 29). With this information, student users could establish what they were able to do in the space and when.

Figure 29: Instructions in the Welcome Centre
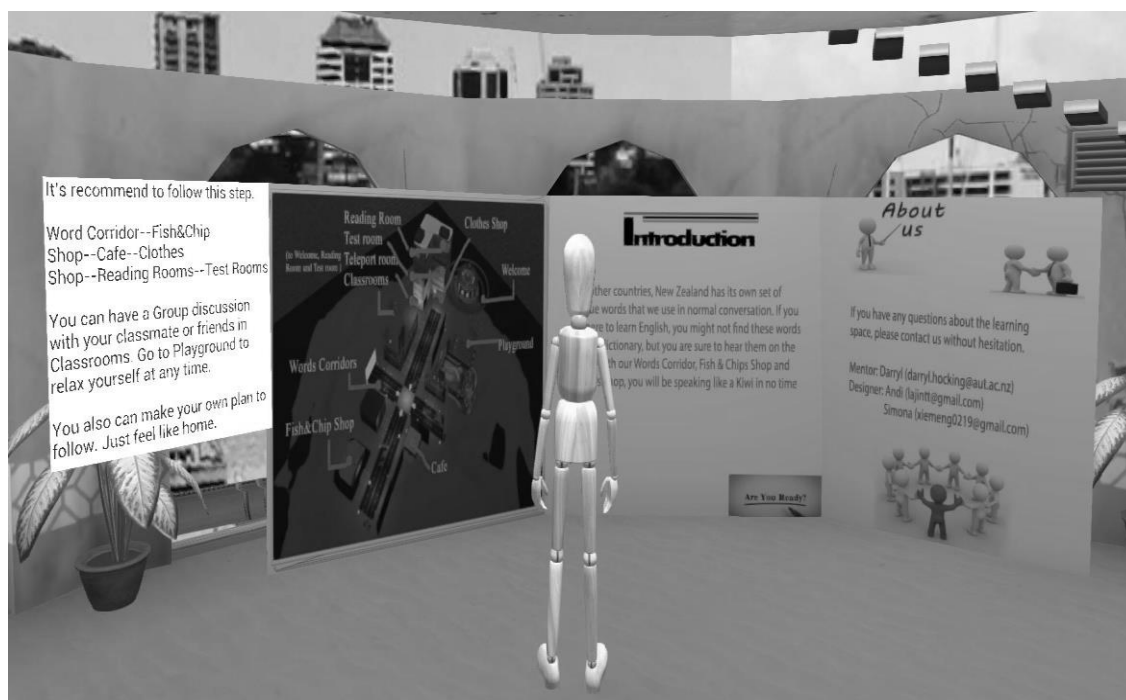
In addition, there are brief instruction for each sim in this space, such as Fish & Chip Shop, Café and Reading Rooms. Each instruction is clear, short and obvious. It introduced the basic information and what people could do in this sim (Figure 30 and Figure 31).

Figure 30: Instructions in the Café

Figure 31: Instructions of the Fish and Chip Shop

ii) The Word Cards

Because of added objects and spaces, such as the Café, major changes were made to the Word Corridor and the word cards. The Word Corridor was reorganized from the existing 'L' shape to an "X" shape to provide opportunities to place the word cards into different categories as suggested by the participants. The words were divided into 3 themes, foods, clothes and everyday conversation. Furthermore, additional words and accompanying images and audio, largely related to clothes, were added to the Word Corridor (Figure 32 and Figure 33).

Figure 32: A word card in the Word Corridor.

Figure 33: A word card in the Word Corridor.

iii) Dialogues

As suggested by participants, and partly in order to create more opportunities for students to practice the new words, service encounter dialogues were added into the Fish & Chip Shop, Clothes Shop and Café. Figure 34 and 35 shows the dialogue in café which could help students learn how to buy a coffee. Furthermore, the audio of these dialogues will play when the users' avatars approach the dialogues.

Figure 34: The dialogue in the Fish and Chip Shop
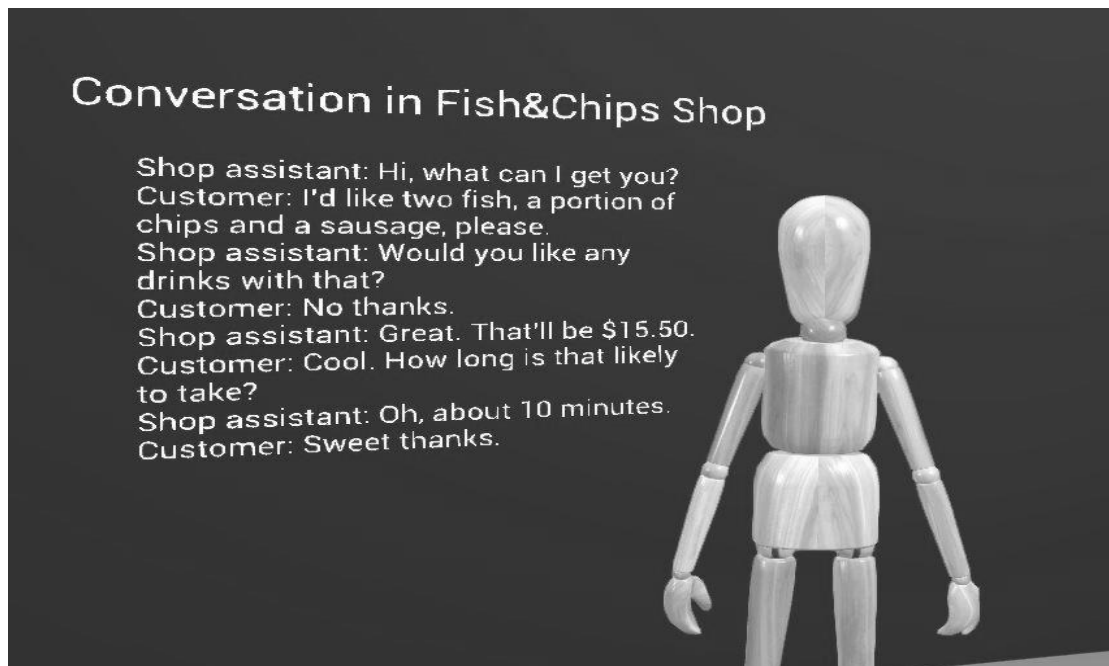
Figure 35: The dialogue in the Cafe
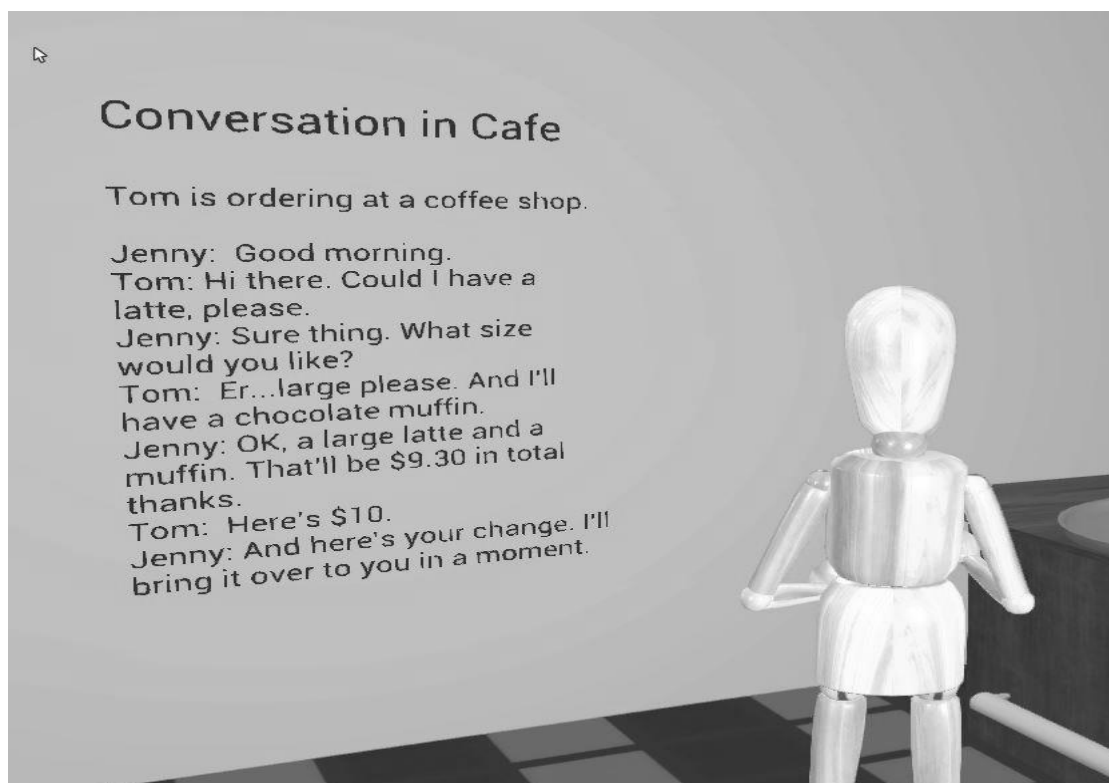
iv) The Café

As participants suggested, a café was added to KiwiLearningSpace, in which information about the different types of popular New Zealand coffee was included. (Figure 36). Student users could not only learn the how to order, but experience the New Zealand coffee culture.

Figure 36: Information about the different types of coffee orders in the Cafe
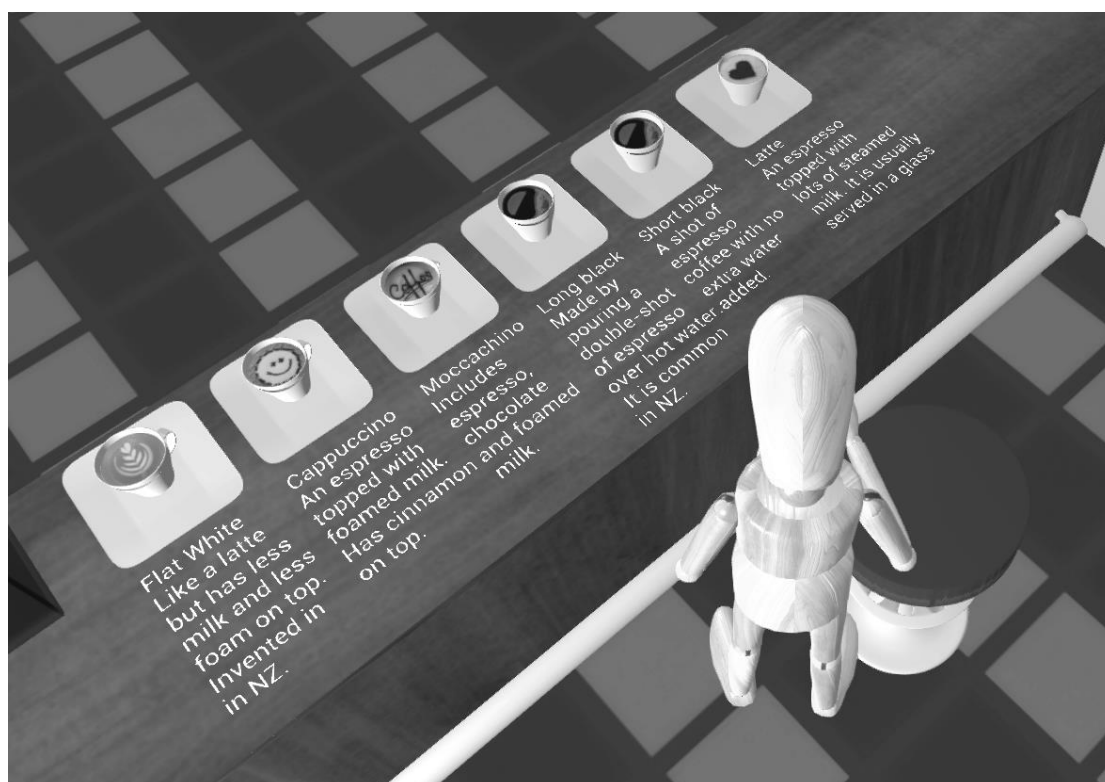
v) The Quiz

Due to the changes made to the Word Corridor, another quiz was developed which included these new words. This quiz can be found in the Test Room (Figure 37).

Figure 37: A quiz in KiwiLearningSpace

vi) The Games

More games were added to the Playground to allow student users to relax (Figure 38).

Figure 38: A game in KiwiLearningSpace
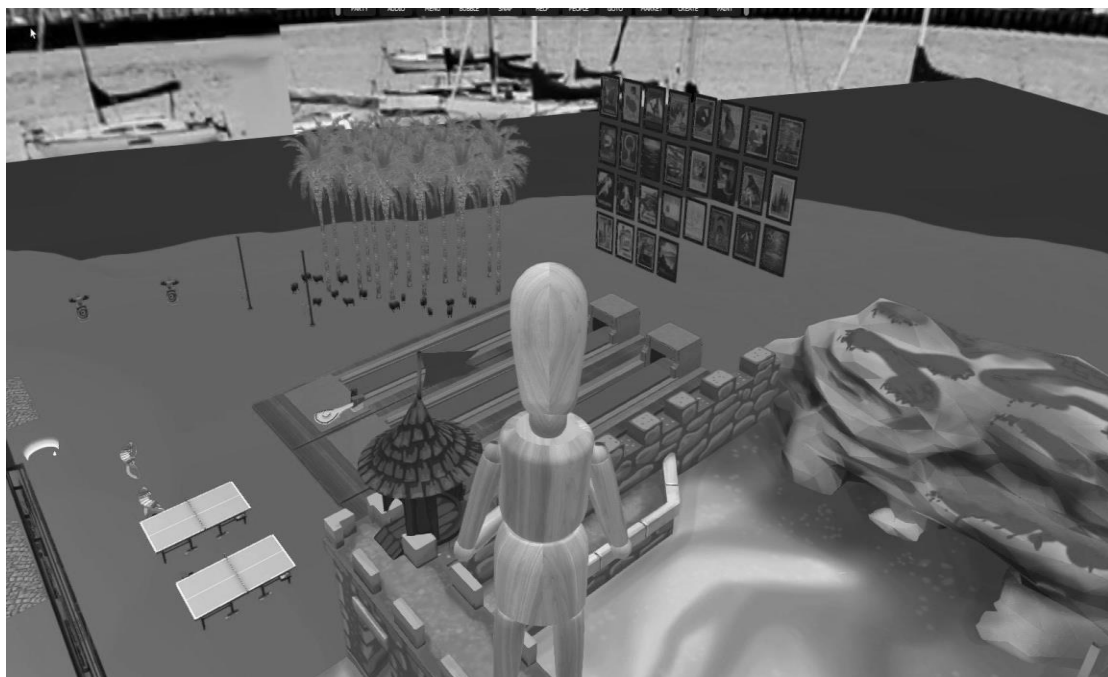
Chapter 6: User evaluation2

The second user evaluation involved eight different participants, all learners of the English language. None of the participants in user evaluation 2 were also participants in user evaluation 1. The observation and interviews for user evaluation 2 were carried out and written up in collaboration with my collaborator on KiwiLearningSpace, Meng Xie (Simona). Therefore the findings of the observation of students engaged in using KiwiLearningSpace and post-use interviews are the same as those in Meng Xie's exegesis.

Observation

Observations on participant's' initial engagement, including adjusting to the VR experience, adjusting to the equipment and spatial adjustment.

It was apparent that the majority of participants found the Oculus goggles comfortable, easily adjustable and easy to wear. However, for the five near-sighted participants who wore glasses, the goggles provided some initial difficulties. They found the goggles a bit tight or heavy on top of their glasses, while others, who forgot, or decided not to wear glasses under their goggles found that the virtual world lacked a degree of clarity. All participants had enough space to move their real bodies in the room.

Observations on the participant's movement around the space.

After spending time becoming used to High Fidelity, all participants could freely walk around, fly and teleport. Three participants sat down, rather than stood up to carry out the evaluation.

Observations on the participant's engagement with learning resources.

The new cafe appeared to be the most popular space for four of the eight participants, where one participant listened to the service encounter audio a number of times. Three participants spent most of their time in the Word Corridor, with one who also used the quiz in the Test Room stating that "it is interesting to learn the words in this way". Another, however, suggested that the pronunciation of the words could be indicated by the inclusion of IPA symbols. Participants also visited in the Fish and Chip shop, the Clothes Shop and the Playground, and showed a broad interest in the different learning spaces in KiwiLearningSpace

Observations of participant difficulties.

Although the participants' initial engagement with the VR experience was generally positive, some difficulties were observed as they continued to engage in KiwiLearningSpace. The most common problem was dizziness, with three participants mentioning that that they felt dizzy. It was also evident that two participants needed additional time to get used to using the Oculus Touch controllers, in particular one who found it difficult to pick up objects.

Other observations

It was evident that all of the participants, except one, felt a sense of dizziness when exploring the space through the touch controllers. The one participant who did not feel dizzy, stated that they regularly played computer games. This participant was able to explore KiwiLearningSpace more easily than the others.

Interview Feedback

1. What did you think about the design of the educational space?

All participants were positive about the design of KiwiLearningSpace (*really good, useful, brilliant, good, clear, quite good*). However four stated that it could be further improved with more detailed modelling and a better design. One participant wanted more interactive audio.

2. Was it easy for you to move around the space? Why/why not?

Five of the participants thought it was easy to move around the space. However, as above, the other participants felt that there movement was impeded due to the feeling of dizziness.

3. Did you know where to go and what to do in the space? Why/why not?

This was one area that was significantly improved from the first user evaluation. All participants found it easy to know where to go, and what to do in the space (*good structure, clear* (x3), *simple directions, clear notes to guide where I need to go, useful guide, and introduction*)

4. Did you feel comfortable when you are in the space? Why/why not?

Again this question resulted in six responses referring to the feeling of dizziness. Two participants, however, stated that they felt comfortable in the space. One of these indicated that they had used virtual reality before. This suggests that overtime users may lose the feeling of dizziness that occurs when virtual reality is first experienced.

5. What did you like about the design of this virtual educational space?

Four of the participants were positive about the design of the virtual space because it resembled the real world, and two commented positively on the design of the skybox. One enjoyed the novelty of the experience, while two commented on ease and enjoyment of learning English or new words in the virtual environment. One

participant praised the modelling, i.e. the café and the fish and chip shop.

6. What didn't you like about this space?

With perhaps the exception of the two participants, who mentioned that the modelling could be improved, there was no dominant pattern of criticism. One participant mentioned that the road signs could be clearer, another felt that the words cards floating in the air looked weird, and another was critical of the stairs at the welcome centre. One participant responded that there was nothing they didn't like about the space.

7. How can the educational space design be improved?

Again while participants provided some useful advice, there was no pattern of response to this question. One participant usefully suggested that the Word Corridor audio should initially be played only once, and only repeated again if the user wanted. Other suggestions included more entertainment in the playground, more content overall, more modelled buildings instead of images, more pedestrians in the street, and a signal to indicate the completion of the user's mission.

8. Was it easy to use the learning materials? Why/why not?

All participants were very positive about the learning materials in KiwiLearningSpace, with five specifically pointing out their simplicity and clarity of use. One participant claimed that the combination of audio and word cards enriched the scenario. However, the lack of interaction with others in the learning environment was raised again.

9. Were the learning materials useful? Why/why not?

Again every participant thought the learning materials were useful. The main reasons were that they learnt words that could be applied in their everyday lives (x3), they learnt very useful local New Zealand words (x3), and that they simply learnt new words (x1).

10. What did you learn from the virtual learning materials?

As with the previous question the participants stated that they learnt new words and useful New Zealand phrases that could be used in everyday speech. Interestingly, a couple of participants identified underpants, knickers and sweet-as, as specific words they learnt in KiwiLearningSpace.

11. How can the learning materials be improved?

There were a number of different suggestions for improving the learning materials, but no dominant patterns emerged, with the exception of two participants who thought that International Phonetic Alphabet symbols could be included on the word cards. One participant suggested more conversations, while another thought the word cards could all be located in a single area, rather then spread out across the street. One participant asked for more New Zealand words.

12. Do you like learning in virtual reality?

All participants stated that they enjoyed the virtual realty learning experience, with only one commenting on the issue of dizziness.

13. Did you enjoy learning in this virtual educational space? Why/why not?.

All participants enjoyed learning in KiwiLearningSpace. Some commented on the realistic quality of the content and the quality of the word cards and accompanying audio. Another stated that is was fun and would become a future trend for learning.

14. Do you think this kind of virtual self-learning is useful? Why/why not?

All participants thought this kind of virtual self-learning is useful. They thought the gaming aspect helped the acquisition of new knowledge, that it would be useful for distance students, and that it was a new and fun method for learning English. One participant interestingly commented that it was difficult to take notes while studying in VR.

15. Would you like to experience learning in this virtual space again? Why/why not?

All the participants stated that they would like to experience learning in KiwiLearningSpace again, with a number describing it as a new and interesting experience. Three, however added that they'd like the issue of dizziness to be fixed.

Changes Made after User Evaluation 2.

A few minor changes were made to KiwiLearningSpace after User Evaluation 2.

i) The Instructions

After the first user evaluation and subsequent development of KiwiLearningSpace, it was opened to other users of High Fidelity. As a result, the contact page was removed to avoid strangers obtaining the creator's personal details. (Figure 39).

Figure 39: The welcome centre

Following the user observation it became clear that some participants did not go to test rooms to take the quizzes. As a result signs were added which can guide users to

the quizzes (Figure 40). These also directed users to the specific quiz related to each learning resource.

Figure 40: A guide sign for the quiz
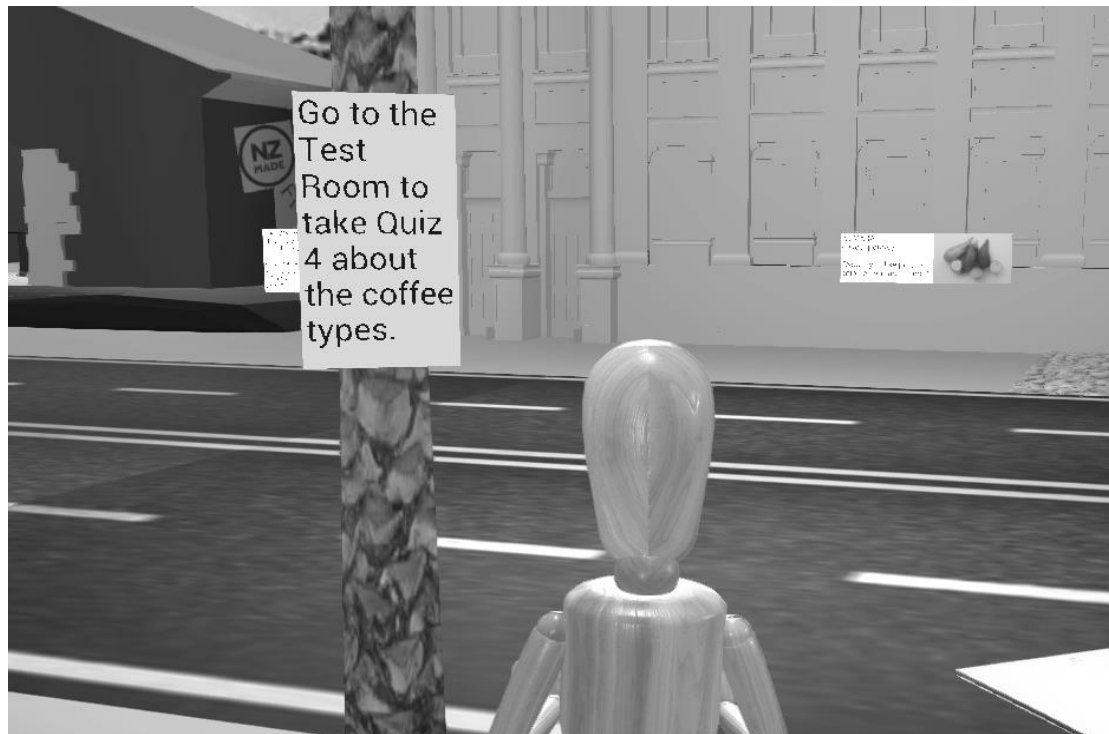
ii) Readings

Given that the participants were extremely positive about those aspects of KiwiLearningSpace to do with New Zealand culture, the stories in the Reading Room were changed to include those about New Zealand wildlife (including the kiwi itself), student life and culture (Figure 41). This may help students to learn more about living in New Zealand, both in terms of their study and social life.

Figure 41: Readings from KiwiLearningSpace

iii) The Quiz

The single quiz was reorganized into four distinct quizzes; everyday dialogue, food, clothes and coffee types (Figure 42). After their initial learning experience in KiwiLearningSpace, students could complete the corresponding quiz by following the guide.
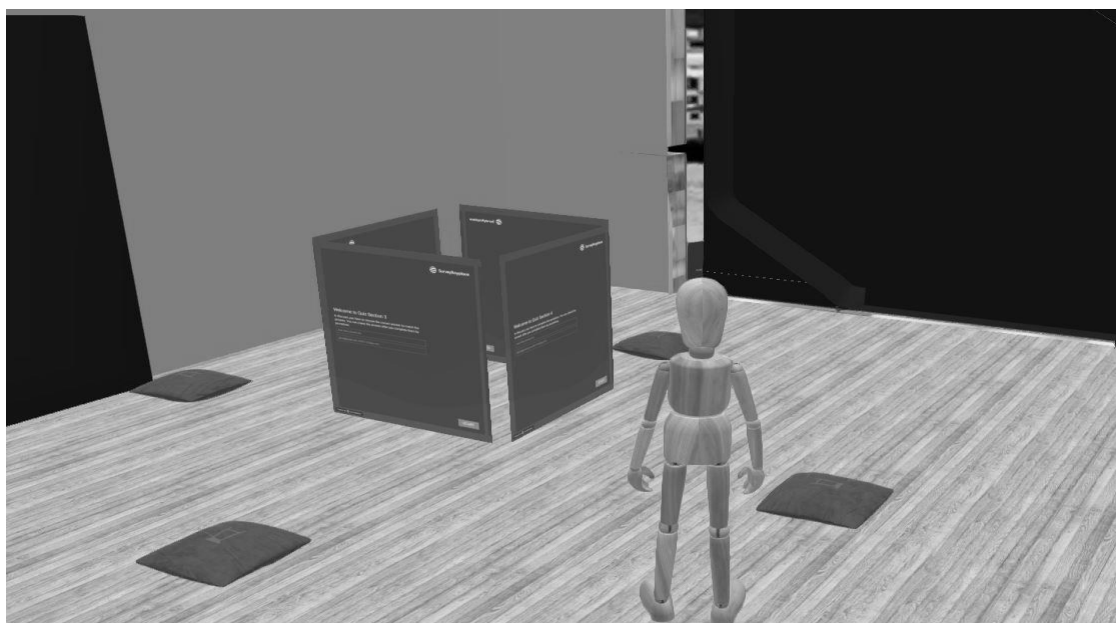
Figure 42: The quizzes in KiwiLearningSpace

Chapter 7: Reflections and Conclusions

The following section provides a final discussion that reflects on the creation and development of learning resources in KiwiLearningSpace using the High Fidelity Beta platform.

3D modelling content

The most common concerns when developing the learning resources in KiwiLearningSpace involve the challenges of 3D modelling content. As many of the participants pointed out, the 3D models needed to be more detailed. To achieve this, teacher/designers must learn how to create their own 3D content, not only in High Fidelity itself, but also in other often quite challenging applications such as Blender and SketchUp. Although there are some free models in the High Fidelity Marketplace, most of them are not suitable, or do not meet the requirements, to be used as teaching resources. It is also possible to source models from online 3D content stores, however this presents certain issues. Most models do not import well into High Fidelity, which has particular technical requirements for 3D content. For example, a model's textures will often disappear during this process. Solving problems such as missing textures requires further technical work in modelling applications such as Blender, much of which is beyond the scope of someone who is not an expert in this area. Furthermore, developing a 3D model as a teaching resource often requires the inclusion of scripting, one of the more difficult aspects of modelling. High Fidelity uses the relatively complex JavaScript. A number of learning resources for KiwiLearningSpace could not be completed because of the difficulties found with scripting. In brief, due to the many challenges with 3D modelling content, it almost always takes teacher-developers longer than expected to design and develop a virtual learning

environment (Lin, et al, 2014; Sarac, 2014; Schiller, 2009; Thompson, 2012; Davis, et al, 2007; Berns, et al, 2013; Lee, et al, 2013).

It is recommended that language educators/designers wanting to use High Fidelity take a course to learn how to build in 3D applications, and how to write and use effective modelling scripts. They also need time and patience to create a complicated 3D model, particularly if they want to develop one that is lifelike. Teachers might also want to consider working with dedicated technicians who could create the models or scripts for them. There is, of course, a degree of technical assistance available in the High Fidelity Welcome space, which I used on a number of occasions. In this space, High Fidelity avatars attempt to help solve any High Fidelity questions or problems experienced by users. In addition, High Fidelity has developed a work list via an official website, which allows content designers to request certain types of models or scripts which will be built by High Fidelity and paid for by the user. Users can also log a modelling job with specific requirements and other users will offer to complete the task for a set fee. These options provide a useful resource for teachers because they can shorten the time of building the virtual space, leaving teachers with more time to prepare the course resources.

Hosting

Unlike Second Life, which is hosted on a central server owned by Linden Lab, High Fidelity is hosted on the user's own computer. Each user has a sandbox which allows them to create their space among their own computer and avatars can visit that space only if they receive an invitation from the space's developer/owner. The sandbox is quite large and offers opportunities to make it interesting. Compared with Second Life users who pay $5-295USD per month for a small island, High Fidelity Sandboxes are free. Users can also choose to pay $20 USD per year to give the space a name and make it available on the 'Go To' menu for other users to visit.

This kind of hosting has a number of problems and benefits. Firstly, the Sandbox must be continually backed up by the user in case the computer crashes. Furthermore the users' computer must be turned on for the Sandbox to be accessed by other High Fidelity users. Moreover, because the hosting takes place on the user's computer, it is relatively easy to create several different Sandbox spaces and switch from a previous one to new one. As a result, the decision to name a space is useful.

Software application

Unfortunately the High Fidelity software, which includes the Sandbox and the High Fidelity application itself, required frequent updates. Each update brings new functions, such as the Wallet and the Worklist. However, the software regularly crashes after each update (Figure 43), and avatars need to move carefully when the space is loading to avoid this situation. Unfortunately, there is no method for users to solve this recurring problem, except to contribute a Crash Report, and wait for the next update to fix the problem.

Figure 43: Crash Report

Computer specifications/space

Users of High Fidelity need a powerful computer with a good graphic and voice card, as well as a fast internet connection to use the High Fidelity application, goggles and hand controllers. While this research project had access to a powerful gaming computer, Schiller (2009) complained that scheduling a computer lab for students which includes a fast computer, a fast-speed Internet connection (cable or DSL), and a good quality graphic card is often difficult. Similarly, the computers in most institutions do not yet meet the specifications required by both High Fidelity and Oculus Rift.

Wearables

As indicated in the users feedback, Oculus goggles are generally easy to wear and very comfortable, with the exception perhaps, for those participants who were short-sight and had to wear glasses. These users stated that the Oculus Rift were too heavy or tight for them while to wear with glasses. Fortunately, most of short-sight participants were able to wear contact lenses to complete their evaluation. Furthermore, the foam pad in the oculus googles improved the feeling of comfort, but it also made the participants sweat. I would suggest that for hygiene purposes users should consider purchasing their own VR wearables. At present, an Oculus Rift headset, 2 Oculus sensors, 2 Touch controllers and all required connecting cables cost US$449, including delivery, and these costs will most likely decrease.

Learning Materials in High Fidelity

There are a number of relatively quick and easy ways to create learning materials in the High Fidelity sandbox. Images can be attached to models as textures, notecards can be created using the text function, and webpage URLs can be embedded into models. Although Second Life, provides a greater number of accessible ways of

creating learning material, those in High fidelity are still useful and relatively accessible.

i) Attaching images to models as textures.

This process requires three steps. Firstly, a text or images are saved as a JPEG. They are then attached to a model as texture in software such as Blender, and then the model is imported into High Fidelity. This is a useful way to import text and images into High fidelity as they cannot be imported into a sandbox independently and placed on an existing object already in the sandbox, as with Second life. For example, in the KiwiLearningSpace Word Corridor, all of pictures were imported as textures attached to models.

ii) Writing a notecard

Unlike second life, the process of writing a notecard in High Fidelity is quite limited, and involves adding text to an object created in the sandbox. As this process involves simply entering the desired text into a single 'text content' line in properties menu of an object, it is difficult to know how the text will ultimately appear on the object in the sandbox. As a result it involves some trial and error on the designer's part. Although it is likely that this function will be improved in the future, it is still an accessible way to get text into the sandbox. Importantly, the font can be adjusted, it is easy to paste words into the 'text content' line, and the size of page/object can be stretched to suit. The simple function helps users to design and create teaching materials efficiently and effectively.

iii) Embedding a webpage on an object

This is perhaps the easiest way to create teaching materials into High Fidelity. It

involves adding a web URL to an object in High Fidelity using the Web button in the create menu. This allows the designer to embed active web pages in the Sandbox that have been created on any of the large number of online educational resources available on the internet. For instance, the multi-choice quizzes in the KiwiLearningSpace test rooms were first developed online in the SuveryAnyPlace web resource and then embedded into objects in KiwiLearningSpace. Although the font of these quizzes appears small on the desktop screen, it is perfect in VR mode. While High Fidelity is a new platform which will develop more functions over time, embedding webpages provides opportunities to enrich the space with different learning content.

Conclusion

Although there were many challenges during the building, the learning resources of the KiwiLearningSpace were very positively received by second group of participants. They stated that they were able to learn Kiwi English words and phrases and a little about new Zealand Culture, such as the different types of coffee in New Zealand, and how these might be ordered. Participants believed that this could help them with their everyday communication needs in a New Zealand environment. Thus, KiwiLearningSpace could help students integrate more quickly into local New Zealand life, if this is what they are interested in. In conclusion, as a new learning method, High Fidelity has the potential to keep both teachers and students absorbed. It not only provides chances and opportunities to connect teachers and students, but also provides a motivating and interesting immersive learning method.

References

Ata, R. (2016). An exploration of higher education teaching in Second Life in the context of blended learning. *Turkish Online Journal of Educational Technology*, 15(3), 9.

Barrett, B. and Barbara Bolt, B. (2007). Practice as Research: Context, Method, Knowledge. *London; IB Tauris*

Berns, A., Gonzalez-Pardo, A., & Camacho, D. (2013). Game-like language learning in 3-D virtual environments. *Computers & Education,* 60210-220.

Bronack, S. C., Sanders, R. L., Cheney, A., Riedl, R. E., Tashner, J. H., & Matzen, N. J. (2008). Presence pedagogy: Teaching and learning in a 3D virtual immersive world. *International Journal of Teaching and Learning in Higher Education,* 20(1), 59–69.

Brown, E., Hobbs, M., & Gordon, M. (2008). A virtual world environment for group work. *International Journal of Web-Based Learning and Teaching technologies* 3(1),1-12. Retrieved from AUT University Library database.

Calongne, C. & Hiles, J. (2007), Blended Realities: A Virtual Tour of Education in Second Life, *Proceedings of Technology, Colleges and Community Annual Conference*, 2007.

Candy, L. (2006). Practice Based Research: A Guide, *CCS Report: 2006-V1.0* November, University of Technology Sydney.

Chen, N. S., Hsieh, S. W. & Kinshuk. (2008). Effects of short-term memory and content representation type on mobile language learning. *Language Learning & Technology,* 12(3), 93-113.

Davis, N., Roblyer, M., Charania, A., Ferdig, R., Harms, C., Compton, L. L., & Cho, M. O. (2007). Illustrating the "virtual" in virtual schooling: Challenges and strategies for creating real tools to prepare virtual teachers. *The Internet And Higher Education,* 10(Special Section of the AERA Education and World Wide Web Special Interest Group (EdWeb/SIG), 27-39.

Dirkx, J. M. (2006). Studying the complicated matter of what works: Evidence-based research and the problem of practice. *Adult Education Quarterly*, 56(4), 273–290.

Dirkx, J. M. (2008). The epistemology of practice: An argument for practice-based

research in HRD. *Human Resource Development Review*, 7(3), 263-269.

Gallego, M. D., Bueno, S., & Noyes, J. (2016). Second Life adoption in education: A motivational model based on Uses and Gratifications theory. *Computers & Education,* 10081-93.

Garrido-Iñigo, P., & Rodríguez-Moreno, F. (2015). The reality of virtual worlds: pros and cons of their application to foreign language teaching. *Interactive Learning Environments*, 23(4), 453-470.

González, M. A., Santos, B. N., Vargas, A. R., Martín-Gutiérrez, J., & Orihuela, A. R. (2013). Virtual Worlds: Opportunities and Challenges in the 21st Century. *Procedia Computer Science,* 25(2013 International Conference on Virtual and Augmented Reality in Education), 330-337

Han, H. s. (2015). Teaching Visual Learning Through Virtual World: Why Do We Need a Virtual World for Art Education?. *Art Education*, 68(6), 22-27.

Honey, M., Connor, K., Veltman, M., Bodily, D., & Diener, S. (2012). Featured Article: Teaching with Second Life®: Hemorrhage Management as an Example of a Process for Developing Simulations for Multiuser Virtual Environments. Clinical Simulation In Nursing, 8e79-e85.

Jarmon, L., Traphagan, T. & Mayrath, M. (2008), "Understanding project-based learning in Second Life with a pedagogy, training, and assessment trio." *Educational Media International*, Vol. 45, No. 3, pp. 157-176.

Kemp, J., & Livingstone, D. (2006). Putting a Second Life "metaverse" skin on learning management systems. *In Proceedings of the Second Life education workshop at the Second Life community convention* (Vol. 20). CA, San Francisco: The University of Paisley.

Keskitalo, T., Pyykkö, E., & Ruokamo, H. (2011). Exploring the Meaningful Learning of Students in Second Life. *Educational Technology & Society*, 14 (1), 16–26.

Kopp, G., & Burkle, M. (2010). Using Second Life for Just-in-Time Training: Building Teaching Frameworks in Virtual Worlds. *International Journal Of Advanced Corporate Learning*, *3*(3), 19-25.

Kuniavsky, M., Goodman, E., & Moed, A. (2012). Observing the user experience: a practitioner's guide to user research. Waltham, *MA : Morgan Kaufmann.*

Kuniavsky, M. (2003). Observing the user experience: A practitioner's guide to user research. *San Francisco, CA: Morgan Kaufmann.*

LaBanca, F. (2011). Online dynamic asynchronous audit strategy for reflexivity in the qualitative paradigm. *The Qualitative Report*, 16, 1160-1171

Lee, M., Gregory, S., Dalgarno, B., Carlson, L., & Tynan, B. (2013). How are Australian and New Zealand higher educators using 3D immersive virtual worlds in their teaching?. *IGI Global*. doi:10.4018/978-1-4666-4205-8.ch013

Lin, T., Wang, S., Grant, S., Chien, C., & Lan, Y. (2014). Task-based Teaching Approaches of Chinese as a Foreign Language in Second Life through Teachers' Perspectives. Procedia Technology, 13(SLACTIONS 2013: Research conference on virtual worlds - Learning with simulations), 16-22.

Mawer, M. (2016). Observational practice in virtual worlds: revisiting and expanding the methodological discussion. International Journal Of Social Research Methodology, 19(2), 161-176.

Monahan, T., McArdle, G., & Bertolotto, M. (2008). Virtual reality for collaborative e-learning. *Computers & Education,* 501339-1353.

Nelson, R. (2013). Practice as Research in the Arts: Principles, Protocols, Pedagogies, Resistances. *Basingstoke: Palgrave Macmillan*

Penfold, P. (2008). Learning Through the World of Second Life—A Hospitality and Tourism Experience. *Journal Of Teaching In Travel & Tourism*, 8(2/3), 139-160.

Ratto, M. (2011) Critical Making: Conceptual and Material Studies in Technology and Social Life, *The Information Society*, 27 (4), 252-260.

Sarac, H. S. (2014). Benefits and Challenges of Using Second Life in English Teaching: Experts' Opinions. *Procedia - Social And Behavioral Sciences*, 158(14th Language, Literature and Stylistics Symposium), 326-330.

Schiller, S. Z. (2009). Practicing Learner-Centered Teaching: Pedagogical Design and Assessment of a Second Life Project. J*ournal Of Information Systems Education*, 20(3), 369-381.

Schön, D. (1983). The reflective practitioner: How professionals think in action. *New York: Basic Books.*

Thompson, L. (2012). Educational Uses of Second Life in the Teaching of Child and Youth Work. Relational Child & Youth Care Practice, 25(1), 43-51.

Whitson, R. (2015) Critical Making in the Digital Humanities. In J. Wolfreys (Ed.) *Introducing Criticism in the Twenty-First Century* (pp. 157-177) Edinburgh: Edinburgh University Press.

Yorks, L. (2007). Adult learning and the generation of new knowledge and meaning: Creating liberating spaces for fostering adult learning through practitioner-based collaborative action inquiry. *Teachers College Record,* 107(6), 1217–1244.

Appendix A

Observation Protocol Form

Participant's pseudonym	
Start time of participation	
Observations on participant's' initial engagement. • Adjusting to the VR experience • Adjusting to the equipment • Spatial adjustment	
Observations on the participant's movement around the space.	
Observations on the participant's engagement with learning resources.	
Observations on the participant's use of the touch controllers.	
Observations of participant difficulties.	
Other observations	
Completion time of participation • Note whether the participant completed early due to discomfort.	

Questions

1. What did you think about the design of the educational space?

2. Was it easy for you to move around the space? Why/why not?

3. Did you know where to go and what to do in the space? Why/why not?

4. Did you feel comfortable when you are in the space? Why/why not?

5. What did you like about the design of this virtual educational space?

6. What didn't you like about this space?

7. How can the educational space design be improved?

8. Was it easy to use the learning materials? Why/why not?

9. Were the learning materials useful? Why/why not?

10. What did you learn from the virtual learning materials?

11. How can the learning materials be improved?

12. Do you like learning in virtual reality?

13. Did you enjoy learning in this virtual educational space? Why/why not?

14. Do you think this kind of virtual self-learning is useful? Why/why not?

15. Would you like to experience learning in this virtual space again? Why/why not?