Journal of Hospitality, Leisure, Sport & Tourism Education 23 (2018) 29–38

Contents lists available at ScienceDirect

Journal of Hospitality, Leisure, Sport & Tourism Education

journal homepage: www.elsevier.com/locate/jhlste

Examining the usability of an online virtual tour-guiding platform for cultural tourism education

Huei-Ming Chiao[a,b], Yu-Li Chen[c,*], Wei-Hsin Huang[d]

[a] Graduate Institute of Design Science, Tatung University, Taiwan, ROC
[b] Department of Digital Game and Animation Design,Taipei University of Marine Technology, Taiwan, ROC
[c] Graduate Institute of International Tourism and MICE Industry, Department of Applied Foreign Languages,Lunghwa University of Science and Technology, Taiwan, ROC
[d] Department of Media Design, Tatung University, Taipei, Taiwan, ROC

ARTICLE INFO

Keywords:
Virtual reality
Technology use
Digital tour-guiding
Game-based learning
Cultural tourism
Experience-based tourism

ABSTRACT

Technology innovation in the tourism industry serves as a vehicle to meet the increasing need for remarkable tourist experiences. This study aims to construct a virtual reality tour-guiding platform and then establish a technology acceptance model based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model. 391 students from a technological university in Taiwan participated in the study. Results indicated their learning effectiveness and technology acceptance within the education system. Interaction was an exogenous variable that has an indirect effect on technology use, implying the importance of interaction between people and devices within a digital tour environment.

1. Introduction

Tourism and education have both undoubtedly encountered challenges in technology transformation in the past decade (Benckendorff, Sheldon, & Fesenmaier, 2014; Kracht & Wang, 2010; Neuhofer, Buhalis, & Ladkin, 2014). International tourism and hospitality constitutes the world's largest service sector (Gnoth & Zins, 2010). An increased emphasis on innovation topics in tourism is found in research (Schegg & Stangl, 2017). Tourism has been revolutionized by tremendous innovation. Technology innovation in the tourism industry serves as a vehicle to meet the increasing need for remarkable tourist experiences (Yovcheva, Buhalis, & Gatzidis, 2013).

Anne-Mette Hjalager (2010) proposed four categories of innovation, including product, process, administration and market. Recently, information and communication technology has become the foundation of process innovation. The tourism industry can improve its productivity through the use of new technology. A company can substantially increase its productivity by combining technology with other strategic and managerial approaches (Blake, Sinclair, & Soria, 2006). A tourist platform can be created to improve the services of a company and simultaneously add to its value proposition (Hjalager, 2010). Technology can result in higher efficiency of an organization by increasing its understanding, attractiveness and accessibility for tourists (Hjalager, 2010; Nielsen & Liburd, 2008).

The development of the Internet has brought never-before seen transformation and unparalleled opportunities to the tourism industry (Buhalis & Law, 2008; Molz, 2012; Rosman & Stuhura, 2013) while changing traveler behavior in many ways (Amaro & Duarte, 2015; Gretzel & Fesenmaier, 2009). Current developments indicate that the Internet is a source of information and travel

* Corresponding author.
E-mail addresses: jojo.chiao@gmail.com (H.-M. Chiao), ylchen@mail.lhu.edu.tw (Y.-L. Chen), wshuang@ttu.edu.tw (W.-H. Huang).

https://doi.org/10.1016/j.jhlste.2018.05.002
Received 10 August 2017; Received in revised form 26 February 2018; Accepted 19 May 2018

experience sharing (Hjalager & Jensen, 2012). The way tourism-related information is accessed has also fundamentally changed (Xiang & Pan, 2011; Xiang, 2011) and traveling information can be easily and increasingly retrieved on the Internet (Pan, Xiang, Law, & Fesenmaier, 2011). Accordingly, information search technology plays a crucial role in destination promotion, either from the government or private sectors, resulting in a strong influence on certain types of tourist experiences, such as travel planning (Kim & Fesenmaier, 2008; Xiang & Gretzel, 2010). In contemporary tourism innovation, customization is a decisive element for experience-based tourism (Hjalager, 2010) where the tourist or end-user designs and produces a tourism product such as a trip or vacation packages according to their tastes and behaviors.

Higher education institutions worldwide are seeking innovation (Adukaite, van Zyl, & Cantoni, 2016; Ali, Nair, & Hussain, 2016) to prepare students for the fast-changing world and unavoidable technology transformation in both education and industry. Accordingly, the purpose of the study was to construct an online platform, named Cultural Tourism Digital Guiding Platform (CTDGP), and to examine its learning effectiveness. A model based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh, Morris, Davis, & Davis, 2003) was established to explain the relationships among the various factors that affect its use. The construction and development of the online platform was in cooperation with various Taiwanese businesses implementing public factory tours by customizing their specific content into the platform. By better understanding student perception, the results of this study may help colleges and assist instructors in using this technology more effectively. Moreover, it can help the system designers improve the learning tools to obtain higher levels of learning satisfaction.

2. Literature review

2.1. Cultural tourism

Cultural tourism has been deemed one of the most important forms in the tourism industry. The United Nations World Tourism Organization predicts that it will become a main form of focus by 2020 (Niemczyk, 2013). Records of protected monuments in the European Union and those of buildings of historical interest in the European Commission indicate that the development of cultural tourism underscores the increasing critical position of culture and cultural attractions in modern society (Richards, 2007). While culture has stopped being the main purpose of tourism in the 20th century, Urry (1990) emphasized that tourism is still culture. In “World Decade for Cultural Development 1988–1997,” the United Nations Educational, Scientific and Cultural Organization gave emphasis to conserving cultural heritage, as it promotes identity and cultural diversity in addition to stimulating economic development (Quijano-Caballero, 1996).

Gali-Espelt (2012) claims that it is not easy to define the concepts of culture and tourism and is even more difficult determining what composes cultural tourism and cultural tourists. Richards (2007) defines culture as the result of its democratization and increasing convergence of ways of life. Culture involves a civilization's ideas and ways of life, which is process, as well as the products of those processes, including buildings, artifacts, art, customs and atmosphere. Accordingly, cultural tourism can mean consuming the way of life in the visited destination in addition to the consumption of the cultural products of the past. Hence, cultural tourism covers heritage tourism related to the artifacts of the past and arts tourism related to contemporary production of culture. Richards (1996)'s definition of cultural tourism has reached certain agreement: “Cultural tourism is the movement of people towards cultural attractions, somewhere other than their habitual place of residence, in order to obtain information and knowledge to fulfill their own cultural demands” (Gali-Espelt, 2012, p. 47).

2.2. Digital tour guiding

Tour guiding plays a significant role in determining whether or not tourists obtain meaningful and enjoyable visiting experiences. The quality of tour guiding depends largely on the interpretation delivered by tour guides (Brito, 2012; Hu & Wall, 2012). Tilden (as cited in Gonçalves, 2015) defined interpretation as “an educational activity which aims to reveal meanings and relationships through the use of original objects, by firsthand experience and by illustrative media, rather than simply to communicate factual information” (pp. 101–102). Hu and Wall (2012) provided another definition of interpretation: “the means by which the meanings of cultural and natural resources are conveyed, with the aims of instilling understanding and appreciation of the interpreted environment and to help to develop a strong sense of place” (p. 83). In short, interpretation is not merely providing factual information about the destination visited, but helping tourists gain a deeper understanding of its cultural and natural context and cultivating their appreciation of the local cultural and natural environment. Tilden (as cited in Ham, 2009) nicely summarized the importance of interpretation by saying, “Through interpretation, understanding; through understanding, appreciation; through appreciation, protection” (p. 50).

Recently, a number of studies have been conducted to explore the potential of digital tour guiding. Na and Weihua (2012) applied virtual reality (VR) to tour guide training. The experiment findings indicate that VR is a unique and potential educational tool and it helped improve tour guide candidates communicative skills and professional knowledge. The web-based VR technology was used for tour-guiding training in the study of Tseng, Huang, Liu, Chung, and Chiu (2013) and can be applied to a scenic spot or classroom. The students in the tour guiding course showed effective learning through the training system. Hsu (2012) investigated the perception of eight travel management students on training regarding tourism knowledge and communicative and interpersonal skills in Second Life. They indicated supportive attitudes and developed higher self-efficacy for being tour leaders in the future.

Innovation is the crucial factor in enhancing the service quality of the tourism industry. Chen, Hsu, Huang, Lin, and Hung (2013) also developed a digital tour guiding system named “TelePort” that allowed users to take a virtual tour of the Mogao Caves in Dunhuang City, China with a mobile device. Through this system, users could see the Buddhist cave artwork, including those

seriously damaged and lost, as if they themselves were there. In addition, it provided users with detailed information about the artwork through 3D animation videos. Cheng and Chiang (2016) developed a digital tour guide system by combining augmented reality technology with smart glasses. This system introduced Dihua Street, Taipei, Taiwan to users through 3D images of its historical buildings and voice guidance. Participants felt that a textual introduction on the screen was enough for them to decide whether they were interested in visiting the historical site and its 3D images allowed users to see some parts of the buildings that were not open to the public.

2.3. Virtual reality and game-based learning environments

Recently, virtual reality (VR) environments have been regarded as an emergent pedagogical approach in education curriculum and business training (Fowler, 2015; Huang, Backman, Backman, Moore, 2013; Huang, Backman, Chang, Backman, Mcguire, 2013; Schaffer, 2017; Schott, 2017). Ali, Murphy, and Nadkarni (2014) compared hospitality student perception on learning with technology from three academic institutions in Switzerland, the UK, and the UAE and called on educators to push forward more integrated and multi-disciplinary approaches to curriculum design. Schaffer (2017) provided immersive learning experiences for students to engage in learning. In using visualization, students had equitable and authentic learning opportunities. Schott (2017) explored the influence of VR fieldtrips regarding climate change. Substantial learning effectiveness was found. Hu, Cao, and Shi (2012) conducted research on interactive virtual tourism and concluded that virtual tourism has a variety of advantages. For instance, from a humanistic viewpoint, it can fulfill dreams of traveling without risk. From an environmental viewpoint, it can reduce natural environment damage by avoiding excessive tourism. Overall, it is a new way to have fun.

Second Life (SL) is an educational platform for real-world simulation, social interaction and collaborative learning. Huang, Backman, Backman et al., (2013) and Huang, Backman, Chang et al. (2013) provided students virtual learning in Second Life (SL). The study linked tourism education to virtual worlds so that engaging and interactive learning experiences were constructed to meet learner expectations and enhance intrinsic learning motivation. Deale (2013) incorporated Second Life into hospitality and tourism education. Results indicated that SL allowed students to effectively engage with each other in the learning process regardless of individual or collaborative group work.

Real-time interactivity, strong immersion and high imagination are three features that should be included to create successful virtual reality tools (Chung, 2012). Whyte (2002) also stated that virtual reality should include the elements of interactivity, spatiality and real time. The elements of immersion and interactivity are essential in making a technology-based virtual learning environment (VLE) more realistic (Ryan, 1999). One technology used for complete immersion is the use of a cave automatic virtual environment (CAVE), which is built around a stereo projection system, providing a high level of immersion in a 3D virtual environment (O'Brien, Levy, & Orich, 2009). The virtual world allows people to become immersed in a similar environment, providing more opportunities for “performative, experiential, collaborative, and game-based learning” (Resta & Shonfeld, 2013, p. 2933). In other words, virtual reality can be defined as the integration of Immersion, Interaction, and Imagination, also known as the I^3 (Burdea & Coiffet, 1994).

Gaming elements not only motivate users in learning by making the process fun, but also provide stimulation in an instructional environment (Din, 2006; Sørensen & Meyer, 2007). Zarzuela, Pernas, Calzón, Ortega, and Rodríguez (2013) intended to increase player knowledge about Valladolid City in Spain by creating a VR serious game using a natural user interface (NUI) based on Microsoft Kinect. Players at any age answered questions freely without pressure. Game-based VLE makes it possible to develop situated understanding, which is an important learning process in which students can solve “authentic problems in real-world situations” in the VLE and practically apply the knowledge later on (Annetta, Folta, & Klesath, 2010).

2.4. Technology acceptance

The current study applied the Unified Theory of Acceptance and Use of Technology (UTAUT) model to explain the relationships among the various factors that affect student technology use. The UTAUT model developed by Venkatesh et al. (2003) consolidates previous Technology Acceptance Model (TAM) related studies (Marchewka, Liu, & Kostiwa, 2007). The TAM is to discover the impact of external variables on internal beliefs about the usefulness and ease of use of a technology, attitudes towards technology use, intentions to use and then the actual behaviors (Davis, 1989). The constructs of perceived usefulness and ease of use in the TAM were applied to the UTAUT model among which are performance expectancy and effort expectancy. The four constructs of the UTAUT model are hypothesized to have a significant role as either direct or indirect determinants of user acceptance and usage behavior. Performance Expectancy (PE) is the extent to which an individual believes that the system will help them do their jobs better. Effort Expectancy (EE) is how easy an individual believes the system is to use. Social Influence (SI) is the degree to which others around an individual influence his or her intention to use the system. Facilitating Condition (FC) is the extent to which an individual has the personal knowledge and institutional resources available to use the system. The relationships between performance expectancy, effort expectancy, social influence and intention to use can be moderated by age, gender or experience.

Many studies have also explored the effects of technology innovation on tourism production process, service, and delivery mechanism based on the UTAUT model. For example, San Martin and Herrero (2012) explored the psychological factors in technology adoption by the users of rural tourism services. Another study examined the attributes of intention to use the website of rural tourism accommodations (Herrero & San Martín, 2012). Venkatesh, Thong, and Xu (2012) synthesized the various studies utilizing the UTAUT model in different contexts and described various types of the UTAUT extensions and integrations. The UTAUT in new contexts is one type. It entails new technologies, new user populations or new settings. Another type is expanding the scope of the

UTAUT's endogenous theoretical mechanism by adding new constructs. Still others added new exogenous variables to predict the UTAUT endogenous variables or used different moderating variables. Among them, most studies used only a subset of the UTAUT constructs by dropping the moderators. While these studies were trying to understand the construct of the UTAUT model in different contexts, an investigation on the factors that would apply to a cultural tourism tour-guiding platform use context is needed.

3. Methodology

3.1. Research design

The Cultural Tourism Digital Guiding Platform (CTDGP) aimed to design 3D virtual and game-based tourist attractions. The current study was based on the UTAUT model to explain student technology use. A web-based questionnaire was designed to collect information about student perceptions and actual use of the CTDGP after they completed each module. Correlation analysis, ANOVA (analysis of variance), multiple regression, structural equation modeling and path analysis, were used for data analysis and the establishment of a cultural tourism digital guiding acceptance model. A paired sample *t*-test was used to compare the pre-and post test for learning effectiveness.

3.2. The Cultural Tourism Digital Guiding Platform (CTDGP)

The Cultural Tourism Digital Guiding Platform (CTDGP) was designed to break the geographical and temporal restrictions by creating 3D virtual and game-based tourist attractions using Unity software. The construction and development of the online platform was in cooperation with various Taiwanese businesses implementing public factory tours by customizing their specific content into the platform. There are four major elements in the CTDGP: itinerary planning, virtual game-based design, cultural tourism features, and tourism English (See Figs. 1 and 2 for screen shots). The original intention regarding the construction of the platform was to let tourists access and manage their personalized travel itinerary anywhere and anytime. It provides travel information and tour-guiding functions to enhance tour richness and convenience. In addition, providing tour information about scenic spots makes it more convenient to design trips that can last from a few hours to several days. To accomplish finding a destination, users have to answer questions or solve problems at certain scenic locations. In addition, the platform shows available transportation through interactive maps and dynamic 3D street views to provide guidance to the attractions. With the guidance of the Creative Map, the platform increases time efficiency and route guidance precision and decreases the amount of time that tourists take looking for scenic spots or getting lost. A simple and clear guide allows tourists to experience an efficient operating process. A location-based system (LBS) customized with quick response (QR) codes was used to enhance contextualized interaction. Tiered with difficulty levels, the games, featuring challenge hurdles such as time limit and penalty, add excitement and competition which motivate the learner.

3.3. Participants

The study adopted purposeful sampling. Students from all four departments under the College of Humanities and Design at a science and technology university in Taiwan were chosen for the quasi-experiments. There were 399 student participants (391 for structural equation modeling analysis due to missing data). Their ages ranged from 18 to 22 years old with more female (286 or 66.3%) than male students (113 or 33.7%). These students majored in Cultural Creativity & Multimedia Design (140 or 35.09%), Tourism & Leisure (100 or 25.06%), Multimedia and Game Science (84 or 21.05%), and Applied Foreign Languages (75 or 18.8%).

3.4. The instrument

The pre- and post-tests were created based on the content of the platform to examine student learning. In addition, a web-based questionnaire was designed to collect information about student perception and their actual use of the CTDGP after they completed

Fig. 1. The CTDGP.

Fig. 2. The CTDGP.

each module. Based on the confirmatory factor analysis result, most measurement items used in this study were, with slight modifications, taken from the original UTAUT study. Since the platform was designed with an emphasis on interaction features, the study expanded the scope of the UTAUT model by including Interaction as an exogenous predictor of the endogenous variables. In the pilot study, the validity of the questionnaire was tested. The content validity of the questionnaire was reviewed by two experts in the field.

4. Results and discussion

A paired-sample *t*-test was applied to compare learning outcomes after the use of the digital tour-guiding platform. There are statistically significant mean differences from the pre-test (M = 3.25, SD = 1.12) to the post-test (M = 3.55, SD = 0.917) for Awareness of Culture Characteristics, $p < 0.000$ and from the pre-test (M = 2.82, SD = 1.14) to the post-test (M = 3.55, SD = 0.917) for Awareness of Surrounding Environment, $p < 0.006$. Tourism English has a significant difference in the pre-test (M = 2.14, SD = 0.972) and the post-test scores (M = 3.10, SD = 0.776), $p < 0.000$ (Table 1).

The overall Cronbach's Alpha of the survey questionnaire is computed as 0.9 and is considered to be of highly reliable (Nunnally & Bemstein, 1994). The individual coefficient alpha of the five major factors ranged from 0.85 to 0.935, which demonstrated very good reliability for research purposes (Hair, Black, Babin, & Anderson, 2010; Johnson & Christensen, 2008). In other words, the alpha coefficients provided an independent corroboration for the results obtained from the use of the factor analysis (Perry, 1996).

The frequency and percentage for the item, '*Before using this platform, the most attractive aspect of it*' was: itinerary planning (31%/124), 3D virtual game-based design (14%/55), cultural tourism features (53%/213), and tourism English (2%/7). As for the item, '*After using this platform, the most satisfying aspect of it*' was: itinerary planning (32%/127), 3D virtual game-based design (42%/166), cultural tourism features (26%/103), and tourism English (0.7%/3).

All the correlation coefficients are above 0.5 and significant at the $p < 0.01$ level. The variables associated with *Intention to Use* (ITU) and *Behavioral Use* (BU) are depicted as below. Performance Expectancy (PE) is positively correlated with Effort Expectancy (EE), r = 0.793; Social Influence (SI), r = 0.543; and Facilitating Condition (FC), r = 0.824. PE is positively associated with ITU, r = 0.774 and BU, r = 0.730. EE is positively correlated with SI, r = 0.606 and FC, r = 0.816. EE is positively associated with ITU, r = 0.742 and BU, r = 0.718. SI is positively correlated with FC, r = 0.529 and it is positively associated with ITU, r = 0.612 and BU, r = 0.589. The variables associated with Interaction are: PE, r = 0.779; EE, r = 0.745; SI, r = 0.547; FC, r = 0.776; ITU, r = 0.762, and BU, r = 0.717 (Table 2).

Since the platform featured 3D interactive, the study expanded the scope of the UTAUT model by including Interaction as an exogenous predictor of the endogenous variables. In addition, most students were from a science and technology university and had similar backgrounds so the moderators were dropped. Cases with missing data were excluded, so the sample size decreased from 399 to 391 for a structural equation modeling (SEM) analysis. Before the SEM analysis, a confirmatory factor analysis was conducted with Cronbach's Alpha value for PE being 0.935; EE = 0.891; FC = 0.901; INT = 0.913; ITU = 0.923 and BU = 0.850.

Maruyama (1998) distinguished between several types of fit indices: absolute fit indices, relative fit indices, parsimony fit indices, and those based on the noncentrality parameter. The analyses of the measurement model and path model were included in the SEM

Table 1
Paired-samples *t*-test comparing pretest and posttest scores.

	Pre-test		Post-test		Levene's F	t	p-value
	Mean	SD	Mean	SD			
Awareness of culture characteristics	3.25	1.12	3.55	0.917	51.701	− 4.179	0.000***
Awareness of surrounding environment	2.82	1.14	3.03	1.097	4.161	− 2.730	0.006**
Tourism English	2.14	0.972	3.10	0.776	24.247	12.737	0.000***

Note. Significance level $P < 0.01$**, $P < 0.001$***.

Table 2
Correlation matrix for key measures.

Measures	PE	EE	SI	INT	FC	ITU	BE
Performance Expectancy (PE)	1.000						
Effort Expectancy (EE)	0.793**	1.000					
Social Influence (SI)	0.543**	0.606**	1.000				
Interaction (INT)	0.779**	0.745**	0.547**	1.000			
Facilitating Condition (FC)	0.824**	0.816**	0.529**	0.776**	1.000		
Intention to Use (ITU)	0.774**	0.742**	0.612**	0.762**	0.820**	1.000	
Behavioral Use (BU)	0.730**	0.718**	0.589**	0.717**	0.739**	0.823**	1.000

Note. P < 0.01**. Correlation is significant at the 0.01 level (2-tailed).

analysis. *AMOS* software was used for the statistical analysis.

Table 3 shows the overall fit measures. Because an index reflects a specific aspect of model fit, it is essential to report a variety of indices (Hooper, Coughlan, & Mullen, 2008). The absolute fit measures include $\chi 2$ value, $\chi 2/d$, GFI, RMA, and RMSEA. Normed chi-square (NC) $\chi 2/df <= 2.0$ (or 3.0 or even 5.0) considered acceptable; the resulting model has a $\chi 2/df$ value of 2.912. Other fit values are Goodness of fit index (GFI) being 0.84 and AGFI being 0.803. The suggested goodness of fit value is above 0.8 (Baumgartner & Homburg, 1996; Doll, Xia, & Torkzadeh, 1994).

The residual variance in the covariance matrix is a variance that can't be explained by the model. The root mean square error of approximation (RMSEA) for the resulting model is 0.074. The root mean square residual (RMR) is 0.068 and the standardized root mean square residual (SRMR) is 0.0369. The SRMR with a value of 0.08 or less indicates an acceptable model (Hu & Bentler, 1999).

Researchers (Hu & Bentler, 1999; Jaccard & Wan, 1996; Marsh, Balla, & Hau, 1996) recommended relying on fit indices that have different measurement properties. The comparative fit measures include Normed Fit Index (NFI), Non-Normed Fit Index (NNFI), Incremental Fit Index (IFI), Comparative Fit Index (CFI), Relative Fit Index (RFI), and Tucker-Lewis index (TLI). A favorable value for the above indices would be greater than 0.9 (Thompson, 2000). For the resulting model, NFI value equals to 0.91; NNFI = 0.92; CFI = 0.93; IFI = 0.93; RFI = 0.90; and TLI = 0.92.

The parsimonious fit measures include Parsimonious Normed Fit Index (PNFI), Parsimonious Goodness-of-Fit Index (PGFI), Akaike Information Criterion (AIC), Consistent Akaike Information Criterion (CAIC), and Hoelter's Critical N (CN). The resulting model has a PNFI value of 0.797 and a PGFI value of 0.691, which are larger than the favorable value of 0.5 indicating a good fit. Fig. 3 shows the SEM model of the Cultural Tourism Digital Guiding Platform acceptance. The CTDGP has an effect on student behavioral use.

Table 4 shows the total effects, direct effects and indirect effects among the latent variables. The guidelines recommended by Cohen about the interpretations of effect size of correlations are based on a standardized path coefficients with absolute values: small effect/less than 0.1, medium effect/0.3, and large effect/0.5 or more (Kline, 1998, p. 118). The standardized direct effects of Performance Expectancy on *Intension to Use* are 0.296, p < 0.001; Effort Expectancy 0.174, p < 0.01; Social Influence 0.193, p < 0.001; Interaction 0.335, p < 0.001. The standardized direct effects of Intention to Use on *Behavioral Use* are 0.846, p < 0.001; and Facilitating Condition 0.132, p < 0.01. That is, due to both direct (unmediated) and indirect (mediated) effects of Performance Expectancy on Behavioral Use, when Performance Expectancy goes up by 1 SD, Behavioral Use goes up by 0.296 SD. The latent variables explain 67% of the variance of the Intention to Use the CTDGP and 69% of the variance of Behavioral Use.

Unlike most search technology created by business marketers, the CTDGP was designed from the perspective and expectations of a tourist and general public; it is primarily created for educational purposes with the hopes to expand the search engine for public use. The platform allows learners (tourists) to interact with local resources and culture to find unique services and products from a destination. With consumers in mind, surveys on tourist search behavior and preference were conducted prior to the design.

The CTDGP allows users to immerse themselves within a destination and its tourist attractions through a virtual world. By navigating through the virtual attractions and a game-based environment, users not only enjoy the fun of sightseeing in-game, but also obtain information and experience the culture of a destination. For example, Fort Zeelandia is the title of one of the modules. With prompts to accomplish a certain task in virtual Fort Zeelandia and through game-based learning, users have the freedom to explore its architecture. In addition to obtaining the corresponding historical knowledge, they also enrich their culture experience

Table 3
The overall model fit measures.

Absolute fit measures	Value	Comparative Fit measures	Value	Parsimonious fit measures	Value
$\chi^2_{(308)}$	970.955**	NFI	0.91	PNFI	0.79
GFI	0.84	NNFI	0.92	PGFI	0.68
AGFI	0.803	CFI	0.93	CN	114.65
RMR	0.068	IFI	0.93		
SRMR	0.0369	RFI	0.90		
RMSEA	0.074	TLI	0.92		

Note. Significance level P < 0.01**.

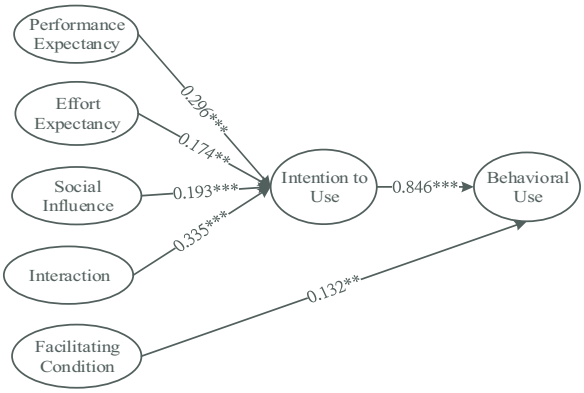

Fig. 3. Model of the cultural tourism digital guiding platform acceptance. *p < 0.05, **p < 0.01, ***p < 0.001.

Table 4
Standardized casual effects for the model.

	Determinants	Direct effect	Indirect effect	Total effect
Intention to use	Performance Expectancy	0.296***		0.296***
(R^2 = .671)	Effort Expectancy	0.174**		0.174**
	Social Influence	0.193***		0.193***
	Interaction	0.335***		0.335***
Behavioral use	Intention to Use	0.846***		0.846***
(R^2 = 0.695)	Facilitating Condition	0.132**		0.132**
	Performance Expectancy		0.250	0.250
	Effort Expectancy		0.147	0.147
	Social Influence		0.164	0.164
	Interaction		0.283	0.283

Note. Significance level P < 0.01**, P < 0.001***

with a sense of presence by interacting with the avatars.

From the study results, *cultural tourism features* ranked highest for being the most attractive among the four categories of the platform design; next is *itinerary planning* and then *virtual game-based design*. In addition, *virtual game-based design* ranked highest for the most satisfying among the four categories; *itinerary planning* next and then followed by *cultural tourism features*. Only a few students ranked *tourism English* highest for the most attractive and satisfying, concluding that *cultural tourism features* and *virtual game-based design* were quite successful. Tourism English was provided in order to comply with the policy of internationalization of the Taiwan Tourism Industry. Even though it is not the main focus of the platform, the results imply that the researchers can improve the platform design by including more interesting elements to motivate students to learn.

From the SEM analysis results, the four factors in the Vendatesh et al.'s UTAUT theory affected student behavioral use either directly or indirectly. Performance Expectancy, Effort Expectancy and Social Expectancy indirectly affected their use of the platform whereas Facilitating Condition directly affected its use. Interaction was added as an exogenous variable that has an indirect effect on student technology use in this CTDGP model

Performance Expectancy is the extent to which an individual believes the system will help them do their jobs better. Survey results show that Performance Expectancy (PE) and Intention to Use (ITU) are significantly correlated, r = 0.774, p < 0.01. Therefore, PE is positively associated with ITU. When students believed the system would help them perform well, they had higher intention to use it. In other words, the higher Performance Expectancy is, the higher the intention to use the platform is. Results are consistent with Vendatesh et al.'s theory (2003) that a technology's performance expectancy has a significant impact on its intention to use. In addition, the results comply with the study results of San Martín and Herrero (2012) and Huang (2011).

Performance Expectancy has a direct effect on student intention to use the platform. The information provided by the platform quickly helped learners with different sights and shops. Students were able to further understand the culture at various destinations. Its traffic information inquiry function helped users locate places and transportation. It helped them understand the scenery and travel information about certain locations. It matched their cultural tourist needs to a certain extent and helped them design their own travel itinerary faster. For a cultural tourism learner, students thought the platform had an adequate amount of information.

Effort Expectancy (EE) is how easy an individual believes the system is to operate. Effort Expectancy (EE) and Intention to Use (ITU) are significantly correlated, r = 0.750, p < 0.01, so EE is positively associated with ITU. Results are consistent with Vendatesh et al.'s theory (2003) that Effort Expectancy has a significant impact on Intention to Use the technology. In addition, San Martín and Herrero (2012) studied users' psychological factors influencing online purchase intention in rural tourism and concluded that when users experience a system that is easy to use, they have intention to use it. Participants who normally search for travel information on the Internet said that they would use the platform when planning a trip in the future. They thought that learning how to operate the

platform wasn't difficult and that it was easy for them to search for information. They discovered that interaction within the platform was easy to understand. Using the digital tour-guiding platform increased their sense of self-efficacy. Overall, they considered it quite easy to use and supported the use of it.

Social Influence is the extent to which others influence an individual's intention to use the system. Social Influence (SI) and Intention to Use (ITU) were significantly correlated, $r = 0.750$, $p < 0.01$, so SI is positively associated with ITU. According to Vendatesh et al.'s UTAUT theory, the use of technology by a community or surrounding peers would increase the participants' intention to use the system. Huang (2011)'s findings show the same results that people around the participants would affect their intention to use the technology. The participants in this study would use the digital tour-guiding platform because the teacher and the school supported its use. They would use the platform to stay in-sync with the current trends because everyone around them used it.

Facilitating Condition is the degree to which an institution supports the use of the system. Facilitating Condition (FC) and Behavioral Use (BU) are significantly correlated, $r = 0.750$, $p < 0.01$, so FC is positively associated with BU. The results validate both Vendatesh et al.'s UTAUT and Ajzen (1991)'s studies; that is, when the participants thought that resources were sufficient to support the environment, it's more likely for them to use the system.

These participants found the digital tour-guiding platform convenient in finding different themes and categories according to their experiences. They perceived that the guiding tours and the operating methods were clear and easy to understand. Students felt that the platform quickly responded to their inquiries and installing the 3D Unity Web Player to use it wasn't difficult.

Regarding the interaction factor, students found the fluid user interface of the platform helpful in searching for the information they needed and the design of the user interface to be very thoughtful. They considered the dynamic feedback of the platform to be well designed. Dalgarno and Lee (2010) distinguished ten characteristics of 3D virtual learning environment under the categories of representational fidelity and learner interaction. The platform has the following characteristics: realistic display of environment, smooth display of view changes and object motion, consistency of object behavior, embodied actions including view control, navigation and object manipulation, as well as control of environment attributes and behavior. On top of that, the customer-centered design of this platform allows users to plan their itineraries, play games and interact with the local resources that are unique in meeting customers' needs. The result was found to be similar to Herrero, & San Martin (2012)'s study where *Perceived Ease of Use* mediates the effect of the *Interactivity of the Website* on *Intention to Use* the websites to search for information and make online reservation.

Performance Expectancy, Effort Expectancy and Social Influence directly affected student intention to use the system. Students considered that when they travel next time, they would still use the tour-guiding platform for searching information and they would like to spend more time on it. When their friends wanted to travel, they would recommend using the platform. Most importantly, they believed that the platform could be a model for other websites. Ultimately, Behavioral Use refers to the participants' actual use of the system. The correlation between Intention to Use and Behavioral Use was found to be statistically significant, so Intention to Use is positively associated with Behavioral Use, which is consistent with Vendatesh et al.'s UTAUT theory. Upon using this digital tour-guiding platform, these students became interested in visiting the actual place. They were willing to install the 3D Unity Web Player to use this digital tour-guiding platform. More excitedly, they made more travel itineraries after using the platform.

The limitations of the study are: Although the college students in this study had travel experience, the study lacked age-specific feedback. Future studies should include people of different ages as participants. Besides Vendatesh et al.'s four constructs, future research can include other meaningful exogenous variables according to the discipline or the technology used as in Ali et al. (2016)'s study in computer supported collaborative classrooms. Further pedagogical approaches and technological innovations could be designed and tested, using these results as a benchmark to compare learning effectiveness and technology acceptance.

5. Conclusion

The development of the integration of information and communication technology services is an inevitable trend for future economic development of tourism. The construction of a Cultural Tourism Digital Tour-Guiding Platform has significance in consolidating interdisciplinary technology to create an industrial alliance between tourism and information technology. The results after the use of the digital tour-guiding platform indicated learning effectiveness. Students became more aware of the culture characteristics and surrounding environments of a destination after learning about them in the virtual world. Among the four features of the platform, tourism English was the least attractive; however, students still demonstrated improvement.

Based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model, the study developed a model to explain the relationships among the various factors that affect student technology use. The model incorporates five explanatory variables as the determinants of intention to use and actual use of the CTDGP. Performance Expectancy, Effort Expectancy, Social Influence, and Interaction directly affect student intention to use the platform and indirectly affect their behavioral use. Facilitating Condition directly affects student behavioral use. Given the importance of interaction in the design of new technology, the study examined the role of this innovation feature as a variable in the formation of the behavioral use of the CTDGP. Findings reveal that the interaction interface and student experience with the technology innovation have a significant impact on learner willingness and practice and implementation, implying the significance of the interaction between people and their devices within a digital tour environment.

Cognitive efforts best aid retention and contextualization is realized through intensified interaction. Tourism can be ideally promoted when travelers are not passively led to certain scenic spots, but prompted to encounter them on a more individual basis. The game is designed with cultural and locality-specific information in mind, where not only real hands-on experience can be acquired but individualism can also make it more memorable and shareable.

Acknowledgements

This work was supported by a grant from Taiwan Ministry of Science and Technology (Project Ref.: MOST 104-2632-H-262-001-MY2).

References

Adukaite, A., van Zyl, I., & Cantoni, L. (2016). The role of digital technology in tourism education: A case study of South African secondary schools. *Journal of Hospitality, Leisure, Sport & Tourism Education, 19*, 54–65.

Ali, A., Murphy, H. C., & Nadkarni, S. (2014). Hospitality students' perceptions of digital tools for learning and sustainable development. *Journal of Hospitality, Leisure, Sport & Tourism Education, 15*, 1–10.

Ali, F., Nair, P. K., & Hussain, K. (2016). An assessment of students' acceptance and usage ofcomputer supported collaborative classrooms in hospitality and tourism schools. *Journal of Hospitality, Leisure, Sport & Tourism Education, 18*, 51–60.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211.

Amaro, S., & Duarte, P. (2015). An integrative model of consumers' intentions to purchase travel online. *Tourism Management, 46*, 64–79.

Annetta, L. A., Folta, E., & Klesath, M. (2010). *V-Learning: Distance education in the 21st century through 3D virtual learning environments.* New York, NY: Springer.

Baumgartner, C., & Homburg, H. (1996). Applications of structural equation modeling in marketing and consumer research: A review. *International Journal of Research in Marketing, 13*(2), 139–161.

Benckendorff, P. J., Sheldon, P. J., & Fesenmaier, D. R. (2014). *Tourism information technology.* Cabi.

Blake, A., Sinclair, M. T., & Soria, J. A. C. (2006). Tourism productivity: Evidence from the United Kingdom. *Annals of Tourism Research, 33*(*4*), 1099–1120.

Brito, M. (2012). Intercultural interpretation strategies in the museum: The case study of a guided visit to the CoachMuseum in Lisbon. *Revista Turismo & Desenvolvimento, 17/18*, 437–450.

Buhalis, D., & Law, R. (2008). Progress in information technology and tourism management: 20 years on and 10 years after the Internet—The state of eTourism research. *Tourism Management, 29*(*4*), 609–623.

Burdea, G., & Coiffet, P. (1994). *Virtual reality technology.* New York, NY: Wiley.

Chen, S. C., Hsu, C. W., Huang, D. Y., Lin, S. Y., & Hung, Y. P. (2013). TelePort: Virtual touring of Dun-Huang with a mobile device. In *Proceedings of the 2013 IEEE international conference on multimedia and expo workshops* (ICMEW) (pp. 1–6). San Jose, CA: IEEE.

Cheng, H. Y., & Chiang, C. W. (2016). July). The discussion of interactive outdoor guidance and appliance on smart glasses from the aspect of human computer interaction: Taking Dihua Street for example. In *Proceedings of 18th international conference on human-computer interaction* (pp. 237–247). Berlin, Germany: Springer International Publishing.

Chung, L. Y. (2012). Incorporating 3D-virtual reality into language learning. *International Journal of Digital Content Technology and its Applications, 6*(*6*), 249–255.

Dalgarno, B., & Lee, M. J. (2010). What are the learning affordances of 3-D virtual environments? *British Journal of Educational Technology, 41*(1), 10–32.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–339.

Deale, C. S. (2013). Incorporating second life into online hospitality and tourism education: A case study. *Journal of Hospitality, Leisure, Sport & Tourism Education, 13*, 154–160.

Din, H. W. H. (2006). Play to learn: Exploring online educational games in museums. In *Proceedings of the 33rd international conference and exhibition on computer graphics and interaction techniques, educators progra*m Article No. 13. Boston, MA.: ACM.

Doll, W. J., Xia, W., & Torkzadeh, G. (1994). A confirmatory factor analysis of the end-user computing satisfaction instrument. *MIS Quarterly, 18*(*4*), 357–369.

Fowler, C. (2015). Virtual reality and learning: Where is the pedagogy? *British Journal of Educational Technology, 46*(2), 412–422.

Gali-Espelt, N. (2012). Identify cultural tourism: A theoretical methodological proposal. *Journal of Heritage Tourism, 7*(1), 45–58.

Gnoth, J., & Zins, A. H. (2010). Cultural dimensions and international tourism role scale: Validation in Asian destinations? *Asia Pacific Journal of Tourism Research, 15*(*2*), 111–127.

Gonçalves, F. J. B. (2015). Tour guides and Tilden's principles for the art of interpretation. In M. Brito, & M. Soares (Eds.). *The IRFGT 2015 abstracts and selected papers* (pp. 100–113). Estoril, Portugal: Escola Superior de Hotelaria eTurismo do Estoril.

Gretzel, U., & Fesenmaier, D. R. (2009). Information technology: Shaping the past, present, and future of tourism. In T. Jamal, & M. Robinson (Eds.). *The SAGE handbook of tourism studies* (pp. 558–580). London: Sage.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis: A global perspective.* Upper Saddle, NJ: Pearson.

Ham, S. H. (2009). From interpretation to protection: Is there a theoretical basis? *Journal of Interpretation Research, 14*(*2*), 49–57.

Herrero, Á., & San Martín, H. (2012). Developing and testing a global model to explain the adoption of websites by users in rural tourism accommodations. *International Journal of Hospitality Management, 31*(4), 1178–1186.

Hjalager, A. M. (2010). A review of innovation research in tourism. *Tourism Management, 31*(1), 1–12.

Hjalager, A. M., & Jensen, J. M. (2012). A typology of travelers based on their propensity to go online before, during and after the trip. In *Proceedings of information and communication technologies in tourism*, *ENTER 2012*. Berlin, Germany: Springer International Publishing.

Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural equation modeling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods, 6*(1), 53–60.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1–55.

Hu, W., & Wall, G. (2012). Interpretative guiding and sustainable development: A framework. *Tourism Management Perspectives, 4*, 80–85.

Hu, Z., Cao, Z., & Shi, J. (2012). *Research of interactive product design for virtual tourism. Advances in Electronic Engineering, Communication and Management*, *2*, Berlin, Heidelberg: Springer411–416.

Huang, Y. C., Backman, S. J., Backman, K. F., & Moore, D. (2013). Exploring user acceptance of 3D virtual worlds in travel and tourism marketing. *Tourism Management, 36*, 490–501.

Huang, Y. C., Backman, S. J., Chang, L. L., Backman, K. F., & McGuire, F. A. (2013). Experiencing student learning and tourism training in a 3D virtual world: An exploratory study. *Journal of Hospitality, Leisure, Sport & Tourism Education, 13*, 190–201.

Huang, Y. H. (2011). *Evaluating mobile navigation system in Shin-She from tourist's experience (M.S. thesis)*. Hsinchu City, Taiwan: National Chiao Tung University.

Hsu, L. (2012). Web 3D simulation-based application in tourism education: A case study with second life. *Journal of Hospitality, Leisure, Sport & Tourism Education, 11*(2), 113–124.

Jaccard, J., & Wan, C. K. (1996). *LISREL approaches to interaction effects in multiple regression.* Thousand Oaks, CA: Sage Publications.

Johnson, B., & Christensen, L. (2008). *Educational research - quantitative, qualitative, and mixed approaches* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Kim, H., & Fesenmaier, D. R. (2008). Persuasive design of destination websites: An analysis of first impression. *Journal of Travel Research, 47*(*1*), 3–13.

Kline, R. B. (1998). *Principles and practice of structural equation modeling.* New York, NY: The Guilford Press.

Kracht, J., & Wang, Y. (2010). Examining the tourism distribution channel: Evolution and transformation. *International Journal of Contemporary Hospitality Management, 22*(5), 736–757.

Marchewka, J. T., Liu, C., & Kostiwa, K. (2007). An application of the UTAUT model for understanding student perceptions using course management software. *Communications of the IIMA, 7*(2), 93–104.

Marsh, H. W., Balla, J. R., & Hau, K. T. (1996). An evaluation of incremental fit indices: A clarification of mathematical and empirical properties. In G. A. Marcoulides, & R. E. Schumacker (Eds.). *Advanced structural equation modeling: Issues and techniques* (pp. 315–353). Mahwah, NJ: Erlbaum.

Maruyama, G. (1998). *Basics of structural equation modeling.* Thousand Oaks, CA: Sage.
Molz, J. G. (2012). Travel connections: Tourism, technology, and togetherness in a mobile world. *Annals of Tourism Research, 40*, 434–448.
Na, L., & Weihua, H. (2012. July). Virtual reality applications in simulated course for tour guides. In *Proceedings of the ieee 7th international conference on computer science & education (ICCSE)*, 2012(pp. 1672–1674).
Neuhofer, B., Buhalis, D., & Ladkin, A. (2014). A typology of technology-enhanced tourism experiences. *International Journal of Tourism Research, 16*(4), 340–350.
Nielsen, N. C., & Liburd, J. J. (2008). Geographical information and landscape history in tourism communication in the age of web. 2.0. *Journal of Travel and Tourism Marketing, 28*(*3–4*), 282–298.
Niemczyk, A. (2013). Cultural tourists: An attempt to classify them. *Tourism Management Perspectives, 5*, 24–30.
Nunnally, J. C., & Bemstein, L. H. (1994). *Psychometric theory.* New York, NY: McGraw-Hill.
O'Brien, M. G., Levy, R., & Orich, A. (2009). Virtual immersion: The role of cave and PC technology. *CALICO Journal, 26*(*2*), 337–362.
Pan, B., Xiang, Z., Law, R., & Fesenmaier, D. R. (2011). The dynamics of search engine marketing for tourist destinations. *Journal of Travel Research, 50*(*4*), 365–377.
Perry, J. L. (1996). Measuring public service motivation: An assessment of construct reliability and validity. *Journal of Public Administration Research and Theory, 6*(*1*), 5–22.
Quijano-Caballero, C. (1996). World decade for cultural development 1988–1997. *World Leisure & Recreation, 38*(*1*), 33–36.
Resta, P., & Shonfeld, M. (2013). A study of trans-national learning teams in a virtual world. In *society for information technology & teacher education international conference* (pp. 2932–2940). Association for the Advancement of Computing in Education(AACE).
Richards, G. (1996). *Cultural tourism in Europe.* Wallingford, UK: CAB International.
Richards, G. (2007). *Cultural tourism: Global and local perspective.* New York, NY: The Haworth Hospitality Press.
Rosman, R., & Stuhura, K. (2013). The implications of social media on customer relationship management and the hospitality industry. *Journal of Management Policy and Practice, 14*(3), 18–24.
Ryan, M. L. (1999). Immersion vs. interactivity: Virtual reality and literary theory. *SubStance, 28*(*2*), 110–137.
San Martín, H., & Herrero, Á. (2012). Influence of the user's psychological factors on the online purchase intention in rural tourism: Integrating innovativeness to the UTAUT framework. *Tourism Management, 33*(*2*), 341–350.
Schaffer, V. (2017). Enhancing learning to diverse cohorts via immersive visualization. *Journal of Hospitality, Leisure, Sport & Tourism Education, 21*, 46–54.
Schegg, R., & Stangl, B. (2017). *Information and communication technologies in tourism 2017*. In *Proceedings of the international conference in Rome, Italy*.
Schott, C. (2017). Virtual fieldtrips and climate change education for tourism students. *Journal of Hospitality, Leisure, Sport & Tourism Education, 21*, 13–22.
Sørensen, B. H., & Meyer, B. (2007). Serious games in language learning and teaching - A theoretical perspective. In the *Proceedings of the 3rd international conference of the digital games research association* (pp. 559–566).
Thompson, B. (2000). Ten commandments of structural equation modeling. In L. G. Grimm, & P. R. Yarnold (Eds.). *Reading and understanding more multivariate statistics* (pp. 261–283). Washington, D.C: American Psychology Association.
Tseng, S. P., Huang, M. W., Liu, H. J., Chung, C. C., & Chiu, C. M. (2013. October). A virtual reality based training system for cultural tourism. In *Proceedings of the international conference on web-based learning* (pp. 272–277). Berlin, Heidelberg: Springer.
Urry, J. (1990). *The tourist gaze: Leisure and travel in contemporary societies.* London, UK: Sage Publications Ltd.
Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(*3*), 425–478.
Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly, 36*(*1*), 157–178.
Whyte, J. (2002). *Virtual reality and the built environment.* Oxford, UK: Architectural Press.
Xiang, Z. (2011). *Dynamic social media in online travel information search: A preliminary analysis. Information and communication technologies in tourism.* Vienna: Springer343–353.
Xiang, Z., & Pan, B. (2011). Travel queries on cities in the United States: Implications for search engine marketing for tourist destinations. *Tourism Management, 32*(1), 88–97.
Xiang, Z., & Gretzel, U. (2010). Role of social media in online travel information search. *Tourism Management, 31*(*2*), 179–188.
Yovcheva, Z., Buhalis, D., & Gatzidis, C. (2013). *Engineering augmented tourism experiences. Information and communication technologies in tourism.* Berlin, Heidelberg: Springer24–35.
Zarzuela, M. M., Pernas, F. J. D., Calzón, S. M., Ortega, D. G., & Rodríguez, M. A. (2013). Educational tourism through a virtual reality platform. *Procedia Computer Science, 25*, 382–388.