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Development of a Chinese Language Learning Content Based on Mixed Reality Technology

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Abstract: This thesis focuses on the design of a Chinese learning system developed using the Unity platform and experiments to test the validity. The validity of the Mixed Reality (MR) learning system was verified by examining the learners' Chinese test levels before and after learning with the MR system, as well as the general affective scale and behavioral engagement and emotional engagement scale for each section of the learning. The results were that learning through the MR system resulted in a significant increase in comprehension and a higher level of positive emotion in the game session with physical participation than in the pronunciation session alone. However, due to the current too small sample size, there was an intentional difference in the overall validity of the negative and emotional engagement. Still, none of the multiple comparisons found a calculated difference.

Keywords: Chinese language learning, Mixed Reality, student engagement

1. Introduction

MR (Mixed Reality, MR) is a technology that adds virtual computer graphics to the real world. And it is a broader category of virtual reality technology (VR) that integrates virtual and natural environments (Maas & Hughes, 2020). Differently from Virtual Reality (VR), which immerses people in a virtual artificially created world (Carmigniani et al., 2011), and Augmented Reality (AR), which presents information by overlaying virtual content on the real world (Azuma, 1997), MR allows users to experience and interact with virtual objects and is highly overlaid with the real and has specific physical properties (Holz et al., 2011). Learning through the MR platform can increase the learner's motivation to learn through the interactive engagement of the body with virtual objects (Lindgren & JohnsonGlenberg, 2013). Moreover, MR technology can amplify the learner's learning experience and provide feedback that cannot be easily obtained in the real world alone (Ohta & Tamura, 1999). Still, there are no studies on Chinese language learning, especially among Japanese learners. Secondly, in recent years, the study mentioned the increasing number of Japanese people learning Chinese (Hirai, 2015). Still, the current Chinese learning, pronunciation, words, and sentences, especially the difficulty of listening and speaking, are the pain points that need to be solved (Liang & Wang, 2022). There are many studies on teaching and learning using multimedia participation to solve related problems because education with multimedia participation can improve learners' engagement, which is called academic engagement or student engagement, or school engagement in the paper (Taylor & Parsons, 2011).

The purpose of this study was to allow learners to learn independently with the MR system installed on HoloLens2 and to validate the effectiveness of the MR system by using general affective scales and engagement scales to measure and test Chinese knowledge comprehension before and after the experiment, respectively.

2. Development

This learning system is developed based on the Unity platform (ver.2019.4.29f1c2). And the system has been developed and integrated using MRTK. The system is divided into six modules in total. This system is designed and integrated based on ARCS theory (Keller, 2016).

The development system's six parts are S0, S1, S2, S3, S4, and S5. S0 communicates the story's background and the MR system's learning objectives with a panda character, "Wang pangpang," who appears in every part of the system and whose function is to provide timely feedback to learners on their learning outcomes. For example, in S0, he is responsible for explaining the course objectives and the story's background, while in S1 to S5, all provide timely feedback on learners' correctness and errors. If correct, the panda will walk up to the learner, perform a random dance move, and give a bilingual "awesome!" If the learner makes a mistake, the panda will say, "What a pity. What about trying again?" The S1 part is to learn the words through the windows system's speech-to-text function, the UI interface; the learner can use the "play" button to play the standard pronunciation, then press the microphone below to follow the pronunciation. After reading, the recognized Chinese words will appear on the left side of the interface and compared with the familiar words; the correct part is green; if wrong, the recognized Chinese words have no color. There is a playback button next to the recording button so that learners can listen to their pronunciation, compare it with the standard pronunciation, and keep learning to imitate it. The UI interface is similar to S1; learners can listen to the standard pronunciation, follow the accent, and see if the pronunciation is correct after recognition. The part without correct pronunciation has no color display, so learners can know which part of it their pronunciation is wrong. The S4 part is to learn the sentence's meaning by interacting with the 3D model in the MR system. The S5 section is a test of learning, where the sequencing of questions is turned into an MR format, and the learner learns from doing rather than relying on their native language. The questions are in MR format, and learners build blocks by placing the right words in the right places and then pressing the last OK button, and the characters on the blocks turn green if they are correct and red if they are wrong, thus learning and trying to make mistakes in sentence grammar.

3. Methods

To validate the effectiveness of the developed MR Chinese learning system, we installed the system in HoloLens2. We conducted a validation experiment with seven students from W university (5 male and 2 female, average age=26.4, SD=5.83). The materials used were the General Affective scale (Ogawa et al., 2000), which consists of three factors, Positive Affect (PA), Negative Affect (NA), and Calmness (CA), with a total of 24 items (8 items for each). The respondents were asked to answer these 24 items using a 4-point scale, with one indicating that they "do not feel at all" and four suggesting that they "feel very much. The Behavioral engagement and Emotional engagement scales of the Student Engagement Scale (Skinner, et al., 2009) asked students to respond subjectively to changes in engagement at each stage of learning. The current experiment consisted of two factors, Emotional engagement (5 items) and Behavioral engagement (4 items). Since there was no discussion and collaboration in this experiment, the question "When I'm in class, I participate in class discussions." in Behavioral Engagement Scale was deleted. The participants were asked to respond to a 4-point scale, with 1 being "not at all applicable" and 4 being "very applicable." And a pre-test and post-test of Chinese knowledge for the participants. The subjects were asked to answer the general mood questionnaire and the engagement questionnaire each time they performed S1 to S5, except for the part of S0 (introduction to the learning objectives and story background). The same Chinese knowledge test paper was administered before and after the experiment to test (Full score of 21 points) the learning outcomes.

4. Results

Figure 1 shows the average scores on the comprehension test. According to the result of the one-way analysis of variance, the main effect indicates a significant difference (F [4,24] = 3.30, p<.05). Multiple comparisons using the Bonferroni method, the results were not found to be substantial. According to the result of the one-way analysis of variance, no significant differences were found in behavioral engagement. A one-way analysis of variance was conducted on the on the comprehension test results of the General Affective scale. For the PA scale, the main effect was significant (*F* [4,24] =3.17, *p*<.05), Multiple comparisons in the Bonferroni method showed that S2 was statistically significantly higher between S2 and S3 (*p*<.05). In the NA scale, the main effect was significant (*F* [4,24] =3.36, *p*<.05), results with multiple comparisons in the Bonferroni method were not found. On the CA scale, the main effect was significant (*F* [4,24] =2.27, *p*<.10), but no results were found for multiple comparisons in the Bonferroni method. The mean of the pre-test scores was 9.71 (standard deviation = 6.36, range 3-20), and the mean of the post-test scores was 19.14 (standard deviation = 1.36, range 17-21). t-test results showed that a significant difference was found between the pre-test and post-test scores (*t* [6] = 3.87 *p*<.01).

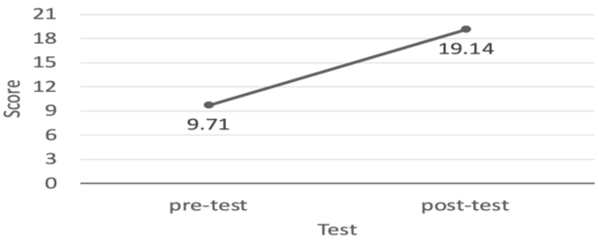

Figure 1. Average points of learners' scores

From the results of the above data analysis, we can currently draw the following conclusions: By using MR Chinese Learning System, learners can learn Chinese effectively. Regarding learners' emotions, positive emotions were significantly higher in the S2 part of the game with physical involvement than in the S3 part, which was purely a pronunciation exercise; therefore, interactive learning games with physical involvement in the MR system helped to increase learners' positive emotions towards learning. Due to the small sample size, there was an overall valid difference in negative affect and emotional engagement. Still, no intentional difference was seen in the individual multiple comparisons, so the study was continued and validated with a larger sample size in subsequent studies. Since all learners were active participants in the experiment this time, the behavioral engagement was high and did not differ significantly. The study will continue in future research in a multi-person classroom.

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