EXPLORING THE IMPACT OF AUGMENTED REALITY ATTRIBUTES OF THE HANDHELD AR APPLICATIONS FOR MUSEUM GUIDANCE ON VISITORS' RECOMMENDATION INTENTION

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INTRODUCTION

Museums in China have witnessed an increase in the adoption and use of handheld augmented reality (AR) applications for museum guidance due to the development of innovative technologies and the COVID-19 pandemic (Do et al., 2020). Developed by the National Cultural Heritage Administration of China and China Mobile, a handheld AR application for museum guidance called 'AR Exploring Mirror' was applied to Anhui Museum in early 2020 and later in more museums. According to the statistics of Anhui Provincial Museum in 2021, it is known that the number of visitors who experienced handheld AR applications for museum guidance reached 5,285 in 2020. In this study, the handheld AR application for museum guidance refers to the handheld device with see-through displays provided by museums (Van Der Vaart & Damala, 2015), which can show visitors 3D images of the surrounding environment, combining natural and virtual elements, and provide a better understanding of artefacts (Schmalstieg & Wagner, 2005).

With more studies focused on the experience of the handheld AR application for museum guidance (Loureiro et al., 2020), AR attributes are considered critical factors in providing a good experience for visitors (Han et al., 2018). Given that AR has distinct characteristics, which include (1) the integration of virtuality and reality, (2) real-time interaction, and (3) 3D registration, exploring how AR attributes of the handheld AR application for museum guidance influence experience and subsequent behavioural intention is imperative (He et al., 2018). While prior studies have paid more attention to continuance intention, the relationship between recommendation intention and AR attributes remains to be further explored.

This study attempts to understand the mechanism of how AR attributes of the handheld AR application for museum guidance influence recommendation intention. This study uses the Stimulus-Organism-Response (SOR) framework to build the research model, including AR attributes as a stimulus, perceived usefulness and enjoyment as an organism and recommendation intention as a response. Several research questions are stated: (1) Which AR attributes will affect perceived usefulness and enjoyment? (2) What is the relationship between perceived usefulness, enjoyment and recommended intention? (3) Do perceived usefulness and perceived enjoyment trigger mediating effects between AR attributes and recommendation intention? For contributions, this study may provide strategies for system developers to enhance the experience and recommendation intention by improving AR attributes of the handheld AR application for museum guidance.

Interactivity, vividness, novelty and augmentation quality are AR's unique attributes in the cultural heritage tourism context (Javornik et al., 2019). Given that the AR presentation system in the museum context is similar to that in the cultural heritage tourism context (Fenu & Pittarello, 2018), those four unique attributes are assumed to be suitable for the museum context. Prior studies have demonstrated that these attributes can be the stimuli for the SOR

model (Nikhashemi et al., 2021). Interactivity refers to controlling the interaction of the augmented sensory content users see with their physical environment (McLean & Wilson, 2019).

METHODOLOGY

Anhui Provincial Museum was chosen as a case study because it is a typical museum that uses handheld AR applications for museum guidance and has many users. Besides, the questionnaire with a five-point Likert scale was modified from prior studies and translated into Chinese because the majority of the respondents who had used Anhui Museum's handheld AR applications in the previous year were Chinese. A pilot test was conducted to confirm the reliability of the measurement items. A total of 276 valid questionnaires were collected online through Weibo and Douban using purposive sampling, and the quantitative results were performed by SPSS and Smart PLS software (See Figure 1).

The hypotheses of this study are as follows:

H_1: The interactivity of the handheld AR application for museum guidance positively influences (a) perceived usefulness and (b) perceived enjoyment.

H_2: The vividness of the handheld AR application for museum guidance positively influences (a) perceived usefulness and (b) perceived enjoyment.

H_3: The novelty of the handheld AR application for museum guidance positively influences (a) perceived usefulness and (b) perceived enjoyment.

H_4: The augmentation quality of the handheld AR application for museum guidance positively influences (a) perceived usefulness and (b) perceived enjoyment.

H_5: Perceived usefulness positively influences recommendation intention.

H_6: Perceived enjoyment positively influences recommendation intention.

H_7: Perceived usefulness mediates the relationship between (a) interactivity, (b) vividness, (c) novelty and (d) augmentation and recommendation.

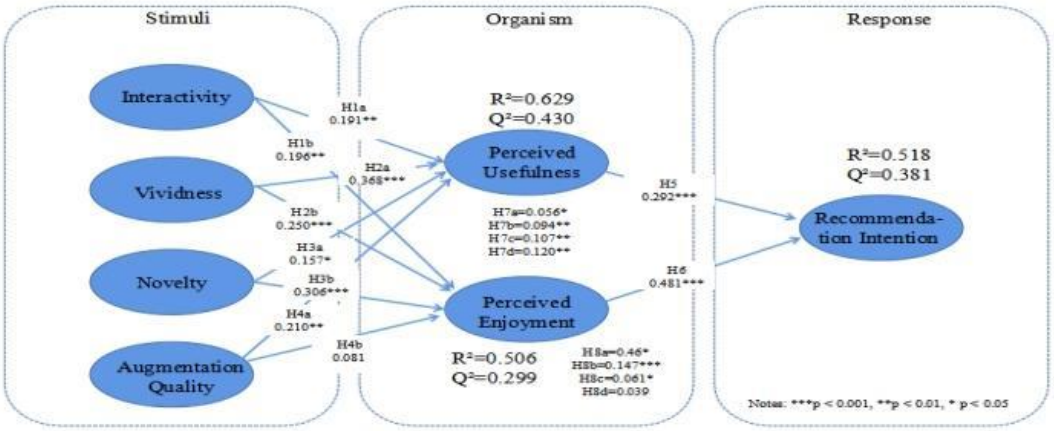
H_8: Perceived enjoyment mediates the relationship between (a) interactivity, (b) vividness, (c) novelty and (d) augmentation and recommendation.

RESULTS AND DISCUSSION

A total of 336 questionnaires were collected during the formal data collection process. After eliminating invalid responses through screening, reverse questions and short response time, 276 valid questionnaires were obtained, with a recovery rate of 82.1%. The validity rate was 82.1%. Regarding visiting frequency, more than half of the respondents visited the museum once or twice in the past year. Figure 1 illustrates the PLS-SEM results. All hypotheses were supported except for H4b (Augmentation of quality would have a positive effect on perceived usefulness ($\beta = 0.210$, $p < 0.01$) positively, but not significantly on perceived enjoyment ($\beta = 0.081$, $p > 0.1$). The results reveal that AR interactivity, vividness and novelty positively affect perceived usefulness and enjoyment, while augmentation quality only affects perceived usefulness. The results also indicate that perceived usefulness and enjoyment significantly impact recommendation intention and demonstrate the mediating role of perceived usefulness and enjoyment. Besides, the results of R^2 and Q^2 were all acceptable, and the GoF index is 0.589.

Figure 1

The study model and structural equation modelling results



CONCLUSION AND IMPLICATIONS

For theoretical implications, this study expands the SOR model to explain how AR attributes of the handheld AR application for museum guidance influence recommendation intention in the museum context. This study also reveals that interactivity, vividness and novelty are essential AR attributes of the handheld AR application for museum guidance to induce positive perceptions and recommendation intention. Augmentation quality is another critical AR attribute, although it indirectly influences recommendation through perceived usefulness. For managerial implications, this study suggests that developers should upgrade the AR attributes by improving the speed and range of AR interaction, providing multi-sensory contents and detailed 3D images of artefacts and offering more personalized points of interest so that the users of the handheld AR application for museum guidance are likely to gain valuable and enjoyable experience and willing to recommend the handheld AR applications for museum guidance. Besides, for the limitations of the lack of considering more subsequent intentions, future studies should consider other intentions, such as reuse intention.

***Keywords**:* Handheld AR application, museum, SOR model, recommendation intention, cultural heritage tourism

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