The Impact of Interaction in Virtual Reality Language Learning as Active Learning

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ABSTRACT

The trend in Virtual Reality (VR)-based learning is increasing. Since the VR apparatus is stable and getting smaller and portable to carry around, many VR contents are available. In this paper, we hypothesized that VR language learning will make people active learners because a high interaction in VR will promote intrinsic motivation. Therefore, we conducted quantitative research to measure perceived interactivity and intrinsic motivation through comparing desktop-based learning (i.e., low-immersive environment) and VR HMD-based learning (i.e., high-immersive environment). We created two different Korean language modules and tested them on participants who had no prior Korean language learning experience. The primary implication of this research was that perceived interactivity served as a full mediator between medium and intrinsic motivation. Overall, this paper emphasizes the importance of interaction in VR environment that can make language learners more active.

Key words: Virtual reality Language Learning, Immersion, Perceived Interactivity, Intrinsic Motivation

INTRODUCTION

The availability of immersive virtual environment experiences for education and entertainment purposes have increased in recent past (Dawley & Dede, 2014). Some people tend to use simulation games like Minecraft, Second Life or The Sims to improve their cognitive engagement through the virtual environment for language learning. Furthermore, people like to portray themselves as a virtual avatar and find joy in interacting with other avatar or game objects. This interaction and communication in an immersive virtual environment can be used for language learning and to remain highly motivated in the process (Ranalli, 2008). In the light of above argument, Miller and Hegelheimer (2006) have worked on finding the effectiveness of English vocabulary learning by using simulation game, The Sims. They found that the simulation game is highly effective in language learning and almost all participants enjoyed the game in learning. In order to find how immersive virtual environment influence on language learning, it is necessary to investigate what element can be affected to increase learners' motivation by comparing different immersive levels.

These simulation games have become practical and highly interactive thus increasing their potential for use in language learning (Coleman, 2002; Crookall, 2002; Purushotma, 2005). This is possible because a computer can generate an authentic environment to help the students achieve a better understanding of visualization. Van Berkum and De Jong (1991) compared traditional teaching pedagogy (e.g., textbooks and lectures) and computer-based learning (e.g., simulation). They found that computer-based learning has more advantages over the traditional teaching method because the students felt less stressed to practice tasks in authentic content and solve the problem in the virtual environment. Vogel et al. (2006) suggested that 3D technology could be more effective than 2D in learning process due to the reason that 3D provides accurate simulated and authentic learning environment. That is why recently, many students have started using virtual environment simulation games such as Minecraft and

Second life to learn a language in authentic content without a fear to exchange the languages. Thus, interactive simulation games provided more active and motivated learning as compared to teacher controlled the learning content (Vogel et al., 2006).

These authentic content increases the autonomy of learning and active learning because virtual environment makes the user less risky. Wolff (1994) put emphasis on learning the second language and claimed that the autonomous language user who is encouraged to interact in the target language will improve language learning because the learners have own responsibility for their learning process. For instances, they can set up their own goal for learning; they can select the content and monitor the progress themselves; they can choose which technique they find suitable; and they can make an evaluation of what has been learned. Thus, the learners can keep practicing or interacting with the objects without fear or lack of immediacy.

Although the desktop-based learning seems to have many advantages such as simulation of authentic environment, a computer monitor is not enough tool to boost immersive level. In this learning setting, students do not often feel connected with their instructors (Vonderwell, 2003). In the article, improving online learning, Song, Singleton, Hill, and Koh (2004) emphasized that it is essential to connect with learners and share emotions. Lack of immersion will limit the concentration of the study. It may affect student's motivation and learning outcomes. To resolve these problems, development in VR has been established to an extent that has increased the level of immersion of three-dimensional virtual environment with the application of supporting devices such as a head-mounted display (HMD), and headphones (Boulos, Hetherington, & Wheeler, 2007).

In Virtual reality (VR), a sense of presence can generate high-immersive environment (Biocca & Delaney, 1995). Presence defines as "being there". It is used to visualize the computer-generated contents, as the environment that VR creates in generating computer-

content is highly immersive (Solak & Erdem, 2015). In an article on immersive training systems, Psotka (1995) states that "What distinguishes VR from all preceding technology is the sense of immediacy and control created by immersion". Limniou, Roberts, and Papadopoulos (2008) compared the effects of 2D images and 3D simulations of molecular structures in chemistry class on keeping the interests and the motivation of students. They found that 3D full immersive virtual reality learning environment (VRLE) keeps students more motivated than 2D images, and they do not easily lose interest in the learning process.

Furthermore, Rose and Billinghurst (1995) emphasize that VR is constructivist in nature: "The experience in which an idea is embedded is critical to individual's understanding of and ability to use that idea" (Duffy & Jonassen, 2013; Wolff, 1994). Virtual reality provides the opportunity for learning and developing an idea in an environment that is similar to a real environment. There are many advantages of virtual reality, some of them are: it keeps students motivated, they play an active role in learning process, provision of learning autonomy, and high immersion (Bricken & Byrne, 1993; Loftin, Engleberg, & Benedetti, 1993; Regian, Shebilske, & Monk, 1992). Thus, with these benefits to use VR, it is important to research why Virtual Reality(VR) can be an efficient language-learning tool.

IMMERSIVE VR IN LANGUAGE LEARNING

Immersion is a state in which one gets a perception of being surrounded by, included in, and having interaction with a virtual environment that provides a stream of stimulus and experience continuously. It depends on how much one feels isolated from its physical environment and have a natural interaction with the virtual environment (Witmer & Singer, 1998). More specifically, Schwienhorst (2002) divided VR into two immersion levels; low-immersive VR, which utilizes a desktop to view the virtual environment and high-immersive VR is using a head mounted display which can generate fully immersive environment.

Depending on immersion levels, the effects such as perceived interactivity or motivation can be different. For example, Merchant (2012) conducted research to find more immersive chemistry class in VR-based learning or traditional methods of instruction. The results showed that students who used the Second Life in chemistry class perceived themselves as being in the environment. This is because 3D virtual reality features are capable of providing higher immersion levels (Hall et al., 2004; Winn, Windschitl, Fruland, & Lee, 2002). Also, Steuer (1992) stated that communication devices (VR) vary in terms of induction of presence. The sense of presence can be a relevant to determine different immersion levels like low or high immersive environment (Azuma et al., 2001; Dede, 2009; Hedley, Billinghurst, Postner, May, & Kato, 2002). Therefore, in this paper, though a different presence level, we determined immersive levels for the two medium (i.e., desktop and VR).

INTERACTION AS CORE OF ACTIVE LEARNING

Modern technologies, e.g. VR, have potential to effect persuasion and learning (Skalski & Tamborini, 2007). It is argued that the key feature of these technologies is interactivity because these technologies have a potential of generating a feeling of presence with vividness and interactivity.

Interactivity is defined as the extent to which a user of the medium could control the content of the virtual environment. This control allows the learner to obtain the information of the content effectively and efficiently. Thus, VR devices provide learners more realistic learning content with interaction (Huang, Rauch, & Liaw, 2010). As Pantelidis (1993) asserts that VR opens new paradigm to learn, they suggest ‘virtual reality classroom’. They point out that VR makes high interaction for learners to maintain on their interest and visualize abstract concept. Moreover, the interaction in VR can make people practicing skills that could not be mastered or practiced in a physical environment. For example, in a medical field, one can easily

practice complex surgeries in a virtual environment before applying to a physical patient. Similarly, Mr.Vetro™ is a popular simulation application consisting of medical scenarios to be practiced on before applying to patients. In this way, it minimizes the risk or probability of failure of the procedure.

Text-based interaction

VR provides behavioral engagement that includes face-to-face talking and texting (Skalski & Tamborini, 2007). It allows interaction between teacher and learners through visual lectures and text chats tools (Huang, Rauch, & Liaw, 2010). Also, this text-based interaction is frequently used in a simulation game, and it provides many benefits. For example, Wehner, Gump, and Downey (2011) have compared text message bubble interaction in Second life: one group with text chatting online in Second Life, and another group without using Second Life. The results showed the group who used Second life text bubble box has less anxiety than non-Second life content users.

Social Agent Interaction

A social presence can be defined as a sense of being with other individuals in a mediated environment (Biocca, Harms, & Burgoon, 2003). According to Heeter (1989), the most interactive medium is those that give natural, human-like characteristics to its user. This kind of medium creates a stronger feeling of social presence because the environment they provide has a human aspect (Durlak, 1987). Therefore, people who use the type of media that provide them with an opportunity to interact with the human-like source are more likely to perceive a greater sense of interactivity and social presence. For example, “Mondly VR” is VRLL application that practices a real conversation with virtual avatars in a certain situation, for instance, the conversation in the hotel reception, café, or train. It has voice recognition

feature that helps learner in getting to feel presence during interaction with the virtual avatar. Thus, we propose the following hypothesis:

H1-1. The participants who are assigned to VR HMD condition perceive a higher interactivity than the participants who are assigned to desktop monitor condition

INTRINSIC MOTIVATION IN VR

Intrinsic motivation is motivation coming from inside or due to internal factors of a learner (Deci, 1975). It is an internal drive which is based on the self-determination theory. According to self-determination theory, people need competence, relatedness (relationships with peers) and autonomy (control over learning) for motivation (Deci & Ryan, 1975, 2000). Froiland, Oros, Smith, & Hirchert (2012) suggest that if intrinsic motivation can be incorporated in learning, it will result in improvement in academic results of students. For example, Bonde et al. (2014) introduced VR Labster which is virtual reality chemistry laboratory and compared three conditions (i.e., traditional lecture, VR Labster, lecture & VR Labster). The result came out that the performance of participants who used virtual reality laboratory was 14% greater than the performance of the students who were taught with traditional lecture.

The biggest challenge faced by VR designers is the integration of VR features into the curriculum for motivation purpose (Shih & Yang, 2008). Although VR has been successful in providing motivation incorporation of features to foster intrinsic motivation is still difficult (Konetes, 2010). Dreher, Reiners, Dreher, and Dreher (2009) believe that virtual worlds provide “more important and often challenging aspects of teaching students to cultivate intrinsic motivation, critical thinking skills, autonomous learning skills, and knowledge/skill transfer between learning domains” (p. 220). Fully developed VR systems such as MUD-object-orient (MOO) can improve constructivist activities, the participation of students in

learning activities and can give a power of control to students. VR can incorporate intrinsic motivation, efficient results, and awareness (Schwienhorst, 2002). Thus, we propose the following hypothesis to compare different medium in intrinsic motivation:

H1-2. The participants who are assigned to VR HMD condition perceive a higher intrinsic motivation than the participants who are assigned to desktop monitor condition.

RELATIONSHIP BETWEEN INTERACTION AND INTRINSIC MOTIVATION

The higher interactivity learners have, the more motivation they will have. In order to corroborate this hypothesis, Mahle (2011) conducted the research by using Keller's ARCS model to measure four motivational categories: attention, relevance, confidence, and satisfaction. He used a web-based course as a stimulus and make three different interactivity levels depending on feedback level: a low interaction, reactive interaction, and proactive interaction. The result was shown that higher levels of interactivity have a positive effect on students' motivation in a web environment.

Another research is that of Roussos et al. (1999) have compared two groups, one with the immersive environment and one without immersive environment. They found out that group with immersive environment had better memory retention of information and they were more interested in VR sessions (Bricken, 1991). Levels of immersion and interaction have a significant impact on the enhancement of learner motivation in VRLE (Huang, Rauch, & Liaw, 2010). Thus, we propose the hypothesis to investigate the correlation between perceived interactivity and intrinsic motivation in language learning:

H 2. There will be correlations between perceived interactivity and intrinsic motivation on virtual reality language learning.

Perceived interactivity as mediator

Based on the research results, we can investigate the relations of perceived interactivity and motivation in virtual reality environment. First, interactivity has long been associated with the concept of vividness or immersion (Fortin & Dholakia, 2005; Hoffman & Novak, 1996). Second, some researchers have argued that immersive environments can support active learning because they allow learners to control content. This active learning can encourage diverse thinking and problem solving, which help stimulate intrinsic motivation (Lee, Wong, & Fung, 2010). Third, there is a high correlation between motivation and interactivity (Mahle, 2011).

In VRLE, an interaction between the learner and virtual environment keeps the learner motivated (Kreylos, Bethel, Ligocki, & Hamann, 2003). Limniou, Roberts, and Papadopoulos (2008) conducted a research to compare learning in 3D and 2D, and the result showed 3D full immersive VRLEs elevated a learner's interest and motivation. VR technology can promote learners interest by engaging media, and by stimulating dialogue. These features of interaction and immersion can be the main characteristics to attract and motivate learners in a VR learning environment. Thus, we proposed the following research question:

RQ 1. Will perceived interactivity mediate intrinsic motivation on virtual reality language learning?

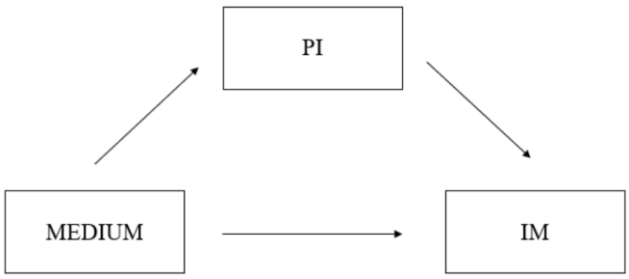

Figure 1. A proposed framework of the perceived interactivity as a mediator.

METHOD

The purpose of the research was to investigate how different medium can result in

distinct media effects in terms of language learning. For manipulation check, we conducted the questionnaire to measure immersion level of how participants perceived differently in the medium. The immersive environment creates a strong sense of presence (Huang, Rauch, & Liaw, 2010). The three questions (α = .76) for immersion such as the content that I participated seems to be immersive were asked (see Appendix a). Bipolar Likert scale from 1 to 7 was applied to this question. The result showed there is significant difference (F (1,62) = 15.90, p <.001, η_p^2 = .20). While mean value on desktop-based module was 4.94 (SD = 1.24), the mean value of virtual reality HMD-based module was 6.00 (SD = .81). Therefore, each group perceived immersion level differently depending on medium (i.e., desktop monitor vs. VR HMD).

In the module, we created a school background where everybody has an experience of 20 school items since background factors have a significant impact on the process of second language learning in a technology supported environment (Liu, Moore, Graham, & Lee, 2002). The items consisted of two Korean phonetic alphabets. The participants will have interaction with two stimuli. One interaction is with text cue cards and another is with a humanoid avatar. When participants go near the object, the Korean cue cards will pop-up above the object. The process of avatar interaction module was adopted from a single user VR system, “designed to teach Japanese prepositions” by Rose and Billinghurst (1995). The Korean teacher avatar appears and speaks Korean words if the user goes near to the object.

Figure 2. Two different interactions (left: text interaction, right: social agent interaction)

The participants were randomly assigned two different conditions: desktop monitor-based learning and virtual reality HMD-based monitor learning. Before conducting the experiment, all participants played a short tutorial content by using each condition's technology. This procedure was to eliminate (1) bias from different technology proficiency, and (2) novelty effect.

In the experiment, the participants played two different contents. Participants were randomly assigned to different medium condition (i.e., computer monitor based learning and virtual reality HMD based learning). The participants in both conditions experienced text interaction module and social agent interaction module. After experiencing both contents, the participants took a set of questionnaires to measure immersion level, interactivity, and intrinsic motivation.

Figure 3. Appearance of the experiment (left: desktop monitor-based condition, right: VR HMD based condition)

In this study, sixty-four university students (age 18 - 65, M = 27.28; SD = 8.02) were recruited, except two participants (doctor, English teacher). Those who have any prior experience of learning the Korean language were eliminated from this study. Each group had 32 participants per the condition.

First, perceived interactivity (PI) was measured by ten items which were adapted from

the research of Skalski and Tamborini (2007) and Huang, Rauch, and Liaw (2010). The questions included, “I felt like pop-up cards were interacting with me,” “I felt like a teacher had taught me,” “I felt like teacher avatar used voice to communicate with me” (α = .81). Second, intrinsic motivation (IM) is defined as Deci and Ryan (1980) as “Intrinsically motivated behaviors are those behaviors that are motivated by the underlying need for competence and self-determination”. The six items used to measure intrinsic motivation entailed asking how their attitude is changed in terms of learning Korean, “After interacting with the module, I want to learn Korean more” (α = .83).

RESULTS

H1 predicted that perceived interactivity and intrinsic motivation are higher in VR HMD condition than those in desktop monitor condition. To measure the differences, ANOVA was used in this analysis. The results showed that there are significant differences in (H 1-1) perceived interactivity (F (1,62) = 7.66, p < .01, η_p^2 = .11), (H 1-2) intrinsic motivation (F (1,62) = 4.50, p <.05, η_p^2 =.07) between two conditions (see Table 1). Therefore, H1-1 and H1-2 were supported.

Table 1

ANOVA of dependent variables

	Desktop		VR HMD				
DVs	*M*	*SD*	*M*	*SD*	*F* (1,62)	η_p^2	*p*
PI	4.88	.76	5.5	.94	7.66**	.08	.00
IM	4.57	1.15	5.12	.92	4.50*	.03	.04

Note2. *p < .05, **p < .01, two-tailed.

H2 predicted that perceived interactivity and intrinsic motivation are positively

correlated, depending on the medium. Pearson correlation was used for the analysis of H2. Perceived interactivity and intrinsic motivation were significantly correlated, $p < .01$. As Evans (1939) suggested for the absolute value of r, the correlation between perceived interactivity and intrinsic motivation was $r = .46$ considered as moderate positive correlation.

RQ 1 was that perceived interactivity mediated the relationship between medium and intrinsic motivation. To examine this aspect, the Parallel Mediation Analysis was used (see Figure 4). The Process macro in SPSS (Preacher & Hayes, 2008) was employed to measure both direct and indirect effects. First, it was found that medium was positively associated with intrinsic motivation ($B = .55$, t (62) = 2.12, $p < .05$). It was also found that medium was positively associated with perceived interactivity ($B = .59$, t (62) = 2.77, $p < .05$). Lastly, results indicated that the mediator, perceived interactivity, was positively associated with intrinsic motivation ($B = .49$, t (62) = 3.47, $p < .001$). Because both the a-path and b-path were significant, mediation analyses were tested using the bootstrapping method with bias-corrected confidence estimates (MacKinnon, Lockwood, & Williams, 2004; Preacher & Hayes, 2004). The confidence level of the indirect effects was 95 % obtained with 5000 bootstrap resamples (Preacher & Hayes, 2008). Results of the mediation analysis confirmed the mediating role of positively perceived interactivity in the relation between medium and intrinsic motivation ($B = .29$; CI = .08 to .67). In addition, results indicated that the direct effect of medium on intrinsic motivation became non-significant ($B = .26$, t (62) = 1.02, $p = .31$) when controlling for positively perceived interactivity, thus suggesting full mediation.

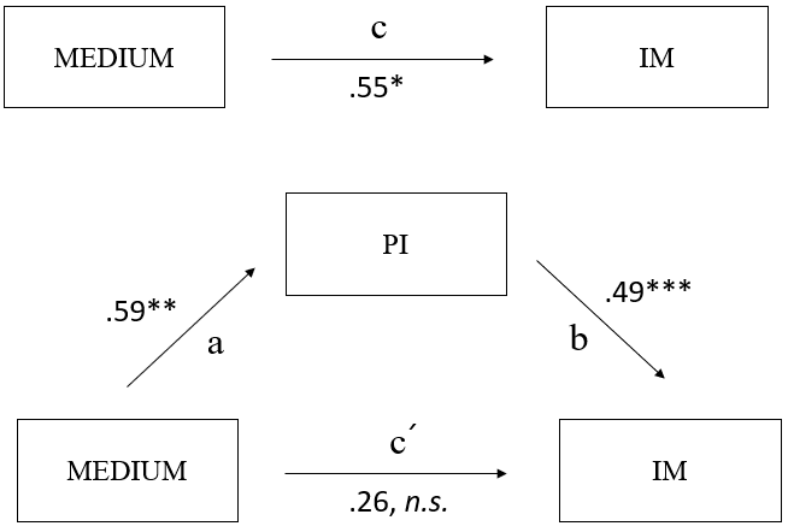

Figure 4. Direct and Indirect Effects of intrinsic motivation on perceived interactivity in medium. Numbers are standardized regression coefficients (Preacher & Hayes, 2008). Significance levels are as follows: *: $p < 0.05$, **: $p <.01$, ***: $p <.001$, *n.s.*: non-significant.

CONCLUSION

The study aimed to examine the underlying problem of how Perceived Interactivity (PI) affects intrinsic Motivation (IM) in the different medium by using Korean learning module. We affirmed using virtual reality HMD has a higher PI and IM than using the desktop in second language learning. It can be explained that because VR has more 3-D elements which generate spatial recognition, this highly increased spatiality might affect PI level. Also, Teo, Lim, and Lai (1999) assert that IM can be as similar as a measurement of enjoyment. Thus, perceived 3-D aspects connect to enjoyment element. In addition, even though the correlation between two measured variables showed moderate positive correlated, the mediation analysis presented the PI fully mediated IM, which means PI is a core to lead IM. In other words, to increase PI, a medium is important, and this PI affected IM to allow students' active learning, especially learning Korean in virtual reality environment.

However, there are limitations to be considered in the future study. In the experiment,

we did not measure interaction separately, meaning that we do not know exactly which interaction is more effective to be used in language learning. Thus, for future study, research can elaborate manipulating a different type of the interaction such as narration, object, text, and video. Also, this is not fully language learning module. We used Korean vocabularies to measure Immersion, PI, and IM. This module simulated the components for a language beginner. For the next research, different learning level can be included such as learning grammar.

In conclusion, this empirical study explored instructional design features of the virtual learning environment in terms of Perceived Interactivity (PI) and Intrinsic Motivation (IM). We expect that VR technology will now be employed more in education technology field as compared to the past. As the current generation is constituted of digital natives, they are easy to adopt and use the latest technology (McNeely, 2005). It is important for not only current students but also next generations to design the proper VR educational content. In other words, VR content creators should create language content more enjoyable and interactive so that intrinsic motivation can be increased (Rauch, 2007; Sims, 2007). This can be attributed to the fact that motivation is considered as the primary factor in influencing student's interest in the course and it is a fundamental requirement for effective learning (Sutcliffe, 2003). Thus, in terms of instructional design, this paper will take a guiding role to show why the interactions are needed and how we can apply it to increase motivation for language learning in VR environment.

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Appendix A.

Questionnaire

Section A (Immersion)

Please circle the option that best describes your **overall experience**.

1. The classroom seems to be more like:

2D	1	2	3	4	5	6	7	3D

2. The content that I participated seems to be immersive.

Not at all	1	2	3	4	5	6	7	Very much

3. I have a stronger sense of ….

Being elsewhere	1	2	3	4	5	6	7	Being in the classroom

Section B (Perceived Interactivity)

Please circle the option that best describes your **response to the interaction.**

1. I felt like pop-up cards were interacting with me.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

2. I felt like the cue cards were easy to remember.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

3. I felt like it was like learning a game.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

4. I felt like a teacher had taught me.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

5. I felt like teacher avatar was interacting with me.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

6. I felt like teacher avatar used his voice to communicate with me.

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

7. I felt like I was learning the language with the teacher together.

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

8. I felt like I was engaged in the learning module program.

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

9. I felt like the learning program led me to learn Korean

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

10. I felt like it was easy to interact with the program

Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

Section C (Intrinsic Motivation)

Please circle the option that best describes **how you perceived the experience**.

1. After interacting with the program, I want to learn Korean more.

Strongly disagree 1 2 3 4 5 6 7 Strongly agree

2. After interacting with the program, I am confident in learning Korean vocabulary.

Strongly disagree 1 2 3 4 5 6 7 Strongly agree

3. I prefer to learn Korean with the program than attending school.

Strongly disagree 1 2 3 4 5 6 7 Strongly agree

4. Using the module increased my language learning skills.

Strongly disagree 1 2 3 4 5 6 7 Strongly agree

5. I found the module useful for my future language learning.

Strongly disagree 1 2 3 4 5 6 7 Strongly agree

6. I think the module enhanced my efficiency of learning a language (e.g., vocabulary).

Strongly disagree	1	2	3	4	5	6	7	Strongly agree

Section D (Demographics)

1. How much do you know Korean?

Not at all	1	2	3	4	5	6	7	Very much

2. Have you ever experienced virtual reality?

First time	1	2	3	4	5	6	7	Very experienced

3. How comfortable are you with using a personal computer?

Totally uncomfortable	1	2	3	4	5	6	7	Totally comfortable

4. Age: ( )

5. Gender: *circle one* – Male / Female

6. Major : ( )

7. How many languages can you speak? ( )

   Which languages? ( )

8. Race/Ethnicity check all that apply

   White_____

   Black/African American____

   Asian_____

   Native American/Alaska Native_____

   Other (please specify)_____