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The Development and Evaluation of a Gamified Virtual Heritage Tour for Cultural Learning: A Perspective of Cognitive and Affective Immersive Learning

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Abstract: This study aimed to integrate gamified mechanism into the design of a web-based virtual heritage tour for cultural learning. There were five core drives of gamification used in this study including (1) *epic meaning & calling*, (2) *development & accomplishment*, (3) *empowerment of creativity & feedback*, (4) *ownership & possession*, and (5) *unpredictability & curiosity*. With 40 post-secondary students' survey responses, we also evaluated the virtual tour from the perspective of cognitive and affective immersive learning. The results showed that the students expressed stronger cognitive perceptions (cognitive benefit) than affective senses (spatial presence and flow experience) when engaging in the gamified virtual heritage tour. The crucial role of the affective variables rather than the cognitive variable in learners' perceived learning outcomes was also identified. The research data of this study has been continuingly collected. We also indicated several directions for this work in the future.

Keywords: Gamification, virtual reality, heritage, cultural learning, presence, flow

1. Introduction

Past research has indicated the significant role of virtual reality (VR) technology in cultural heritage education (Carrozzino & Bergamasco, 2010; Sylaiou et al., 2010). With the affordance of VR, cultural heritage could be reconstructed in the virtual world for the cultural preservation and communication, particularly for the purposes of cultural learning. Virtual tour, a VR application for users to virtually navigate certain places without physical visit has been increasingly exploited to the field of cultural heritage tourism (Debailleux et al., 2018; Guan et al., 2020). Previous studies addressed that the virtual heritage tour was able to enhance users' attention and motivation to cultural learning (Han et al., 2020; Poux et al., 2020), as well as to foster their understandings of intangible cultural knowledge (Mah et al., 2019). However, it has been argued that simply navigating in spherical video-based (also known as VR360) virtual environments without interaction with cultural contexts could not remain intention to engage in virtual tours and may not acquire in-depth cultural understandings. The integration of gamification into the design of virtual tour was therefore suggested by a recent study (Argyriou et al., 2020). Following the ideas, this study considered that the design of a gamified virtual heritage tour for cultural learning should be explored.

The issue regarding learners' perceptions of immersive learning when engaging in virtual learning environments has been noted in recent VR research. For example, Makransky and Lilleholt (2018) identified the essential role of several cognitive and affective variables in learners' perceived learning outcomes. It was found that, in a cognitive path, the learners' perceptions of cognitive benefit significantly predicted their perceived learning outcomes. On the other hand, the variable of presence was an antecedent to the perceived learning outcomes in an affective path. Similar findings were found in the research of spherical video-based virtual museum navigation, indicating the importance of affective perceptions such as spatial presence in behavioral attitudes (Cheng, 2021). Moreover, researchers have paid attention to explore to what extent that learners were involved in in the context of game-based

learning through the evaluation of flow experience. In general, individuals' flow experience was documented its benefits for learning engagement and outcomes (Perttula et al., 2017).

In sum, the purpose of this study was to develop a gamified virtual heritage tour application for cultural learning in the context of Taiwanese culture. To evaluate the gamified virtual heritage tour developed by this study, we aimed to include the cognitive variable of cognitive benefit and the affective variables of spatial presence and flow experience to examine how these variables influence learners' perceived learning outcomes (i.e., perceived learning and behavioral intention) through the perspective of cognitive and affective immersive learning.

2. Method

2.1 The gamified virtual heritage tour application

With the utilization of spherical video-based VR techniques (VR360), this study developed a web-based virtual tour application for cultural learning of a Taiwanese heritage commemorating a famous woman with chastity in Taichung County. As shown in Figure 1, learners can freely transport to certain positions of the heritage and observe the panoramic scenes. Several hot spots on the scenes can be interactively triggered for attaining additional information such as the cultural background of the heritage and the features of the heritage in details.

To enhance learning motivation for the cultural knowledge, this study integrated the Octalysis gamification mechanism (Chou, 2015) into the design of the virtual tour application. Specifically, there were five core drives of gamification used in this study including (1) *epic meaning & calling*, (2) *development & accomplishment*, (3) *empowerment of creativity & feedback*, (4) *ownership & possession*, and (5) *unpredictability & curiosity*. For instance, for achieving the goal of *epic meaning & calling*, learners act as an explorer to accomplish the tasks which the virtual tour assigned to. Through the design of *unpredictability & curiosity* and *empowerment of creativity & feedback*, there were several puzzles situated in the virtual scenes for learners to seek, solve, and acquire feedback hints for understanding the cultural context of the heritage. Learners can also increasingly collect badges by solving the puzzles for achieving the gamified drives of *development & accomplishment* and *ownership & possession.*

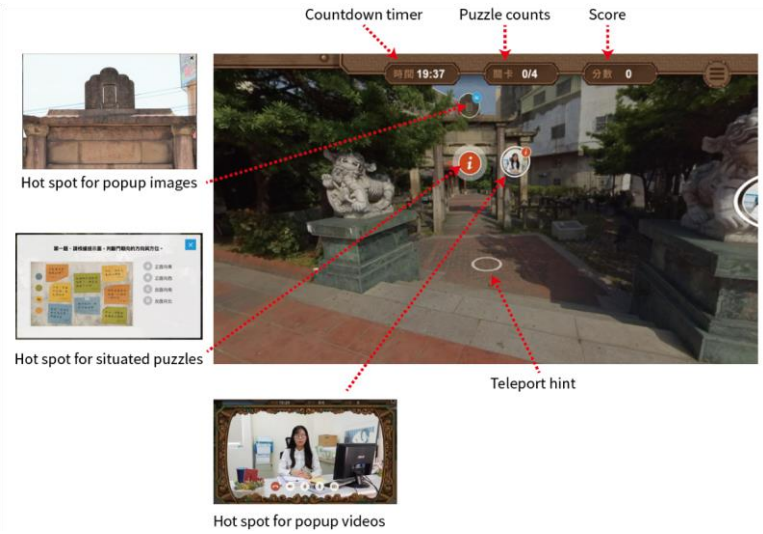

Figure 1. The interface of the gamified virtual heritage tour application.

2.2 Respondents and research procedure

This study recruited 40 post-secondary students (22 females and 18 males) to participant in the virtual heritage tour for cultural learning. The mean age of the students was 25.38 years old (*SD*=6.17). Firstly, the students were invited to freely use the virtual tour application through desktop PCs. The average duration for the virtual cultural learning was approximately 20 minutes. The students were required to respond to the questionnaire of this study (described later) for understanding their cognitive and affective perceptions of immersive learning.

2.3 Instrument

The scale of *spatial presence* used in Cheng's (2021) study and the scale of *flow experience* used in Kim and Ko's (2019) study were adopted to examine the students' affective perceptions of immersive learning. Moreover, this study adopted the scale of *cognitive benefit* used in Makransky and Lilleholt's (2018) study to probe their cognitive perceptions of immersive learning. The scales of *perceived learning* and *behavioral intention* (Makransky & Lilleholt, 2018) were also adopted to understand how the students' cognitive and affective perceptions of immersive learning influenced their perceived learning outcomes. All the scales were measured on a five-point Likert scale ranging from strongly disagree (1 point) to strongly agree (5 points). The Cronbach's α of these scales were all higher than 0.7, indicating the acceptable reliability of the measurement in this study.

3. Results and discussion

The results of the repeated ANOVA analysis for the students' cognitive and affective perceptions of immersive learning showed that their perceived cognitive benefit (M=3.99, SD=0.74), perceived learning (M=3.79, SD=0.74), and behavioral intention to visit the physical heritage (M=3.74, SD=0.85) were significantly stronger (F=8.81, p<.001) than their affective perceptions of immersive learning such as flow experience (M=3.49, SD=0.88) and spatial presence (M=3.61, SD=0.94). Further correlation analysis for the variables of cognitive and affective immersive learning in this study revealed that there were significant relationships among the students' flow experience, spatial presence, cognitive benefit, perceived learning, and behavioral intention. Subsequent results of the stepwise regression analysis showed that the students' affective perceptions of flow (β=0.51, p<0.01) and spatial presence (β=0.40, p<0.01) rather than cognitive perceptions significantly predicted their perceived learning in the context of virtual heritage tour, with 71% of explained variance. The students' willingness to visit the physical heritage was significantly predicted only by their flow experience (β=0.81, p<0.001) in the learning activity, with 64% of explained variance.

To summarize, although the students expressed stronger cognitive perceptions than affective senses when engaging in the gamified virtual heritage tour for cultural learning, this study identified the crucial role of the affective variables (flow experience and spatial presence) rather than the cognitive variable (cognitive benefit) in learners' perceived learning outcomes. The findings of this study were similar to the results addressed by the previous VR research (e.g., Parong & Mayer, 2018). The research data has been continuingly collected for this work. With a large sample size, the structural relationships among the variables of this study could be examined through structural equation modeling analysis for verifying the cognitive affective model of immersive learning (CAMIL) proposed by Makransky and Petersen (2021). We also attempt to examine the instructional effectiveness of the gamified virtual heritage tour for cultural learning through the experimental research design (e.g., gamification vs. non-gamification) in the future.

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