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Abstract: This paper explores how tourism virtualisation enables consumers to experience memorable feelings in the virtual world and affects the experiential value of virtual tourism and customers' intention to travel in the future. A virtual reality system, The Panoramic Palace Museum, is utilised to conduct a sequence of experiments in tourism experience, and two phases are designed to analyse travel intention. Before using the virtual-reality system, the theory of planned behaviour constructs and involvement are employed to explore travel intention. Two identical experiments are conducted on 243 subjects independently, and 211 valid samples are collected. The results show that travel intentions before and after a virtual visit are significantly different and that experiential value significantly increases the intention to travel.

Keywords: virtual experience; experiential value; service experience; virtualisation; travel intention.

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1 Introduction

Recently, the internet has been abundant with virtual-reality-related systems, ranging from online games such as *World of Warcraft* to virtual life sites such as *Second Life*. Virtual reality (VR) commonly refers to using computer technology to create an interactive three-dimensional environment where objects have a sense of spatial presence (Bryson, 2013). With the emergence of the metaverse, the world is recently engaging in VR development. *Second Life*, launched by Linden Research Inc. on 23 June 2003, is aggressively taking on the Facebook Meta (Bobrowsky, 2022). Different businesses have their unique market orientations leading to different functionalities. Virtual experience has become a new lifestyle for customers and emerged as a critical determinant of decision-making and consumption behaviour. Pine and Gilmore (1998) were the first to propose the concept of virtual experience in the *Harvard Business Review* and emphasised the experience economy era in the book *The Experience Economy*. The product is no longer the crucial business focus but the unique service that gives customers memorable experiences. Schmitt (1999) also presented that experiential marketing is one way of getting in touch and interacting with customers. Traditional marketing is always

focused on the quality and functionality of products, but experiential marketing is intended to provide unforgettable experiences to customers. In the era of competitive service marketing, corporate advantage comes from the functional attributes of products and consumption value derived from customer experience.

Product quality and characteristics affect consumption intention based on trends in worldwide consumption patterns. Ajzen (1985, 1991) proposed three factors that affect the willingness of consumers: the consumer's attitude, subjective norm, and perceived behavioural control, all included in the theory of planned behaviour (TPB). In the experience economy era, Cheong (1995) stated that a virtual reality (VR) system plays a significant role in helping customers to experience their intended destinations and affects customers' decision making regarding travel arrangements. The more interactive, engaging, and attractive the environment a website can offer, the more richness of virtual experience customers can receive (Cano and Prentice, 1998; Gretzel et al., 2000; Bogicevic et al., 2019; Yung et al., 2021; de Amorim et al., 2022).

However, will the experiential value derived from experience service directly affect travel intention? Various virtual experience technologies have been applied to services in different industries, including online games, *Second Life*, and virtual cities. For the scope of this study, we selected the tourism industry as our research domain. Through utilising the applications of information technology, this research aims to discover which constructs and factors of information technology are the determinants of experiential value. A research model and a two-phased experimental design are proposed to explain and answer these questions.

Besides considering how virtual experience affects travel intention, a virtual reality system's functions and feature designs are considered. A virtual reality system, The Panoramic Palace Museum (PPM), developed by The Palace Museum of China (https://en.dpm.org.cn/), is adopted to explore how virtual experience influences customers' experiential value and travel intention, as well as their involvement with the virtual world. The PPM is a feature of the official website of the Palace Museum in Beijing, China. It uses omnidirectional cameras, also known as 360-degree cameras or VR cameras, to record interactive photography and mix with virtual elements to merge reality and fiction through special effects. The PPM system enables visitors to interactively explore the 600-year-old ancient architectural compound of the Forbidden City, including the labyrinth of its halls, gardens, and courtyards. Visitors can also learn about the story of every exhibit that interests them (China Daily, 2020). Two main reasons are why we selected this virtual system for our research experiment:

1 the system displays one of the famous tourist spots in China that is of interest to our research participants

2 the system uses the same language, Mandarin, to introduce the virtual scenes which is the mother tongue of our participants.

The remaining sections of the paper are organised as follows. The next section introduces the theoretical background and hypotheses development. We then describe the research model, method, and experimental procedure and outline the data analysis and results. Finally, conclusions and recommendations for future work are also provided.

2 Theories and hypotheses

First, we briefly describe the TPB and some of its modifications and constructs. In essence, the TPB provides a theoretical foundation for our research model. Furthermore, we introduce to this model one critical construct of Involvement. We then briefly review the other three key constructs: interactivity, vividness, and experiential value. The hypothesis for each construct is posited accordingly.

2.1 Theory of planned behaviour

The TPB is considered a theoretical framework for developing and assessing the behavioural process of consumption intention in different domains and industries (Ajzen, 1991). TPB has been applied to predict behavioural intention and can be utilised to explain individual behaviours and other behavioural models (Ajzen, 2006; Cano and Prentice, 1998; Steuer, 1992). The theory consists of three key constructs below:

- *Attitude* is a state of mind when a person assesses a product or service and exhibits a general inclination to recognise that product or service. For example, a person likes or dislikes a specific product (Oh, 2003). When a consumer acts in response to a particular behaviour, he/she will consider the possible benefits or advantages before making a decision (Gretzel et al., 2000). According to Ajzen's definition, attitude is the positive or negative assessment of actions taken by an individual. If customers feel positive about a product or service, their attitude will be positive and affect their behavioural intention (Lastovicka and Gardner, 1978; Ajzen, 1991). Therefore, Hypothesis 1 is posited below:

  H1 Attitude toward visiting a tourist spot (the Palace Museum) directly influences travel intention.

- *Subjective norm* is defined as how people decide their behavioural intention under social pressure or referring to suggestions and ideas from others, such as families, classmates, or business partners (Ajzen, 1991; Olson and Zanna, 1993; Murphy et al., 2007). Other people's perceived favourableness also influences individuals to take action (De Lucia et al., 2009). Therefore, subjective norm can also be regarded as group norm. When a group of people believes a specific behaviour is appropriate, individuals will increase their behavioural intention under group pressure (Gretzel et al., 2000). Cheong (1995) also indicated that when individuals perform behaviours, decision making is influenced by organisations or others, and the influence intensity depends on how important the organisations or persons are to the individuals. Therefore, Hypothesis 2 is posited:

  H2 Subjective norm toward visiting a tourist spot (the Palace Museum) directly influences travel intention.

- *Perceived behavioural control (PBC)* is a belief in self-control. The increase or decrease in an individual's behavioural intention is based on his/her belief in – and perception of – self-control (Ajzen, 1985); in other words, whether it is easy or difficult for that individual to perform a particular behaviour (Ajzen, 1991). In addition, individuals must be capable of controlling objective conditions such as time, money, or resources when willing (Cheong, 1995). Studies have concluded that self-confidence will also positively influence behaviour or intention (Taylor and

Todd, 1995; Conner and Abraham, 2001; Baker et al., 2007). For example, everyone could have the idea to travel around the world, but when the idea goes into practice, it will be controlled by time, money, self-control, and other factors. The intensity of perceived behavioural control will determine if the action will occur. According to the discourse above, the following hypothesis is posited:

H3 Perceived behavioural control over visiting a tourist spot (the Palace Museum) directly influences travel intention.

2.2 Involvement theory

When consumers decide on their travel plans, personal background and service features must be considered. For this reason, involvement is added to the TPB in our research model to examine whether it significantly impacts customers' travel intentions.

The involvement theory has been applied to elicit an individual's psychological or mental state. As customers perceive the importance of services or products that mean something to them, they will pay different degrees of attention according to the influence of other people, the environment, services or products, and so on. Petty and Cacioppo (1986) indicated that involvement is the intensity of decisions to buy or not to buy and the extent of individual involvement when customers select services or products. Product value and brand loyalty are also involvement factors (Kozak, 2001). Moreover, inherent needs, personal values, and perceived favourableness of particular objects also affect the degree of involvement (Zaichkowsky, 1985, 1986). Under the same time constraints and circumstances, the degree of involvement will affect customer decision making (Huang et al., 2010a).

Rothschild (1979) and Zaichkowsky (1986) classified involvement into more detailed categories according to involved objects and targets. This research employed three kinds of involvement: situational involvement (Rothschild, 1979), product involvement, and purchasing involvement (Zaichkowsky, 1986). Firstly, since the experiment time is relatively short, situational involvement is used to explore if a specific tourist spot's involvement positively impacts travel intention under certain conditions or time constraints. Secondly, product involvement represents the degree of attention toward target products or services and personal subjective thoughts. Thirdly, purchasing involvement tends to focus mainly on purchasing activities. Usually, the higher the purchasing involvement, the more consumers will collect product-related information and take longer to consider the action. Thus, the following hypothesis is posited:

H4 The involvement in visiting a tourist spot (the Palace Museum) directly influences travel intention.

2.3 Interactivity and vividness

Interactivity and *vividness* are two common constructs employed to evaluate the feeling or perceived sensation experienced in a virtual environment. Steuer (1992) stated that when individuals experience a virtual system, interactivity and vividness are the key factors influencing telepresence. However, each individual may perceive telepresence influence differently. In some cases, the term 'presence' appears to explain the same as the term 'telepresence', and they are regarded as the same factor (Baños et al., 2000). Therefore, telepresence is used in this paper to introduce the related literature.

Telepresence makes people feel like they are truly inside the virtual environment (Rizzo et al., 1998). Although computer programs generate every move in a virtual environment, users can instantly manipulate and change the virtual scenes by operating user interfaces. This operational control allows users to feel they are a part of the virtual world (Witmer and Singer, 1998; Slater, 1999; Usoh et al., 2000). Therefore, the stronger customers perceive telepresence, the more experiential value they obtain. Interactivity measures the degree of system methods or contents that users can manipulate and is classified into speed, range, and mapping. Speed represents the input ratio that a virtual environment can allow users to input at a particular time, and range is the maximum number of actions accepted by a system at any time. Mapping represents that a virtual system can process maps or graphs smoothly in predictable circumstances. In this vein, Hypothesis 5 is posited:

H5 The interactivity of a virtual reality system (the PPM) positively influences the experiential value of the system.

Vividness represents the richness of perceived sensations derived from the virtual environment and is often measured by the breadth and depth of sensation. The breadth of sensation is the number of senses being stimulated at the same time; that is, the multiple senses are affected simultaneously. The depth of sensation is the clarity and precision attained by the senses of sight, sound, and touch. Inside the virtual environment, users with a first-person perspective can interact with other participants or virtual characters, not just remain on the sidelines (Benford et al., 1997; Greenberg et al., 1996). Furthermore, the virtual environment provides various ways for non-verbal communication or information exchange; therefore, the perceived sensation will increase accordingly (De Lucia et al., 2009). In addition, a comprehensive system design makes users feel that virtual reality is just like magic being enjoyable and fantastic, and fills them with the desire to keep going (Takatalo et al., 2008). Hence, this study proposes Hypothesis 6:

H6 The vividness of a virtual reality system (the PPM) positively influences the experiential value of the system.

2.4 Experiential value

Pine and Gilmore (1998) believe that interaction is essential for experience. Interaction with customers during the service experience evokes joy and happiness. During consumption, experiential value is the degree of perceived favourableness toward products or services. Some scholars (e.g., Chang and Wildt, 1994) believe experiential value is crucial to a customer's consumption intention. In this study, we assess experiential value by utilising four factors proposed by Williams and Soutar (2009): functional value, social value, emotional value, and epistemic value. The functional value measures how specific functionality and attributes of products or services can meet consumers' demands, such as tourism quality, tour prices, travel communication, tour guides, tourist spots and sceneries, and interaction with other tourists. The social value allows consumers to link to other social groups or peers to increase the effectiveness of products and services. In tourism-related literature, social value mainly affects the decision regarding travel product brand and type. The emotional value refers to the consumer's potential feelings or emotional state, such as happiness, fear, excitement, and

joy which can be derived from products or services. Finally, the epistemic value can evoke consumer curiosity, inspire new attempts, and fulfil desired product knowledge. From this discourse, we hypothesise the following:

H7 The experiential value of a virtual reality system (the PPM) positively influences travel intention.

2.5 Travel intention

Intention represents the probability of a person engaging in a behaviour that usually correlates highly with actual behaviour (Ajzen, 1991). Behavioural intention can be measured by certain factors, including willingness to do and word-of-mouth recommendations (Baker and Crompton, 2000; Bigné et al., 2001; Conner and Abraham, 2001; Kozak, 2001). As defined in this study, behaviour is related to customers' travel, so it is more appropriate to use the term 'travel intention' instead of 'behavioural intention'. *Travel intention* represents the customers' willingness to visit the intended tourist spot. In the tourism literature, various relationships have been discussed, such as the relationships of satisfaction with value and intention (Gallarza and Saura, 2006; Murphy et al., 2000; Oh, 2003; Petrick, 2002). However, very few empirical studies were found to explore the relationship between experiential value and travel intention (Baker and Crompton, 2000). In particular, there is a dearth of experimental research into how a VR system influences this relationship.

Following the study of Shen et al. (2010), two constructs of travel intention are identified to assess subjective willingness to travel respectively before and after the virtual experience. The former focuses on exploring the willingness to go to the target travel spot, as judged by consumers themselves, and that judgement is affected by the consumers' attitude, subjective norm, PBC, and involvement. The latter aims to validate whether the experiential value significantly affects travel intention after the tourist experiences the PPM system. In addition, some prior shopping studies indicated that satisfaction significantly influences future intentions; therefore, purchase intention varies over time, mainly depending on consumer experience and satisfaction with products or services (Mittal et al., 1999; Williams and Soutar, 2009). In this vein, we predict that travel intention changes after consumer experience a virtual reality system. Furthermore, the two scores of travel intention constructs (before and after visiting the virtual system) are compared to see if any significant difference resulted from the virtual experience. As such, we posit the following two hypotheses:

H8 Travel intention before a virtual visit directly influences that after a virtual visit.

H9 Travel intention changes significantly after the virtual experience.

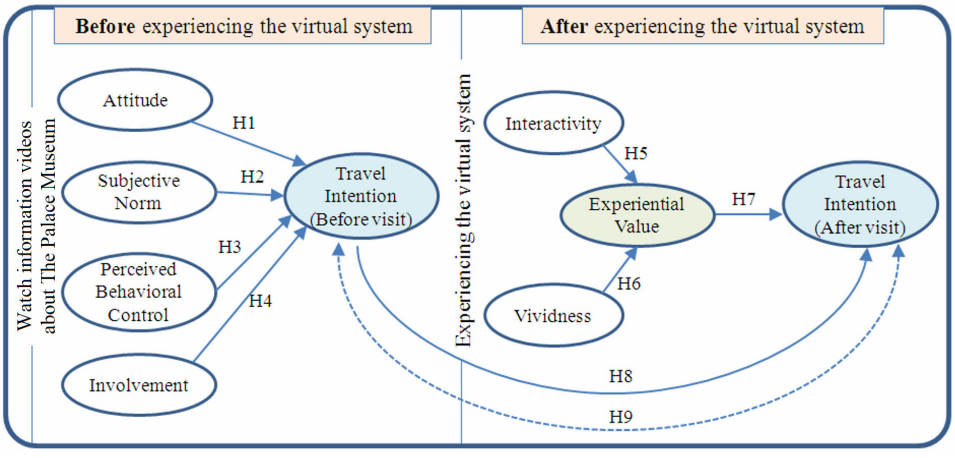
3 Methodology

3.1 Research model

Based on the study's purposes and research questions, a research model is proposed, as shown in Figure 1. In this model, two stages of an experiment are conducted. First, before the virtual experience, the subjects must watch two video tours introducing the

Palace Museum, each lasting about 10 minutes (see https://www.youtube.com/watch?v=UO5TdL5Hsbw&t=60s for tour 1 and https://www.youtube.com/watch?v=rBlAmDHyzro for tour 2). Then, they use for 20 minutes a virtual system showing 360-degree interactive photography of the Palace Museum as a virtual tour. The research model contains all the constructs and the corresponding hypotheses before and after the virtual experience. The core structure of the research model is based on TPB. In addition to three TPB constructs (attitude, subjective norm, and PCB), a new construct of involvement is added to predict the travel intention of research subjects in the first stage. In the second stage, two constructs, interactivity and vividness, are employed to predict experiential value after having a virtual experience service. The perceived value of this experience may further affect the travel intention toward the tourist target spots. Table 1 lists the operational definitions and sources of our research constructs. In addition, all constructs have been reworded appropriately to meet the research themes and purposes.

Figure 1 Research model (see online version for colours)



Note: The dotted two-way arrow indicates that the two constructs of travel intention are subjected to the Student's t-test of paired difference in mean scores.

Table 1 Definition of the research constructs

Construct	*Definition*	*Sources*
Attitude	The customer evaluation or perceived favourableness of products or services	Olson and Zanna (1993)
Subjective norm	The group influence making customers change their behavioural intention	Eagly and Chaiken (1995) and Park (2000)
Perceived behavioural control	The perception of self-control (constraints of time or money) regarding buying products or services	Ajzen (1985), Baker et al. (2007) and Conner and Abraham (2001)
Involvement	The customer's attention to products or services when they make a decision	Zaichkowsky (1986), Havitz and Mannell (2005), Huang et al. (2010b) and Lin (2008)
Travel intention	The customer's intention to perform favourable behaviours	Woodside et al. (1989), Sparks (2007), Han et al. (2010) and Tsai (2010)

Table 1 Definition of the research constructs

Construct	*Definition*	*Sources*
Interactivity	The design for telepresence in the virtual system with various display and interaction styles	Sanchez-Vives and Slater (2005)
Vividness	The perceived sensation provided in the virtual world is live and vivid	De Lucia et al. (2009) and Takatalo et al. (2008)
Experiential value	The perceived favourableness toward products or services	Ho and Ko (2008), Williams and Soutar (2009) and Chen et al. (2008)

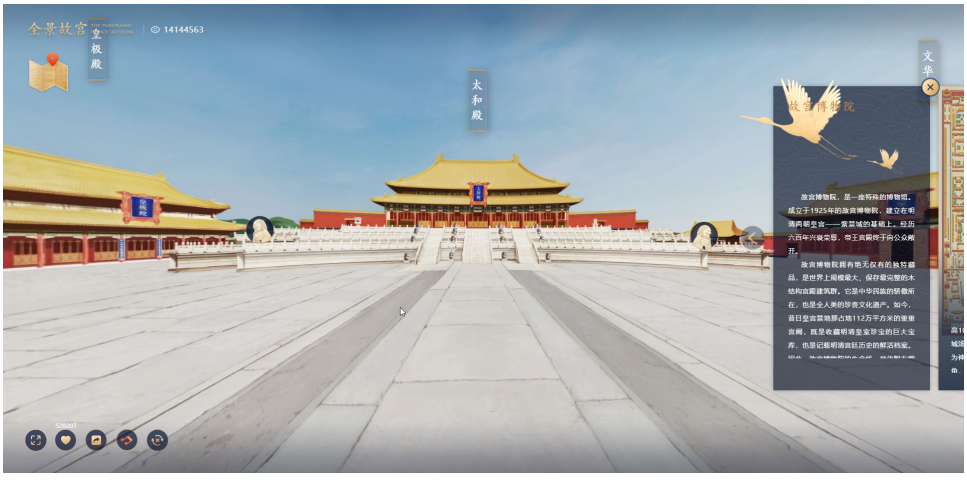
3.2 The Panoramic Palace Museum system

This study aims to discover travel intention using a VR system that simulates a realistic tourist spot. Furthermore, the language of the tour guide is also considered since our subjects are all Chinese; thus, Mandarin is the chosen language with which they are most familiar. For the reasons above, this study selects the PPM virtual system as the experimental tool. The PPM has a navigation system in Mandarin developed for a realistic Forbidden City in China. It is a 360-degree virtual system developed by the Palace Museum in Beijing to demonstrate China's most significant historical museum via the internet. The major features of the PPM are listed in Table 2, while a sample screen of the PPM virtual system is shown in Figure 2.

Table 2 Features of the PPM

System / *Feature*	*The PPM*
Tour guide	Visitors are self-guided and can turn the screen around at any degree and move on to any direction or labelled attraction.
Tour duration	There is no limit, but a research participant is suggested to complete the tour in 20 minutes, with one minute for each site.
Introduction to the scenic spot	Text-based and more interpretive. Additional graphs are provided for each scene in the introduction window.
Route planning	The tour route has been organised using labelled attractions by the system officials.
Technology	It uses omnidirectional cameras, also known as 360-degree cameras or VR cameras, to record interactive photography.
User interface	It supports interactivity with a mouse, touchpad, or touch pen.
Function icon	Icons to keep in the album, display in full-screen, vote a like, share URL, turn on music, and auto-rotate the scenes.
Mini-map	Yes
Photograph	Yes

Figure 2 Sample screen of the PPM virtual system (see online version for colours)

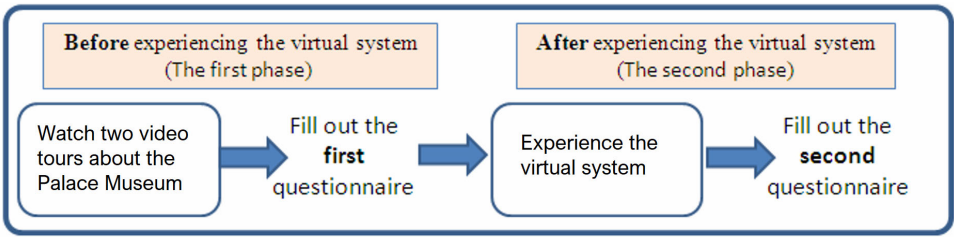


Source: China Daily (2020)

3.3 Experimental procedures and participants

This study adapted the experimental process of a previous study (Shen et al., 2010) on the virtualisation of the Forbidden City tour in China. To ensure the quality of the experiments, all the independent variables and potential factors of dependent variables were strictly controlled. We used the same experiment condition and equipment (a laptop and network equipment), limited the experiment time, two video tours of the Palace Museum, the PPM virtual system, and two sets of questions before and after the virtual tours. The 20-minute tour time for the PPM virtual system is monitored by an alarm clock, with a reminder bell 5 minutes before the time is up. This reminder lets the informant wrap up the virtual tour within 20 minutes.

Figure 3 Experimental procedure (see online version for colours)



Source: Adapted from Shen et al. (2010)

We used an electronic board system (bulletin board system; BBS; telnet://ptt.cc) to recruit volunteers to participate in the experiments, and all subjects must not have visited the Palace Museum. Our research assistant explained the experimental procedure and necessary precautions when a subject arrived at the experiment room. Then, two tour videos of the Palace Museum were provided for the subject to watch in 25 minutes, allowing 5 minutes to rewind and revisit certain missed scenes. After watching the video

tours, the subjects were asked to fill out the first questionnaire, including the first set of questions and additional demographical questions. Before the subject experienced the PPM, the research assistant double-checked the system's stability and initial settings. After the virtual experience, the subject answered the second set of questions. Figure 3 exhibits the experimental procedure.

3.4 Questionnaire design and subjects

The items in the questionnaire were adapted from several sources. The items for TPB are from Ajzen (2006). Those for involvement are adapted from De Lucia et al. (2009) and Oh (2003). Items for interactivity and vividness are from Eagly and Chaiken (1995) and Baños et al. (2000). Moreover, items for experiential value are from Williams and Soutar (2009). Finally, items for travel intention are from Havitz and Mannell (2005) and Takatalo et al. (2008). These items are listed by each construct in Appendix A. Experience tells us that respondents tend to select the midpoint (i.e., the neutral option) when they do not want to inform the researcher. Therefore, this study uses a six-point Likert-type scale to require respondents to make a positive or negative decision. The scale of all items of focal constructs thus ranges from '1 – strongly disagree' to '6 – strongly agree'.

4 Data analysis and results

For the PPM virtual experience experiment, we collected 243 questionnaires, of which 32 were removed due to low internal consistency, leaving 211 valid samples. Among the 211 respondents, 36.62% were male and 63.38% were female. The bulk of the sample's age ranged from 18 to 30. Also, 88.26% of the subjects had monthly disposable income less than NT$20,000 (new Taiwan dollars); the exchange rate is about US$1 to NT$30. Furthermore, most (60.56%) respondents had at least a college degree. Regarding average internet usage frequency, 2.35% used the internet four days per week, 4.69% five days per week, 6.10% six days per week, and 86.85% every day. Moreover, 91.55% of the subjects had travelled abroad. A summary of the characteristics of the respondents is shown in Table 3.

Table 3 Respondents' characteristics

		Frequency	*Percent*
Gender	Male	77	36.62%
	Female	134	63.38%
Age	21 or less	56	26.76%
	21–25	136	64.32%
	26 or more	19	8.92%
Education	High school graduate	3	1.41%
	Bachelor's degree	125	59.15%
	Advanced degree	83	39.44%

Table 3 Respondents' characteristics (continued)

		Frequency	*Percent*
Monthly disposable income	NT$20,000 or less	186	88.26%
	NT$20,001~40,000	15	7.04%
	More than NT$40,000	10	4.69%
Average internet use usage (day/per week)	4 days or less	5	2.35%
	5 days	10	4.69%
	6 days	13	6.10%
	Every day	183	86.85%
Frequency of travel abroad	Never	18	8.45%
	6 months or less	6	2.82%
	6 months–1 year	42	19.72%
	1–5 years	100	47.42%
	5–10 years	20	9.39%
	10 years or more	26	12.21%

4.1 Measurement model

The confirmatory factor analysis (CFA) is employed as a measurement model to verify whether the constructs are qualified for validity and reliability. SPSS and SmartPLS are utilised to examine the correlation between variables and assess the proposed hypotheses. Through factor analysis (in particular, the principal components analysis), we examined the value of Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity to see if the potential factors meet the criteria of factory analysis.

In the *before*-visit model, 15 variables (Q1_1 to Q1_15) were assessed, and the value of the KMO for this set of variables was 0.813, which is higher than the acceptable threshold of 0.80. In addition, all values of factor loadings from these 15 variables are higher than the acceptable threshold of 0.50 recommended by Fornell and Larcker (1981), and the cumulative percentage of variance was 75.156%. The result reveals five extracted factors: attitude, subjective norm, PCB, involvement, and travel intention before the visit. For the details of the questionnaires and factor analysis, please refer to Appendix A and Appendix B, respectively.

In the after-visit model, after assessing 17 variables (Q2_1 to Q2_17), three invalid variables (Q2_4, Q2_12, Q2_13) were eliminated because their factor loadings are high on multiple factors in confirmatory factor analysis. The remaining variables were re-analysed, and the results showed that the KMO score (0.88) was greater than 0.80, and the factor-loading values of the 14 variables were higher than 0.50. The analysis extracted four valid factors: interactivity, vividness, experiential value, and travel intention after the visit, and the cumulative percentage of variance was 68.131%.

Concerning the reliability of the constructs, Table 4 reveals that all values of factor loadings, ranging from 0.545 to 0.951, surpass the threshold of 0.50. In addition, the internal consistency reliability (i.e., the composite reliability) values were all higher than 0.80, meeting the threshold of 0.70 (Hair et al., 2011). Furthermore, the average variance extracted (AVE) value for each factor was higher than 0.609, meeting the threshold of 0.5 for convergent validity (Fornell and Larcker, 1981; Hair et al., 2011).

Table 4 Reliability and convergent validity of constructs

Construct	*Item*	*Factor loading*	*Mean*	*Standard deviations*	*Cronbach's α*	*Composite reliability*	*Average variance extracted*
Attitude	Q1_1	0.866	3.66	0.759	0.790	0.878	0.707
	Q1_2	0.909	3.78	0.795			
	Q1_3	0.738	4.30	0.683			
Subjective norm	Q1_4	0.882	4.19	0.919	0.771	0.865	0.682
	Q1_5	0.848	4.07	0.904			
	Q1_6	0.743	3.95	0.925			
Perceived behavioural control	Q1_7	0.896	3.72	0.876	0.705	0.836	0.640
	Q1_8	0.906	3.69	0.852			
	Q1_9	0.545	2.62	0.917			
Involvement	Q1_10	0.884	3.19	1.021	0.859	0.914	0.780
	Q1_11	0.932	3.14	1.085			
	Q1_12	0.830	3.27	1.177			
Travel intention (before the visit)	Q1_13	0.919	4.15	0.888	0.923	0.951	0.867
	Q1_14	0.951	4.05	0.915			
	Q1_15	0.923	3.80	0.972			
Interactivity	Q2_1	0.861	3.88	0.869	0.613	0.823	0.613
	Q2_2	0.849	4.15	0.841			
	Q2_3	0.615	4.04	0.809			
Vividness	Q2_5	0.842	4.20	0.922	0.609	0.861	0.609
	Q2_6	0.708	4.30	0.826			
	Q2_7	0.749	4.50	0.872			
	Q2_8	0.816	4.06	0.904			
Experiential value	Q2_9	0.825	3.57	0.972	0.618	0.865	0.618
	Q2_10	0.790	3.15	1.014			
	Q2_11	0.825	3.90	0.882			
	Q2_14	0.697	4.02	1.005			
Travel intention (after the visit)	Q2_15	0.915	4.49	0.833	0.848	0.944	0.848
	Q2_16	0.929	4.47	0.833			
	Q2_17	0.919	4.29	0.885			

To assess discriminant validity, one must compare the square root of AVE values with correlation coefficients. As shown in Tables 5 and 6, the values on the diagonal are the squared root of AVE values, and the remaining elements are the correlation coefficients among different constructs. It can be seen that each squared root of the AVE value is higher than the correlation coefficients for all constructs in the same column and row, indicating the discriminant validity of all constructs in the study.

Table 5 Discriminant validity (before visiting the PPM)

Construct	*Involvement*	*PBC*	*Subjective norm*	*Attitude*	*Travel intention (before the visit)*
Involvement	*0.883*				
PBC	0.237	*0.800*			
Subjective norm	0.125	0.389	*0.826*		
Attitude	0.212	0.390	0.457	*0.841*	
Travel intention (before the visit)	0.285	0.510	0.515	0.644	*0.931*

Table 6 Discriminant validity (after visiting the PPM)

Construct	*Interactivity*	*Vividness*	*Experiential value*	*Travel intention (after the visit)*
Interactivity	*0.783*			
Vividness	0.532	*0.780*		
Experiential value	0.538	0.612	*0.781*	
Travel intention (after the visit)	0.306	0.432	0.321	*0.921*

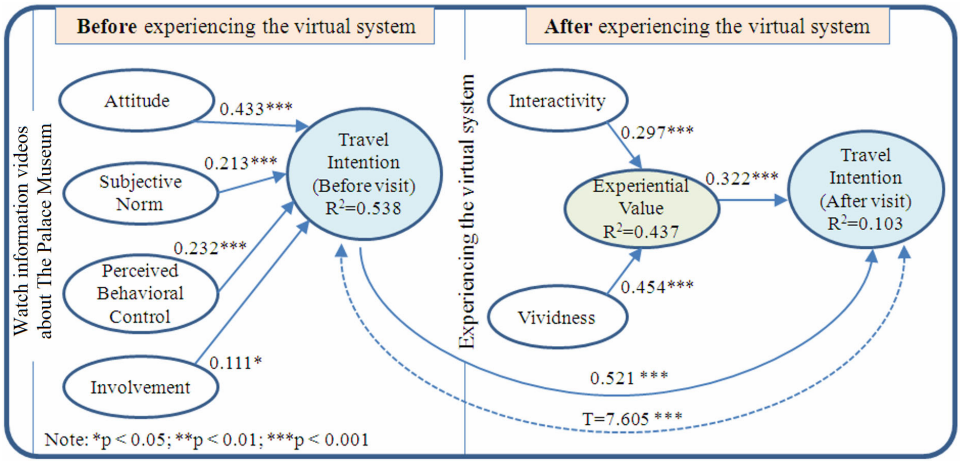
4.2 Structural model

Through PLS's computation and bootstrapping method, the path coefficients and t-statistics were derived. The results of the before-visit model support hypotheses related to TPB, i.e., H1, H2, and H3 (see Figures 1 and 4). Specifically, the attitude had a significant influence on travel intention ($\beta = 0.433$, $p < 0.001$), subjective norm had a significant effect on travel intention ($\beta = 0.213$, $p < 0.001$), and the PBC had a significant effect on travel intention ($\beta = 0.232$, $p < 0.001$). In addition, hypothesis 4 was also supported; that is, involvement directly impacted the travel intention of visiting the Palace Museum ($\beta = 0.111$, $p < 0.05$).

The results of the after-visit model showed that interactivity had a significant effect on experiential value ($\beta = 0.297$, $p < 0.001$), and vividness significantly impacted experiential value ($\beta = 0.454$, $p < 0.001$), supporting Hypotheses 5 and 6, respectively. Furthermore, as expected, the experiential value had a significant and positive influence on travel intention ($\beta = 0.322$, $p < 0.001$), supporting Hypothesis 7, and travel intention before the visit has a direct impact on travel intention after the visit ($\beta = 0.521$, $p < 0.001$), supporting Hypothesis 8.

Finally, the paired Student's t-test was conducted to compare before-and-after travel intentions and assess the proposed Hypothesis 9. The mean intention before the visit was 3.998 with a standard deviation of 0.861; the mean intention after the visit was 4.419 with a standard deviation of 0.783. Indeed, the results showed that the after-visit travel intention is higher than the before-visit intention. The t-statistic was 7.605 and significant at $p < 0.001$, as shown in Table 7. Therefore, the travel intention changed positively and significantly after experiencing the PPM, supporting Hypotheses 9.

Figure 4 Research model with test results (see online version for colours)



Note: The dotted two-way arrows indicate that the two constructs of travel intention are subjected to the Student's t-test of paired difference in mean scores.

Table 7 Paired t-test

Travel intention (before the visit)		*Travel intention (after the visit)*		*Paired difference**			*t*	*df*	*Sig. (2-tailed)*
Mean	*Std. deviation*	*Mean*	*Std. deviation*	*Mean*	*Std. deviation*	*Std. error mean*			
3.998	0.861	4.419	0.783	0.421	0.808	0.055	7.605	212	0.000

Note: *The difference between before-visit and after-visit travel intentions = (travel intention after the visit – travel intention before the visit)

5 Conclusions and recommendations

This study utilised experiment and survey methods to collect data and analyse them with SPSS and SmartPLS to examine the constructs and their associations in the research model. The main objective of this study was to explore whether or not a virtual reality system could affect consumers' decision-making on travel spots. The study used confirmatory factor analysis to examine the underlying dimensions for the key constructs, including attitude, subjective norm, perceived behavioural control, involvement, interactivity, vividness, experiential value, and travel intention. In addition to the original constructs of the well-known theory (TPB), this study further confirms that the newly added construct from involvement theory can be considered as an influencer affecting an individual's travel intention. Furthermore, by experiencing the interactivity and vividness of a VR system, users can derive experiential value. The results further confirm that experiential value positively impacts users' behavioural intention toward visiting the tourist spot. A summary of the hypothesis test results is shown in Table 8.

Table 8 Results of hypothesis tests

	Research hypothesis	*β value*	*Decision*	*T value*	*P (2-tailed)*
H1	*Attitude* toward visiting a tourist spot → *Travel intention* before the visit	0.433	Supported	6.336	$p < 0.001$
H2	*Subjective norm* toward visiting a tourist spot → *Travel intention* before the visit	0.213	Supported	3.636	$p < 0.001$
H3	The *personal behavioural control* over visiting the tourist spot → *Travel intention* before the visit	0.232	Supported	3.589	$p < 0.001$
H4	*Involvement* toward visiting a tourist spot → *Travel intention* before the visit	0.111	Supported	2.323	$p < 0.05$
H5	*Interactivity* of the virtual system → *Travel intention* after the visit	0.297	Supported	3.746	$p < 0.001$
H6	*Vividness* of the virtual system → *Travel intention* after the visit	0.454	Supported	4.939	$p < 0.001$
H7	*Experiential value* of the virtual system → *Travel intention* after the visit	0.322	Supported	4.960	$p < 0.001$
H8	*Travel intention* before the visit→ *Travel intention* after the visit	0.521	Supported	8.336	$p < 0.001$
H9	*Travel intention* increases significantly after the virtual experience	N/A	Supported	7.605	$p < 0.001$

In several short interviews after the experiments, several subjects stated that their curiosity about the virtual city was satisfied. We found that people with less contact with similar experiential services (e.g., ordinary virtual games) will be significantly influenced after the virtual experience. However, if a virtual tour takes longer than 20 minutes (e.g., virtual scenes move slowly, the text guide involves too many details, or descriptive historical introductions are too long), participants may have less patience with the tour.

Finally, the results of this study offer two recommendations. First, tourism service providers could promote their tour packages by using tour videos or VR systems to virtually experience the destinations. Customers who experience the tours through these media could increase their intentions to purchase the tour packages. Our study shows that after watching the two video tours, all the travel intention scales scored above the midpoint of 3.50 and between 3.80 to 4.15, showing a slightly-positive intention to visit. Not surprisingly, the PPM virtual system further enhanced these intention scales and reached 4.29 to 4.49, supporting the first recommendation. Second, attitude toward a destination and vividness of the PPM system are the two determinants of travel intention. Their path coefficients are the highest before and after virtual visits. While attitude reflects a customer's willingness (thus intention) to travel, vividness represents the joyous sensation of the tour destination a customer perceives in memory. Tourism service providers should strive to improve the values of these two constructs, leading to higher travel intention and more sales of tour packages.

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Appendix A

Questionnaires used to measure the constructs

Construct	*ID*	*Question*	*Source*
Attitude	Q1_1	After studying the tour guide of the Palace Museum, I desire to travel there.	Ajzen (1985)
	Q1_2	After studying the tour guide of the Palace Museum, I like to travel there.	
	Q1_3	After studying the tour guide of the Palace Museum, I feel positive about it.	
Subjective norm	Q1_4	If the Palace Museum is on the hot list, I also want to go.	Ajzen (1985)
	Q1_5	I would like to visit the Palace Museum, recommended by friends/family.	
	Q1_6	Tourist information providers (e.g., internet, television, magazines, agents, etc.) can affect me to visit the Palace Museum.	
Perceived behavioural control	Q1_7	Next time I travel to China, I have enough money to visit the Palace Museum.	Ajzen (1985)
	Q1_8	Next time I travel to China, I have enough time to visit the Palace Museum.	
	Q1_9	Next time I travel to China, no reason can stop me from visiting the Palace Museum.	
Involvement	Q1_10	I spend plenty of time collecting and studying information about the Palace Museum.	De Lucia et al. (2009) and Oh (2003)
	Q1_11	I review a lot of tour reviews/comments regarding the Palace Museum.	
	Q1_12	I spend time comparing the tour prices of the Palace Museum.	
Travel intention (before the virtual tour)	Q1_13	I would like to go to the Palace Museum.	Ajzen (1985), Havitz and Mannell (2005) and Takatalo et al. (2008)
	Q1_14	I would like to spend time on visiting the Palace Museum.	
	Q1_15	I would like to spend money on visiting the Palace Museum.	
Interactivity	Q2_1	The operations provided by the virtual reality system are easy for me to control and use.	Eagly and Chaiken (1995) and Baños et al. (2000)
	Q2_2	The virtual objects are vivid to me.	
	Q2_3	The system provides quite adequate information.	
	Q2_4*	My interactions with the virtual world seem natural to me, like those in the real world.	
Vividness	Q2_5	I feel like being in the real world while touring the virtual reality system.	Eagly and Chaiken (1995) and Baños et al. (2000)
	Q2_6	I feel like being a tourist in the real world while taking the tour.	

Questionnaires used to measure the constructs (continued)

Construct	*ID*	*Question*	*Source*
	Q2_7	The virtual tour of the Palace Museum is impressive.	
	Q2_8	The characters or objects in the system bring the virtual tour alive.	
Experiential value	Q2_9	The quality of the virtual tour is as good as that of a real tour.	Williams and Soutar (2009) (refer to novelty value to intention)
	Q2_10	After the virtual tour, I felt I had fulfilled my wish to travel.	
	Q2_11	When I take the virtual tour of the Palace Museum, I really enjoy it.	
	Q2_12*	When I take the virtual tour of the Palace Museum, I feel joyful.	
	Q2_13*	After the virtual tour, it offered me knowledge about the Palace Museum.	
	Q2_14	After the virtual tour, my curiosity was satisfied.	
Travel intention (after the virtual tour)	Q2_15	I am willing to visit the Palace Museum.	Ajzen (1985), Havitz and Mannell (2005) and Takatalo et al. (2008)
	Q2_16	I am willing to spend time visiting the Palace Museum.	
	Q2_17	I am willing to spend money on visiting the Palace Museum.	

Note: *The item is removed because it is cross-loaded highly on multiple factors in the confirmatory factor analysis.

Appendix B

Factor analysis

1 Factor analysis (before the visit)

	Involvement	*Attitude*	*Travel intention (before the visit)*	*Subjective norm*	*Perceived behavioural control*
q1_11	*.915*	.064	.094	.047	.091
q1_12	*.857*	.007	.035	.134	.035
q1_10	*.841*	.123	.121	–.084	.115
q1_2	.108	*.813*	.296	.105	.122
q1_1	.050	*.753*	.262	.184	.193
q1_3	.053	*.620*	.278	.241	–.006
q1_14	.157	.383	*.729*	.202	.274
q1_15	.132	.335	*.708*	.196	.352
q1_13	.148	.432	*.687*	.262	.228

1 Factor analysis (before the visit) (continued)

	Involvement	*Attitude*	*Travel intention (before the visit)*	*Subjective norm*	*Perceived behavioural control*
q1_5	–.064	.091	.223	*.827*	.091
q1_6	.100	.155	–.013	*.801*	.101
q1_4	.070	.213	.279	*.712*	.228
q1_8	.087	.054	.261	.127	*.839*
q1_7	.073	.025	.324	.141	*.808*
q1_9	.139	.453	–.392	.134	*.600*
Extraction method: principal component analysis					
Rotation method: equamax with Kaiser normalisation					
A rotation converged in nine iterations					
Total variance explained – initial eigenvalues					
Eigenvalue	5.734	2.118	1.258	1.253	0.910
% of variance	38.224	14.120	8.389	8.356	6.066
Cumulative %	38.224	52.344	60.734	69.090	75.156

2 Factor analysis (after the visit)

	Travel intention (after the visit)	*Experiential value*	*Vividness*	*Interactivity*
q2_17	.905	.080	.096	.161
q2_16	.896	.103	.165	.122
q2_15	.870	.127	.190	.079
q2_10	–.025	.839	.128	.158
q2_9	.138	.765	.260	.166
q2_11	.140	.655	.302	.295
q2_14	.204	.603	.188	.145
q2_6	.078	.253	.771	–.091
q2_5	.192	.193	.715	.359
q2_8	.131	.318	.646	.280
q2_7	.334	.104	.629	.281
q2_1	.074	.271	.163	.756
q2_3	.216	.047	.013	.707
q2_2	.035	.250	.296	.706
Extraction method: principal component analysis				
Rotation method: equamax with Kaiser normalisation				
A rotation converged in six iterations				

2 Factor analysis (after the visit) (continued)

	Travel intention (after the visit)	*Experiential value*	*Vividness*	*Interactivity*
		Total variance explained – initial eigenvalues		
Eigenvalue	5.542	1.942	1.101	0.953
% of variance	39.586	13.870	7.866	6.809
Cumulative %	39.586	53.456	61.323	68.131