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## Exploring the factors influencing the adoption and usage of Augmented Reality and Virtual Reality applications in tourism education within the context of COVID-19 pandemic

Shiwei Shen, Kexin Xu, Marios Sotiriadis<sup>\*</sup>, Yuejiao Wang

Ningbo University-University of Angers Joint Institute at Ningbo, Ningbo University, China

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## ABSTRACT

Augmented Reality and Virtual Reality are regarded as smart and digital technologies that made their impact in many industries and settings. On the other hand, the ongoing pandemic of COVID-19 raises a series of issues and challenges for the tourism education, one of the main being the shift from the conventional/face-to-face to digital/hybrid learning forms and tools. The adoption and usage of these digital technologies raise a series of challenges for all stakeholders involved. The research question and study's aim were the influencing factors that determine the acceptance of Augmented Reality and Virtual Reality applications in the tertiary tourism education within the context of current pandemic. To address this aim, the study was drawn on the theoretical basis of Technology Acceptance Model (TAM). It takes a students' perspective to suggest a research model that was empirically investigated within the Chinese context (tourism departments in Chinese universities). The sample population consisted of 604 Chinese students and data was collected during February 2021. The data were analyzed using PLS-SEM. Findings indicated that perceived usefulness, hedonic motivation and price value are important predicting factors for Chinese students' adoption and use of these applications. These findings contribute to the extension of the TAM theory and the effective implementation of digital technologies in university settings. The study is completed by summarizing theoretical and practical implications of findings.

### 1. Introduction

Over the last two decades, we are witnessing fast technological progress, the development of computer technology along with new digital devices, tools and applications being developed almost on a daily basis. Rapid technological advances in the areas of hardware miniaturization and processing power is enabling the development of compelling devices that allow users and consumers to experience new 'kinds of realities' (EU, 2017). Digital technologies, such as augmented reality (AR) and virtual reality (VR) gained importance and popularity and made their impact over the last years thanks to technological advances (Ye, Ye, & Law, 2020). AR/VR applications become more widely used thanks to number of enabling elements/factors, namely the technological progress (e.g., processing power of computing and image, mobile internet and devices, interactive platforms), the creation of meaningful content based on a better

<sup>\*</sup> Corresponding author. Joint Institute of Ningbo University and Angers University, Ningbo University, 1188 Beihuan East Road, Zhenhai District, Ningbo, 315211, China.

E-mail addresses: [shiwei\\_shen@163.com](mailto:shiwei_shen@163.com) (S. Shen), [1049096090@qq.com](mailto:1049096090@qq.com) (K. Xu), [sotermarios@outlook.com](mailto:sotermarios@outlook.com) (M. Sotiriadis), [yuejwang@163.com](mailto:yuejwang@163.com) (Y. Wang).

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understanding of the user/consumer experience, realistic and convincing interaction of the virtual with the physical environment, and the unique value that goes beyond what other technologies deliver (BSG, 2021; Deloitte Access Economics, 2019; Jung, Tom Dieck & Rauschnabel, 2020; Ye et al., 2020). AR/VR technologies are evolving rapidly, along with Artificial Intelligence and automation, to transform our everyday life due to their capability to add to the search experiences by offering interactive and engaging information (Deloitte Access Economics, 2019; Hunter, 2016; OECD, 2018).

On the other hand, the Covid-19 pandemic has caused a global crisis in higher/tertiary education (Clune, 2020; Raaper & Brown, 2020). This health crisis causes restrictions for travelling and social distancing and raises a series of issues and challenges for tertiary education; one of the main being the shift from conventional to digital and hybrid forms, methods and tools (Olsen, Faucon, & Dillenbourg, 2020; Qiu, Li, & Li, 2020). The pandemic creates a context of resource and geographical constraints, forcing universities to utilize digital platforms for various teaching activities (Chan, Chan, & Fong Tsz, 2020). It is believed that technology-enhanced learning activities are more valuable and beneficial to students and improve educators' effectiveness (Olsen et al., 2020). That is the reason why, around the world, universities and colleges are adopting and incorporating digital tools to enhance learning activities and tasks (Choi, Dailey-Hebert, & Estes, 2016). By using AR and VR, education is becoming more interactive and fun, bringing abstract concepts to life within more interesting environments and enhancing students to develop specific skills (Radianti, Majchrzak, Fromm, & Wohlgenannt, 2020).

The adoption and usage of these digital technologies raise a series of opportunities and challenges for all stakeholders involved in educational services; that is tertiary education institutions, educators and students (Akçayır & Akçayır, 2017; Radianti et al., 2020). Both technologies contribute to improve educational services, are facilitating the learning experience and supporting teaching/knowledge processes (Choi et al., 2016; Boulton, Kent, & Williams, 2018; Radianti et al., 2020). More specifically in the field of tourism education, focus of our study, it is believed that AR/VR technologies are valuable educational platforms and beneficial for an innovative learning experience (Yung & Khoo-Lattimore, 2019). Therefore, it is valuable to explore the acceptance of AR/VR technologies within the new normality created the pandemic. This constitutes the main reason and motivation for this research article.

Some interesting review articles and conceptual papers were published in this research field (Radianti et al., 2020); however, the empirical studies are very limited (Yung & Khoo-Lattimore, 2019). This study aims to explore the students' perceptions about the acceptance and usage of AR/VR applications in the field of tourism education. The research question is stated as follows: "What are the influencing factors that determine the acceptance and usage of AR and VR in the tertiary tourism education within the context of ongoing pandemic?" Addressing this question is the study's aim by taking a students' perspective. The remainder of this article is structured as follows. Section 2 is devoted to the previous studies in this research field and the study's theoretical basis. This is followed by the development of research hypotheses and model. The suggested research model was tested through an explorative study, who's the main elements and findings are presented and discussed in sections 3 and 4. This is followed by the conclusion, the study's implications and limitations.

## 2. Literature review

In this section are presented the concepts, extant literature, the theoretical basis chosen for this study, as well as the suggested research model.

### 2.1. Augmented Reality and Virtual Reality

AR and VR are both digital technologies, the only difference is the extent of immersion. While AR allows users to interact within their current environments, VR immerses the user in other places (Yung & Khoo-Lattimore, 2019). AR can be defined as a technology which overlays virtual objects (augmented components) into the real world (Akçayır & Akçayır, 2017, p. 1). These virtual objects then appear to coexist in the same space as objects in the real world. VR is a form of information technology which enables users to navigate in computer-simulated environments and to immerse in an interactive digital representation of places or scenarios (Hunter, 2016, p. 1006), enhancing to perform better tasks/activities for various purposes (Hunter, 2016; Jung et al., 2020; Yung & Khoo-Lattimore, 2019). Academic research suggests that AR/VR are an efficient way of education, fully compatible with the current push towards digital/hybrid learning (Boulton et al., 2018).

### 2.2. Adoption and usage of AR and VR in tertiary and tourism education

Yung and Khoo-Lattimore (2019) indicates that AR/VR have the potential to provide more beneficial, interesting and interactive learning experiences, without neglecting the related issues and challenges. The benefits of and the issues related to AR in sports education and training were explored by Soltani and Morice (2020). It was suggested that various AR approaches could be used for learning and providing feedback (visual, auditory, and haptic information) in order to improve the learners' experience and efficacy, as well as for designing training scenarios. More specifically in the field of tourism education, it is believed that AR/VR have the following benefits/contributions: provide enjoyment and increased motivation of students (Huang, Backman, Chang, Backman, & McGuire, 2013), the potential to reduce cognitive overload and develop their skills (Bower, Howe, McCredie, Robinson, & Grover, 2014), and the potential to conduct teaching activities based on cooperative principles (Pratt & Hahn, 2016). Overall, the above-mentioned studies provide evidence that AR/VR have a great potential in the field of tourism education. These studies also highlighted significant challenges for the general adoption of the technology; the main being the time commitment for training needed to improve the digital competence of educators and students for efficient usage (Deale, 2013; Hsu, 2012).

The extant literature on usage of VR/AR in tourism education is outlined below classified into three main topics/issues. First, students' perceptions about using VR and virtual environments as educational platform and learning tool. Previous studies found that students had positive perceptions of using them as teaching platforms. It was found that the perceived usefulness, playfulness, attitude toward, and behavioural intention to use virtual environment were significant among students (Singh & Lee, 2009). Flow experiences had a significant and positive impact on students' attitudes toward virtual learning (Huang, Backman, & Backman, 2010), students had supportive attitudes toward virtual environments in providing training related to tourism knowledge as well as communicational and interpersonal skills (Hsu, 2012). Likewise, virtual learning provides interesting learning opportunities and allows students to work together on group projects in online hospitality education (Deale, 2013). Moreover, Schaffer (2017) explored the use of immersive visualization in tourism education, and found that students believed that the experience contributed to a better understanding and engagement.

Second issue is the learning effectiveness of online virtual platforms and the factors affecting student virtual learning experience. The study by Sun, Li, Zhu, and Hsiao (2015) explored the effect of immersion and involvement in Taiwanese context and found that the involvement is a determining factor of learning. The user's perceived effectiveness is positively influenced by involvement and promotion focus. The effectiveness of an online scenario game-based learning for education purposes was explored by Chan et al. (2020). Third issue is the factors impacting students' usage of technology-enhanced learning experiences. The study by Singh and Lee (2009) found that perceived usefulness and playfulness were significant factors whereas the easy-of-use was not important in predicting the students' attitude and intention to use these tools for learning. The study by Ali, Kumar Nair, and Hussain (2016) investigated the computer supported collaborative classrooms based on the UTAUT2 model and revealed that all examined factors impact their acceptance and usage by students. Likewise, the acceptance of online virtual platforms as digital game-based learning within Taiwanese university was examined by Chiao, Chen, and Huang (2018). It was found that all examined factors directly affect students' behavioral intention to use them.

Overall, the above outlined studies contributed to acquire a better understanding on issues regarding the usage of AR/VR technologies in tertiary tourism education. It could be argued that a body of knowledge was built up in this field. However, there are issues under-researched, extant literature calling for more research in this field (Chan et al., 2020; Radianti et al., 2020; Yung & Khoo-Lattimore, 2019). It is believed that there is a need for continued research in tourism education and to explore the factors impacting on the adoption and implementation in learning by users (educators and students) within an evolving educational environment. Our study is placed in this research realm by adopting the Technology Acceptance Model (TAM) as theoretical basis.

### 2.3. Theoretical basis and developing research hypotheses and model

Users adopt technologies in different ways and scholars proposed several theories and models aiming to explore their acceptance and use (Ukpabi & Karjaluoto, 2017). Some of these theories originated mainly in the field of information systems, e.g., Davis' (1989) Technology Acceptance Model (TAM) and Venkatesh, Morris, Davis and Davis's (2003) Unified Theory of Acceptance and Use of Technology (UTAUT). The TAM theory is based on the idea that perceived usefulness (PU) and perceived ease-of-use (PEOU) are the main influencing factors to predict users' attitudes toward and their intention to use a technology (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Venkatesh & Davis, 2000). Our study adopted and implemented TAM because it has received extensive empirical support (Ukpabi & Karjaluoto, 2017). Studies were conducted in different situations and contexts, such as university education, online learning and secondary education (Shroff, Deneen, & Ng, 2011; Singh & Lee, 2009; Wojciechowski & Cellary, 2013), suggesting that TAM is a solid theoretical model. According to Yung and Khoo-Lattimore (2019), TAM model is the most used theory by the studies on tourism education.

As indicated, TAM suggests four constructs, namely: Perceived usefulness (PU), Perceived ease-of-use (PEOU), Attitude towards use (ATT) and Behavioral intention to use (BI). PU is defined as the degree to which a person believes the use of a technology improve his/her performance (Davis, 1989; Davis et al., 1989). In this study, it is defined as the extent to which a student believes that AR/VR applications are useful for improving his/her effectiveness. PEOU is defined as the degree to which a person believes that the usage of a particular technology is easy and without efforts (Davis et al., 1989; Venkatesh, 2000). ATT is the user's evaluation of the desirability of employing a specific technology (Fishbein & Ajzen, 1975; Ajzen, 1991). Behavioral intention (BI) to use is a measure of the likelihood a person will use the technology (Fishbein & Ajzen, 1975; Ajzen, 1991).

The relationships between PU and PEOU and ATT were confirmed by many studies (e.g., Ali et al., 2016; Singh & Lee, 2009; Wojciechowski & Cellary, 2013). It is therefore expected that students' attitude toward AR/VR applications will be positive, if they have the perception that their use will assist them to achieve better performance (PU), and that these applications are effortless and easy to use (PEOU). Therefore, this study advances two hypotheses:

**Hypothesis 1.** (H1): Perceived usefulness positively influences students' attitude to use AR/VR applications for educational purposes.

**Hypothesis 2.** (H2): Perceived ease of use positively influences students' attitude to use AR/VR applications. for educational purposes.

Nevertheless, scholars indicated that TAM is too general and do not have the ability to provide insights on users' perceptions within a specific context (Ukpabi & Karjaluoto, 2017). Consequently, researchers should incorporate additional factors in order to improve its predicting utility (Mehta, Morris, Swinnerton, & Homer, 2019). In the context of tourism and education, scholars implemented an extended TAM by adding other antecedents to achieve higher explanatory/predictive capacity (Yung & Khoo-Lattimore, 2019; Mehta et al., 2019). This study argues that two factors are the most significant in the context of university education, namely (i) hedonic

motivation (HM) described as enjoyment, fun and reward (Agarwal & Karahanna, 2000), and (ii) perceived price value (PPV) implying cost and benefits, as perceived by students (Chau, 2010; Chen & Sun, 2014). Chau (2010) suggests that digital education should be regarded as a commodity, rendering factors such as HM and PPV fully relevant to the acceptance of digital technologies by students. Therefore, this study incorporates two additional factors that could significantly influence the adoption and use of VR/AR applications in the tertiary tourism education context.

**Hedonic motivation (HM):** this factor relates students' enjoyment and playfulness with the efficiency and the effectiveness of digital learning experience (Barak, Watted, & Haick, 2016; Padilla-Meléndez, del Aguila-Obra, & Garrido-Moreno, 2013). More particularly, enjoyment specifies the extent to which a person derives fun from using a technology (Van Der Heijden, 2004). HM is related to students' perception that digital learning is useful by facilitating their activities/tasks. Therefore, this study suggests that students who are intrinsically motivated are more likely to believe that AR/VR applications are useful and to intend to use them for learning purposes. Hence, this study argues that HM constitutes a factor influencing the students' attitude and posits a third hypothesis:

**Hypothesis 3.** (H3): Hedonic motivation (HM) positively influences students' attitude to use AR/VR applications for educational purposes.

**Perceived price value (PPV)** is the users/consumers' cognitive trade-off between the perceived benefits of technological applications and the monetary cost of using them (Dodds, Monroe, & Grewal, 1991; Venkatesh, Thong, & Xu, 2012). This construct incorporates the users' perception about a cost-benefit decision-making. The price value construct originated from the perceived value, which is often regarded as an important indicator in predicting user behaviour (Huang & Kao, 2015). It implies that users will have a positive opinion about the usefulness if the benefits are regarded as higher than the cost involved (Venkatesh et al., 2012). The concept was adopted to analyze users' adoption of digital technologies or smart mobile devices (Huang & Kao, 2015; Kim, 2016). This factor should be incorporated because university learning requires indirect monetary costs, such as commitment in time and effort, and the expected benefits are seen as the learning outcomes from Mehta et al. (2019), linking overall learning value to commitment and intentions to use technologies (Ain, Kaur, & Waheed, 2016). Therefore, this study includes PPV in the suggested research model as a predictor of students' attitude, advancing a fourth hypothesis.

**Hypothesis 4.** (H4): Perceived price value positively influences students' attitude to use AR/VR applications for educational purposes.

In this study's context, behavioral intention (BI) refers to the likelihood that students will use AR/VR applications for learning purposes. There is a strong relationship between BI and actual use (Huang et al., 2010; Yang, 2013; Nunkoo & Ramkissoon, 2013). Attitude refers to the students' general feeling that engaging in digital and hybrid learning. Favorable attitude toward a behavior results in strong intention to engage accordingly (Ajzen, 1991). Scholars demonstrated the strong relationship between the constructs ATT and BI (e.g., Singh & Lee, 2009; Escobar-Rodriguez & Monge-Lozano, 2012;; Ali et al., 2016; Chiao et al., 2018). Hence, this study postulated the fifth and last hypothesis:

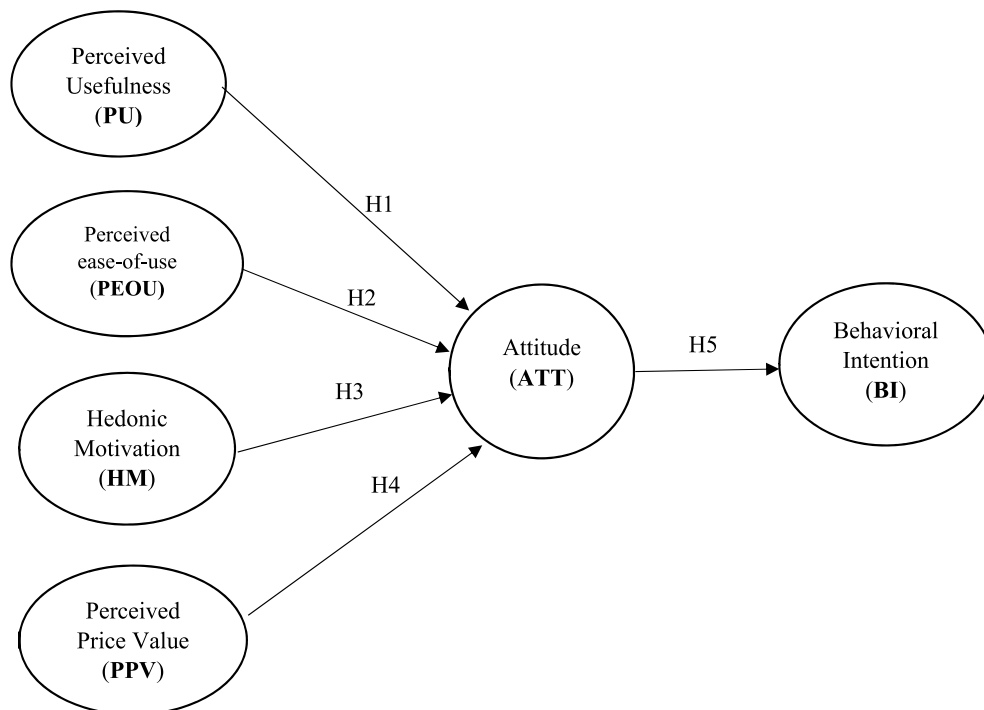


Fig. 1. Research model.

**Hypothesis 5.** (H5): Students' attitude towards use of digital learning environments positively effects their behavioral intention to use AR/VR applications for their studies.

Therefore, this study proposes six research constructs associated with the students' adoption of AR/VR in higher tourism education: Four antecedents (independent variables) and two dependent variables, i.e., Attitudes (ATT) and Behavioral intentions (BI), as depicted in Fig. 1.

An empirical study was performed in order to test the above research model.

### 3. Empirical study - methodology

In the following points are presented the main elements of empirical study who aimed to test and validate the suggested research model.

#### 3.1. Study context and research instrument

This study aimed to explore the students' perceptions about the factors influencing the acceptance of AR/VR applications in tourism education. To attain this aim, a research model was developed and an empirical investigation/survey was conducted. This study opted to conduct the empirical study in the Chinese context. The research team used the technique of survey (sessions and online).

The research instrument (questionnaire) encompassed four sections on: (i) concepts of AR/VR (with two questions); (ii) familiarity with and uses of AR/VR (with three questions); (iii) the six research constructs; and (iv) demographics (with six questions). The research constructs and items are depicted in Table 1. A total of 21 items were measured on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

The measurement scale and items were derived from the TAM model and previous studies in this field - such Venkatesh et al., 2012; Nunkoo & Ramkissoon, 2013; Huang & Kao, 2015; Ali et al., 2016; Mehta et al., 2019 - and were adapted to the specific context of this study (Chiao et al., 2018; Yang, 2013). A reliability analysis was conducted during the pilot test to assess the internal consistency of each measurement item in this study.

#### 3.2. Sampling

This study opted for a non-probability/purposive sampling and employed convenience and purposeful sampling technique. The targeted population was the students in tourism from Chinese universities. All the respondents were Chinese students following tourism studies and recruited via class announcements, posts on popular social networks and the assistance of colleagues from other universities. Participating students were from the Tourism Department, Ningbo University, Zhejiang Province, China (representing 61 per cent), the other participants coming from universities located in another 13 Chinese provinces. In class announcements, posts on WeChat and Weibo, and emails about the research project participation were made by the research team and all participants were recruited voluntarily. Primary data were obtained through self-administered (online and offline). A similar approach was adopted by previous studies in the same research area (e.g., Chiao et al., 2018; Huang et al., 2013; Sun et al., 2015). Data were collected from a sample of 630 undergraduate and postgraduate students; and the study yielded 604 useable questionnaires. Participants' age ranged

**Table 1**  
Questionnaire - Constructs and measurement items.

Constructs	Items
Perceived usefulness (PU)	PU1: AR/VR applications are useful in tertiary tourism education PU2: AR/VR applications enhance the quality of my learning PU3: AR/VR applications enable me to accomplish tasks more quickly PU4: Using AR/VR applications enhance my learning effectiveness
Perceived ease of use (PEOU)	PEOU1: Learning to use/operate AR/VR applications would be easy to me PEOU2: It is easy for me to become skillful at using AR/VR applications PEOU3: I find that the use of AR/VR applications is not complicated/does not require a lot of mental effort PEOU4: My interaction with AR/VR applications is clear and understandable
Hedonic motivation (HM)	HM1: Using AR/VR applications in learning is fun HM2: Using AR/VR applications in learning is enjoyable HM3: Using AR/VR applications in learning is very entertaining
Perceived Price Value (PPV)	PPV1: AR/VR applications could be beneficial for me compared to the needed efforts. PPV2: AR/VR applications should be worthwhile for me compared to the requested sacrifice. PPV3: Overall, AR/VR applications are of good value
Attitude to AR/VR applications (ATT)	ATT1: I like the idea of using AR/VR applications in my studies/learning ATT2: AR/VR applications make my learning more interesting ATT3: I like learning with AR/VR applications ATT4: My general opinion regarding AR/VR applications is positive
Behavioral intention (BI) to use AR/VR applications	BI1: I intend to use AR/VR applications for my studies in the future BI2: I predict I would use AR/VR applications for my learning experiences BI3: I plan to use AR/VR applications frequently

from 17 to 30 years with more female (77 per cent). Table 2 depicts the participant's profile. This phase was followed by the data collection conducted in February 2011.

### 3.3. Data collection

To collect the data, the research team implemented two methods, namely (i) survey sessions for the students of our university, and (ii) online questionnaire for the students from other Chinese universities because of the distance. As for the former, the following steps were taken. First, the research instrument was designed in English and Chinese. Second, a pilot test was conducted with a group of ten students in Tourism Management. Participants were asked to fill in the initial questionnaire with the aim to check out whether all questions were clearly and properly formulated. The questions were then finalized accordingly. Third, the research team searched and identified suitable videos demonstrating the AR/VR applications and their uses in tertiary education. An editing of various videos was performed in order to have a concise and short presentation of the topic in 16 min. Fourth, we organized survey sessions for briefing the students about the project, and then, to show them the video. Following the video watching, a short discussion was engaged. Overall, five sessions of groups, composed of various years of studies, were organized. Then, fifth and last step was the distribution of questionnaire asking the participating students to fill in. The survey sessions lasted in average 45 min. Regarding the second category of

**Table 2**  
Profile of sample ( $n = 604$ ).

Characteristics	Frequency (n)	Percentage (%)
<b>Gender</b>		
• Male	137	22.7
• Female	467	77.3
<b>Age group</b>		
• 17-	2	0.3
• 18 to 20	383	63.5
• 21 to 23	168	27.8
• 24 to 26	32	5.3
• 27 to 29	8	1.3
• 30+	11	1.8
<b>Degree/Diploma</b>		
• Higher vocational college student	157	26.0
• Undergraduate	347	57.4
• Master graduate candidate	74	12.3
• Doctoral candidate	6	1.0
• Other	20	3.3
<b>Year of studies</b>		
• First year	336	55.6
• Second year	91	15.1
• Third year	45	7.5
• Fourth year	39	6.5
• Master 1st year	41	6.8
• Master 2nd year	24	4.0
• Master 3rd year	24	4.0
• Doctorate candidates	4	0.7
<b>Specialty</b>		
• Tourism Management	392	64.9
• Hotel Management	55	9.1
• Tourism related (Tourism & Culture, Animation, Cruise Management, Geography, etc.)	157	26.0
<b>Location of university/Province</b>		
• Zhejiang	369	61.1
• Jilin	89	14.7
• Inner Mongolia	47	7.8
• Sichuan	20	3.3
• Anhui	16	2.6
• Xinjiang	15	2.5
• Jiangxi	7	1.2
• Fujian	6	1.0
• Guizhou	6	1.0
• Guangdong	5	0.8
• Shandong	5	0.8
• Other Provinces (Beijing, Shanxi, Jiangsu, Ningxia, Shanghai, Liaoning & Hubei)	19	3.2

students (participants from other Chinese universities), a similar approach but digital was followed making the briefing on the research project and the questionnaire available at the link: <https://www.wjx.cn/jq/104620952.aspx>.

The data was collected during February 2021 and received from 630 students. All completed questionnaires surveys were checked for missing data. A volume of 604 questionnaires were found utilizable for further analysis. According to Hair, Black, Babin, and Anderson (2009), partial-least-squares structural equation modelling (PLS-SEM) requires a sample size of ten times the number of indicators of the construct with the largest number of indicators. The sample size was 604, which is above the minimum required volume (Somekh & Lewin, 2005).

### 3.4. Data analysis: Analytical methods

This study applied PLS-SEM for testing the proposed model. SEM method gained increasing popularity and is widely accepted in tourism and education research (Nunkoo, Ramkissoon, & Gursoy, 2013). The SmartPLS 3 software was used for the analysis (Ringle, Wende, & Becker, 2015) by performing a two-step approach consisting of estimation of measurement model and testing of structural model (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014).

## 4. Results and discussion

### 4.1. Measurement model

Two types of validity were assessed, convergent validity and discriminant validity (Hair et al., 2009). The Confirmatory Factor Analysis (CFA) results show a good convergent validity, factor loadings of all items were greater than 0.70 (Table 3). Therefore, all items were suitable for further statistical analysis (Hair et al., 2009, 2014).

Three techniques - the correlations between variables and Average variance extracted (AVE), comparison between items loadings and cross loadings, and the heterotrait-monotrait ratio (HTMT) – were used to evaluate discriminant validity as suggested by Fornell and Larcker (1981). Discriminant validity showed to be very good (Table 4).

### 4.2. Structural model

Predictive capacity of research model: The main goal of PLS-SEM is to assess the structural model by evaluating the coefficient value ( $R^2$ ) of constructs (Hair et al., 2009). As shown in Table 5, the two dependent constructs meet the required level, ATT ( $R^2 = 0.719$ ) and BI ( $R^2 = 0.705$ ). The values were greater than 60 per cent demonstrating a very good explanatory power/predictability level. Moreover, the goodness of fit (GoF) index was calculated based on the adjusted  $R^2$  values of constructs. As shown in Table 5, the value of 0.800 indicates GoF.

Additionally, the model was evaluated by examining the predictive relevance ( $Q^2$ ) - critical to assess the predictive validity of a model -, effect size ( $f^2$ ) and multicollinearity (VIF) of the predicting constructs (Peng & Lai, 2012). As shown in Table 6, the all four predicting (exogenous) constructs had very large effects. Likewise, the predictive sample reuse technique ( $Q^2$ ) was applied (Chin, Peterson, & Brown, 2008). All  $Q^2$  values are positive (presented in Table 6) indicating acceptable predictive relevance of the model (Peng & Lai, 2012).

**Table 3**

Measurement model's results.

Variables	Items	Loadings	Cronbach's alpha	Composite reliability	Average variance extracted
Perceived Usefulness (PU)	PU1	0.944	0.966	0.975	0.909
	PU2	0.960			
	PU3	0.951			
	PU4	0.958			
Perceived ease-of-use (PEOU)	PEOU1	0.943	0.961	0.972	0.895
	PEOU2	0.959			
	PEOU3	0.942			
	PEOU4	0.941			
Hedonic Motivation (HM)	HM1	0.960	0.966	0.978	0.936
	HM2	0.969			
	HM3	0.972			
Price Value (PPV)	PPV1	0.943	0.927	0.954	0.873
	PPV2	0.934			
	PPV3	0.925			
Attitude (ATT)	ATT1	0.962	0.965	0.975	0.906
	ATT2	0.950			
	ATT3	0.950			
	ATT4	0.942			
Behavioral Intention (BI)	BI1	0.951	0.928	0.954	0.875
	BI2	0.953			
	BI3	0.900			

**Table 4**  
Discriminant Validity: Fornell-Larcker Criterion, Cross Loadings and HTMT ratio.

	ATT	BI	HM	PEOU	PPV	PU
ATT	<b>0.952</b>					
BI	0.839	<b>0.935</b>				
HM	0.781	0.702	<b>0.967</b>			
PEOU	0.627	0.598	0.693	<b>0.946</b>		
PPV	0.801	0.791	0.754	0.733	<b>0.934</b>	
PU	0.703	0.696	0.685	0.665	0.785	<b>0.953</b>

**Table 5**  
R<sup>2</sup> and goodness of fit index.

Constructs	AVE	R <sup>2</sup>
PU	0.909	—
PEOU	0.895	—
HM	0.936	—
PPV	0.873	—
ATT	0.906	0.719
BI	0.875	0.705
Average Scores	0.899	0.712
AVE*R <sup>2</sup>		0.640
√AVE*R <sup>2</sup> (GoF)		<b>0.800</b>

**Table 6**  
Blindfolding process: f<sup>2</sup>, Q<sup>2</sup> and VIF Values.

Constructs	Q <sup>2</sup>	F <sup>2</sup>	Collinearity statistics (VIF)
PU	0.758	0.015	2.818
PEOU	0.740	0.005	2.452
HM	0.738	0.221	2.651
PPV	0.643	0.193	3.752
ATT	0.754	2.385	1.000
BI	0.648		

Finally, standardized path examination was used to assess the hypothesized relationships, analyzing the effects of the independent constructs on dependent variables. Results (shown in Table 7 and Fig. 2) indicated that four hypotheses – H1, H3, H4, and H5 - had positive path coefficient and were significant at  $p < 0.001$  level. Therefore, these hypotheses are supported. On the contrary, hypothesis H2 (Influence of PEOU on ATT) was not supported. Thus, the results demonstrated support for four out of five hypotheses postulated by the study.

#### 4.3. Discussion of findings

This study attempted to analyze the factors influencing the acceptance of AR/VR applications in the Chinese universities within the context of ongoing Covid-19 pandemic. According to study's results, four out of five advanced hypotheses were supported. The study's findings are discussed and compared to the extant literature hereafter. Regarding H1, postulating that perceived usefulness is positively associated with students' attitude, was supported (path coefficient = 0.108). This finding confirms the suggestions by Singh and Lee (2009), Escobar-Rodriguez and Monge-Lozano (2012), Wojciechowski and Cellary (2013), and Ali et al. (2016), indicating that PU influenced students' attitude/behavioral intention. The finding is implying that when students believe that the AR/VR applications are useful, enhance their learning quality and performance, they are likely to use them for learning purposes. With respect to H2, advancing that the ease of use positively influences students' attitude, the result was not significant (path coefficient = -0.057). It seems that this factor does not have an influence on students' attitude. This finding is in line with Singh and Lee (2009); however, is

**Table 7**  
Structural Estimates: Path coefficients.

Hypotheses (H1 to H5)	Path coefficient (Beta - $\beta$ )	Standard deviation	T Statistics	p value	Study results
PU→ATT	0.108	0.049	2.185	0.029	Supported
PEOU→ATT	-0.057	0.052	1.092	0.275	Not supported
HM→ATT	0.406	0.087	4.689	0.000	Supported
PPV→ATT	0.452	0.069	6.552	0.000	Supported
ATT→BI	0.839	0.029	28.876	0.000	Supported



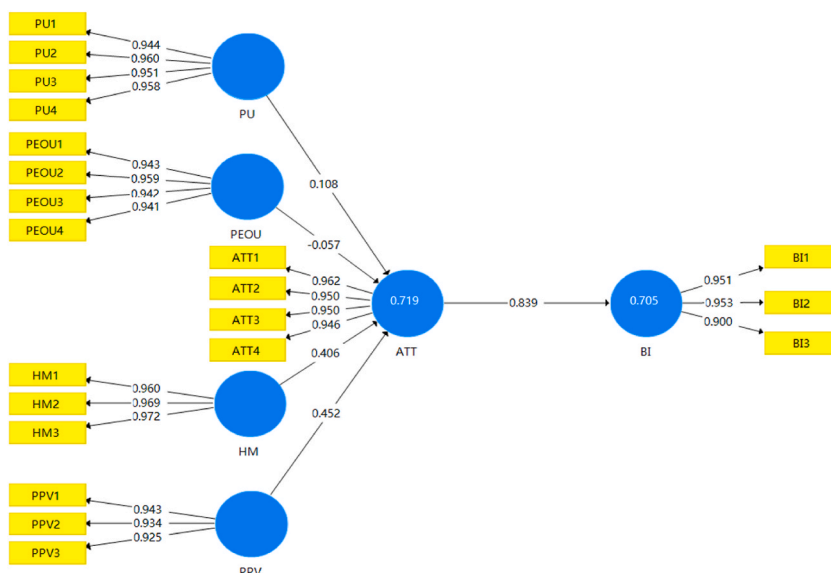


Fig. 2. Structural model with results.

different from other studies' findings (Ali et al., 2016). One possible explanation could be the familiarity of students belonging to Gen Z (or Centennials). Most of these students are very familiar with digital technologies; they use them in their everyday life. They believe that they have the skills and knowledge to use AR/VR applications, consequently this factor is not regarded as being influential on their attitude toward/intention to use them.

The results related to H3, proposing that hedonic motivation is positively related to students' attitude, were significant (path coefficient = 0.406). This finding confirms the results of studies conducted by Singh and Lee (2009), Venkatesh et al. (2012), and Ali et al. (2016). The study by Wojciechowski and Cellary (2013) revealed that the BI depends much more on perceived enjoyment than on PU. It is believed that higher playfulness or hedonic motivation would result in a higher attitude toward AR/VR applications. This finding confirms previous studies, indicating that students have positive attitude when they believe that AR/VR are more entertaining and interesting as compared to conventional teaching forms (Wojciechowski & Cellary, 2013; Ali et al., 2016). This finding highlights the importance of playfulness, fun, joy and entertainment as determining factors for using AR/VR applications in learning. Students of Gen Z expect these applications to be interesting, attractive and entertaining. Consequently, developers and educators should consider these elements when they design AR/VR applications and to encourage students for their usage.

With regard to H4, suggesting that there was a positive relationship between perceived price value and students' attitude, this hypothesis was supported (path coefficient = 0.452). This finding is in line with and confirming previous studies, e.g., Venkatesh et al. (2012), Ali et al. (2016), Ain et al. (2016), and Mehta et al. (2019). It is suggested that perceived price value constitutes an influential factor of students' intentions to use digital technologies (Ali et al., 2016; Escobar-Rodriguez & Monge-Lozano, 2012). Students in tourism believe that the usage of AR/VR is beneficial and of good value, deserving to make sacrifices. The resulting benefits are higher than the sacrifices needed. Therefore, perceived price value is an influencing predictor of students' attitude. In sum, perceived usefulness, hedonic motivation and price value directly affected student's attitude (intention to use) AR/VR applications for learning purposes. Chinese students considered that AR/VR applications are useful and improving their performance, fun and entertaining, worthwhile and beneficial to them.

Lastly, behavioural intention refers to the students' actual use of a technology. As for the last hypothesis, H5, proposing that students' attitude towards use of learning environments positively influences their behavioral intention to use AR/VR for educational purposes, the results were significant (path coefficient = 0.839). It was found a strong support for this hypothesis suggesting a significant effect of students' attitude toward AR/VR on their actual usage, which is consistent with TAM theory. Likewise, this finding is consistent with the study performed by Escobar-Rodriguez and Monge-Lozano (2012) and Ali et al. (2016). Therefore, universities and tourism related departments should devote resources to motivate users (students and educators) to boost their usage intentions for AR/VR applications. To achieve this aim, the most determining factors are usefulness, hedonic motivation and price value.

## 5. Conclusion and implications

### 5.1. Conclusion

All over the world, universities and other tertiary education institutions are currently facing many challenges and issues. Some of these challenges are incumbent and others have emerged due to the health crisis we are experiencing at global scale. Within this context, the continuous need for improvement is becoming an imperative for universities to tackle the challenges related to designing

and developing effective student experiences. New approaches, innovative ideas and applications are essential in times of crisis. The current health crisis therefore raises an opportunity for universities to consider how to capitalize on and make effective use of AR/VR potential. There is an imperative to deliver useful, interesting and entertaining educational experiences. Extant literature indicates that these applications could play an important role in the learning/teaching experience and improve its effectiveness. It is worth pointing out that AR/VR applications are definitely not a panacea for university education, and present many challenges for all stakeholders involved. This article argues that the main issue is to approach and consider these digital applications in an adequate manner and properly manage their implementation. In order to attain this strategic aim, universities and education practitioners should acquire an in-depth understanding of students' perceptions.

This study explored the students' perceptions by focusing on the factors influencing the acceptance and usage of AR/VR technologies in the Chinese tertiary tourism education, by implementing an extended TAM model as theoretical basis. Usefulness, hedonic motivation/playfulness and price value were found to be the determining factors for Chinese students' behavioral intentions to use AR/VR applications for learning purposes.

## 5.2. Implications

It is believed that study's contribution is twofold. First, the theoretical contribution is the elaboration of an extended TAM framework for the adoption and usage of digital technologies for educational purposes. The study supports the validity of TAM model and extends our knowledge in the field of adoption of smart technologies within the university setting for online/hybrid education. It contributes to a better knowledge of students' perceptions in the paradigm shift, by extending the validity of TAM theory in tourism education and allowing to acquire a better understanding of the students' perceptions and behavioral intentions and then, use this knowledge for educational purposes.

Second, the practical implication is to suggest key issues for education practitioners, as well as designers and developers of AR/VR applications regarding their effective use in tertiary tourism education. The implementation of AR/VR technologies should be fully compatible with a well-designed approach and appropriate strategies. Education practitioners in the field of tourism education, as well as designers and developers of AR/VR applications, should take seriously into account the students' perceptions and develop the adequate tools and activities. Universities and other tourism education providers must embrace the AR/VR and apply the right practices in their teaching strategies. The main issue is to utilize the right/suitable forms at the right time, in the right way within the adequate setting. This challenge is closely related to the issue of digital competence in the context of tertiary education; universities should devote more resources to the development of students and educators' digital competence. AR/VR applications that are well-designed, interacting and engaging are regarded as useful and entertaining by students and educators. The adequate utilization will enhance the offering of efficient and effective services to the students, if properly designed and used.

It is worth noticing that our study encompasses some limitations. The context of the empirical investigation constitutes the first limitation. China has some particularities and special features. Future research endeavors should investigate the research model in other countries/continents. Scholars could analyze the differences and similarities between in the influencing factors in other study contexts. Another interesting research pathway is to explore the perceptions of tourism educators about the value and effectiveness of AR/VR technologies. As digital technologies are implemented in the education, the empirical testing of the research framework from a temporal perspective could be the third research pathway. Future studies could more deeply explore the manner the AR/VR applications is put into practice and used. The aim of these research projects should be to identify possible improvements and issues to tackle. Another limitation is the chosen research approach. It is believed that the real impact of digital technology tools/applications in education are better understood with experimental research approaches which will help to determine the degree and nature of effects of their adoption and usage in learning. The perception-based studies are therefore limited in understanding the impact to that extent. This issue could be addressed by future research endeavors opting for experiment-based approach. Another interesting pathway is to explore possible improvements of the suggested research framework by adding factors/variables as moderating variables, such as students' personality traits and technology self-efficacy, to improve its value. Another research pathway could be the comparative analysis of the influence and the effectiveness of various forms of digital technologies used for educational purposes, by analyzing the distinct effect as well as the combined influence of various forms. Lastly, researchers could conduct comparative studies with a diversified sampling, i.e., students in tourism and in other disciplines/degrees.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jhlste.2022.100373>.

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