Figure 1: Overview of a shared learning space of an IVE.

Preliminary studies-Measures

Intrinsic motivation: To confirm the psychological responses to the learning climate, we asked the participants' intrinsic motivation using Intrinsic Motivation Inventory (IMI) in the post-session. IMI is comprised a forty-five-item questionnaire consisting of six sub-scales (i.e., interest/enjoyment, perceived competence, effort/importance, pressure/tension, perceived choice, value/usefulness, and relatedness). All items were measured on a seven-point Likert-type scale ranging from one = "not at all true" to seven = "very true."

Beyond Learning Alone – How Other Learners Affect Self-Study in IVE

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Abstract

For most learners, appropriate learning environments selected for self-study (e.g., libraries) are helpful in sustaining self-regulated learning. In order to provide learners with appropriate self-study spaces, we examined an immersive virtual environment (IVE) for English phonemes acquisition practice. Social settings of learning environment sometimes yield positive effects, but sometimes not. To assess the influence of other learners being present in a space against learning behaviors towards the continuous skill development of learners, we have conducted several exploratory studies. In this paper, we shared preliminary study results, to discuss the influence of shared space with other learners in the IVE. After the 10-day self-regulated English practicing class, we observed positive influences on intrinsic motivational factors; however, persistent self-regulated learning effort did not necessarily result in such a shared learning space.

Author Keywords

IVE; Intrinsic Motivation; Self-Regulated Learning; English Phonemes Acquisition.

CSS Concepts

•Human-centered computing~Human computer interaction (HCI)~Interaction paradigms~Virtual reality;

Preliminary studies-Measures ***Self-regulated learning efforts:*** In order to estimate how a learning climate foster participants' effort towards self-regulated phoneme acquisition, we calculated *each session's recorded phoneme ratio by a user over voice recognition system as a* ***recorded phoneme score (RPS)*** for each phoneme item of forty-two-phoneme.

For example, if a unique word occurrence in a Session-X's text including the phoneme '*w*' was registered as 4 (i.e. 'would', 'between', 'one', 'requires'), the situation observed as "User Alice's RPS for the phoneme '*w*' was 50 for a Session-X" means that Alice recorded 2 words included in the registered list in the Session-X over the system. The reasons why the rest of registered words not being recorded would not be affected from only the leaning climate but also the situation such as a voice recognition environment. However, we think the RPS can be a measure that is being reflected participant's self-regulated learning efforts.

Introduction

For most learners, selecting appropriate learning environment is important for sustaining self-regulated learning. Depending on learners' preferences, such environments range from isolated spaces (e.g. a closed space in a library) to public spaces (e.g. a street for dancing practices). Literatures show that social environment in a learning space, i.e., existence of other people, sometimes yield positive effects [6]. However, people in a same space sometimes negatively impact psychological safety, in turn, pose challenging learning behaviors [1,4]. Similarly, while Immersive Virtual Environment (IVE) is expected to be an effective environment for distance learning, Meng-Yun et al. discussed that designers of IVE classrooms should consider the tradeoff between learning experience and social interactivity [3]. For example, an IVE full of friendly peers may be comfortable environment, but it may also hinder his/her challenging learning behaviors. Therefore, our research question is:

RQ: How does other learners being present in an IVE affect a learner's self-regulated learning behaviors?

System

Figure 1 and Figure 2 show the overview of the IVE we developed. Specifically, the IVE is designed for phonemes acquisition practice. We used a voice recognition device (VRD)[1] to measure a learner's RPSs (see "Measures" the sidebar) and showed those to the learner as a feedback of his/her learning progress. Each participant wore a head-mounted display (HMD), through which the learner could observe the IVE and his/her own body from a first-person perspective. We

[1] Google Home; And Dialogflow, https://dialogflow.com/

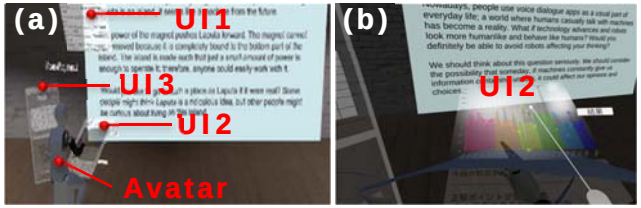


Figure 2: IVE overview – (a) is an overview of an IVE and (b) is a first-person perspective of an avatar watching a desktop board (UI2). Recently pronounced words are shown on an overhead board (UI1). Each dot of the line graph on UI2 is plotted the RPS of each phoneme item. UI3 is a lookup table showing the guidance to pronounce various phonemes.

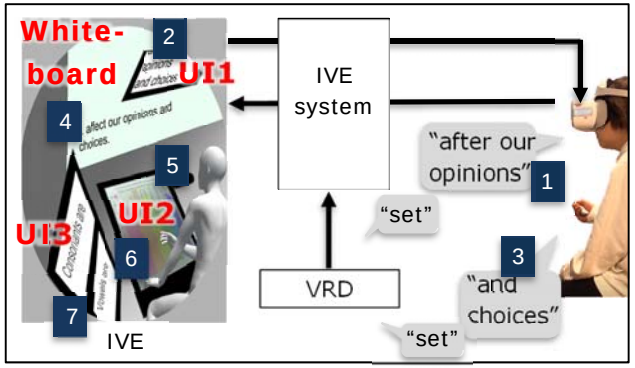


Figure 3: System use case.

used a six-degree-of-freedom standalone VR HMD[2] to allow participants a full range natural motion. Participants' real-world movements were synchronized with their avatars' motions.

General use case is as follow (numbers in the parentheses and user interface numbers (i.e. UI1, UI2, UI3) correspond with those shown in Figure 3). After an

[2] Lenovo Mirage Solo with Daydream

Participants' English skill level: Pre-intermediate

Difference between Study 1 and 2: Study 1 was conducted at the laboratory using the solitary IVE. All the participants practiced seven English texts. In Study 2, each learner logged in to the shared IVE from his/her home. The number of English texts that the participants practiced varied from nine to twenty-nine.

Contents of the English text: Each text consisted of 150 to 180 words so that participants with pre-intermediate English skill level could read it generally in less than three minutes.

Pre/post session: A pre-test and a post-test were conducted at a laboratory using the solitary IVE. English content used as a test content was a same text in both of Study 1 and Study 2.

Table1: Overview of preliminary studies

English text is displayed on the whiteboard in the IVE (in this case, '... affect our opinions and choices.'), a learner launches the VRD using a wake-up phrase and starts to read the text. By recognizing the short silence after the learner's voices, for example, "affect our opinions," the VRD responses with a word "set" (1) and the IVE system shows the recognized phrase in the UI1 (2). Then, the learner continues to read the text "and choices" (3, 4). The learner can check his/her RPSs by pressing a button on the UI2 (5) and displaying a line graph (6). To figure out which phonemes need further practices, the learner sees the UI3 (7).

Preliminary studies

In this paper, we present two preliminary studies. In Study 1, we observed self-regulated learning in a solitary IVE as data for reference. And to examine characteristics of self-regulated learning behaviors in the shared learning space, in Study 2, we designed a shared IVE for small practice class. Each participant of these studies basically conducted a self-regulated reading practice for phoneme acquisition. Table 1 shows the overview of the two studies.

Study 1 – Solitary IVE. We recruited ten participants (five males and five females). We asked them to practice English phoneme alone in the IVE. The English texts displayed on the whiteboard changed automatically every six minutes. Participants completed the whole task in less than 60 minutes. Even though the displayed text changed automatically after every pre-determined time slot, natural use included taking short breaks at any point between task beginning and task end and was not limited to after participants finished reading each English text.

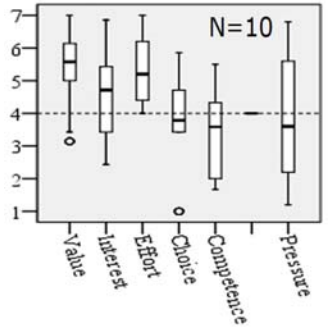
Study 2 – Shared IVE. Seven participants (five males and two females) were recruited for Study 2 and we asked them to practice in the shared IVE with other participants. One native speaker also participated in the IVE and played a role of an instructor. The class was held for ten days in total and the participants were asked to attend at least five days. On each day of participation, they could study maximumly three texts led by the instructor. The study included not only self-regulated readings but also shadowing practices. Since other participants were in the same IVE simultaneously and moreover their practicing voices were audible, the learning environment in the IVE was somewhat noisy.

Results

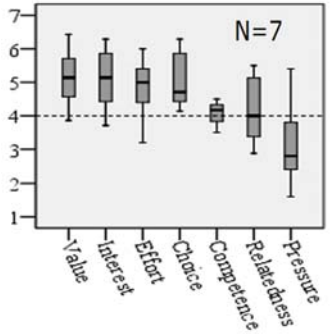
Due to the limited number of participants and the conditions of two studies being very different, we do not compare these studies statistically. In this paper, we present our thoughts based on the results of the experiments.

Intrinsic motivation[5] (see “Measures” the sidebar)***:*** Figure 4 shows the intrinsic motivation of the participants which was asked by a questionnaire during the post-session. We are interested in the higher level of perceived competence that the lower quartile of competence was higher in the shared IVE compared with the solitary IVE.

Self-regulated learning efforts *(RPSs;* see “Measures” the sidebar***):*** Figure 5 shows the RPSs in the post-test for both studies. In the figure, we grouped the participants into three, two participants who took the lowest RPSs (lower2), two participants who took the highest RPSs (upper 2), and the rest



(a) Solo IVE (Study 1)

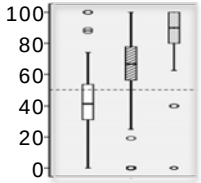


(b) Shared IVE (Study 2)

Figure 4: Boxplot of the intrinsic motivation.

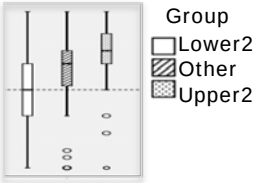
(other). The interesting thing is that the RPSs of upper2 in Study 2 was not higher than those in Study 1.

N = 10
for each 42-phoneme



(a) Solo IVE (Study 1)

N = 7
for each 42-phoneme



(b) Shared IVE (Study 2)

Figure 5: Boxplot of the RPSs in the post-test.

Discussion and conclusion

In this paper, we introduced the preliminary studies. We found that, if learners learned literally alone in the IVE, they had potential feelings of incompetence. In the small practice class in the IVE designed to facilitate immersive co-present experiences, the learning climate exerted from the other learners seems to have a good influence on intrinsic motivational factors. In the Study 2, almost all of the learners' perceived competence were positive. According to the Dunning–Kruger effect [2], people in groups, including those in the bottom and top quartiles, estimate their ability and performance as above average. We think people's above average feeling in groups might mitigate perceived incompetence, especially for people in the bottom quartiles. This could lead to a better learning experience that fosters long-term self-regulated learning, at least more so than solo learners having potentially feelings of incompetence.

Regarding how a learning climate could lead to positive learning efforts, the environment in which learners were surrounded by other learners was not necessarily better than the solo environment. The reasons why the shared IVE was not better for self-regulated learning are not clear from the preliminary studies, but one of the reasons might be related to the lower attentiveness of learners among other noisy learners.

Our next step is to consider how we can design an appropriate IVE for self-regulated learning that incorporate the strengths of both of a solitary environment and a shared environment.

References

[1] Marion Dadds. 1993. The feeling of thinking in professional self - study. *Educational Action Research* 1, 2: 287–303.

[2] Justin Kruger and David Dunning. 1999. Unskilled and unaware of it: how difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of personality and social psychology* 77, 6: 1121.

[3] Liao Meng-Yun, Sung Ching Ying, Wang Hao-Chuan, and Lin Wen-Chieh. 2019. Virtual Classmates: Embodying Historical Learners Messages as Learning Companions in a VR Classroom through Comment Mapping. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*.

[4] Stephen W. Porges. 2011. The polyvagal theory: neurophysiological foundations of emotions, attachment, communication, and self-regulation. W. W. Norton, New York.

[5] The Center for Self-Determination Theory (CSDT). Intrinsic Motivation Inventory (IMI). Retrieved from https://selfdeterminationtheory.org/intrinsic-motivation-inventory/

[6] Gregory M Walton, Geoffrey L Cohen, David Cwir, and Steven J Spencer. 2012. Mere belonging: The power of social connections. *Journal of personality and social psychology* 102, 3: 513.