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Research Paper

Quality of virtual reality and its impacts on behavioral intention

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ABSTRACT

Although virtual reality (VR) has received growing attention and been adopted as customer engagement and marketing tools in the hospitality and tourism industry, little research has been conducted in quality assessment of VR and its impact on customers' psychological acceptance. Building upon the DeLone and McLean's IS success model, this study identifies the quality factors of VR and examines their impacts on customers' behavioral intention. This study develops a quality-driven VR framework and tests the proposed hypotheses assessing customers' behavioral intentions. For the empirical analysis, this study recruits potential U.S. customers and asks them to browse a VR-based destination website and then to answer the online survey related to VR applications. The collected responses are analyzed by PLS-SEM. Findings suggest that content quality, system quality, and vividness positively influence customers' attitude and telepresence, leading to their positive behavioral intention to visit the destination.

1. Introduction

Advanced digital technology has been reshaping the way customers plan for their trips and search for destination information nowadays. Customers do not have any spatial and temporal restrictions to experience their potential destinations prior to the actual visit. Various types of intelligence technologies such as virtual reality (VR) have transformed the traditional ways that people travel to and experience in a future destination. Through the digitally-accommodated environment, VR allows customers to experience products, services, or places before they purchase (Chung et al., 2015; Tussyadiah et al., 2018).

In this paper, VR refers to the use of a computer-generated three-dimensional (3D) environment, called as a 'virtual environment' (Guttentag, 2010). Customers are able to to navigate and interact with the virtual environment using a mouse or touchscreen (Guttentag, 2010). For instance, customers can move around and explore the virtual destination, and choose and arrange objects through navigation and interactive features (Guttentag, 2010). As VR enables customers to navigate and interact with the virtual environment, it offers a real-world feeling, called as telepresence, enhancing participants' active engagement in all features available in the given settings (Guttentag, 2010). Telepresence refers to "the sense of being present in the remote environment" (Steuer, 1992, 75). Telepresence explains customers' indirect, virtual experiences through the website (Li et al., 2002). With an advanced technology, customers are able to indirectly experience their future experiences via the mediated website features in a computer screen.

As one of the most innovative technologies and marketing tools, VR has been widely implemented in various hospitality and tourism areas including theme parks, museums, hotels, and destination marketing (Wei, 2019). Immersing in their future travel destination, customers can realistically portray their future travel activities and make feasible travel plans accordingly (Guttentag, 2010; Wei, 2019). Dependent upon whether the virtual destination is met to offer their expected travel activities, customers can mindfully be ready to make a booking decision or look for better options that satisfy their upcoming travel needs. VR can be a great marketing tool for hospitality and tourism destinations by generating more traffic and drawing customers' attention to the destination. For instance, Visit Santa Clara, the official destination marketing organization (DMO), provides a virtual tour service on its official website (www.santaclara.org) shown in Fig. 1. This VR destination tour gives potential customers dynamic views of the destination through website-based VR feasures and applications, such as 3D maps, videos, sounds, 3D graphics, and aerial views. However, it would be critical and important for VR developers or industry practitioners to answer whether VR carries quality features that satisfy customers'

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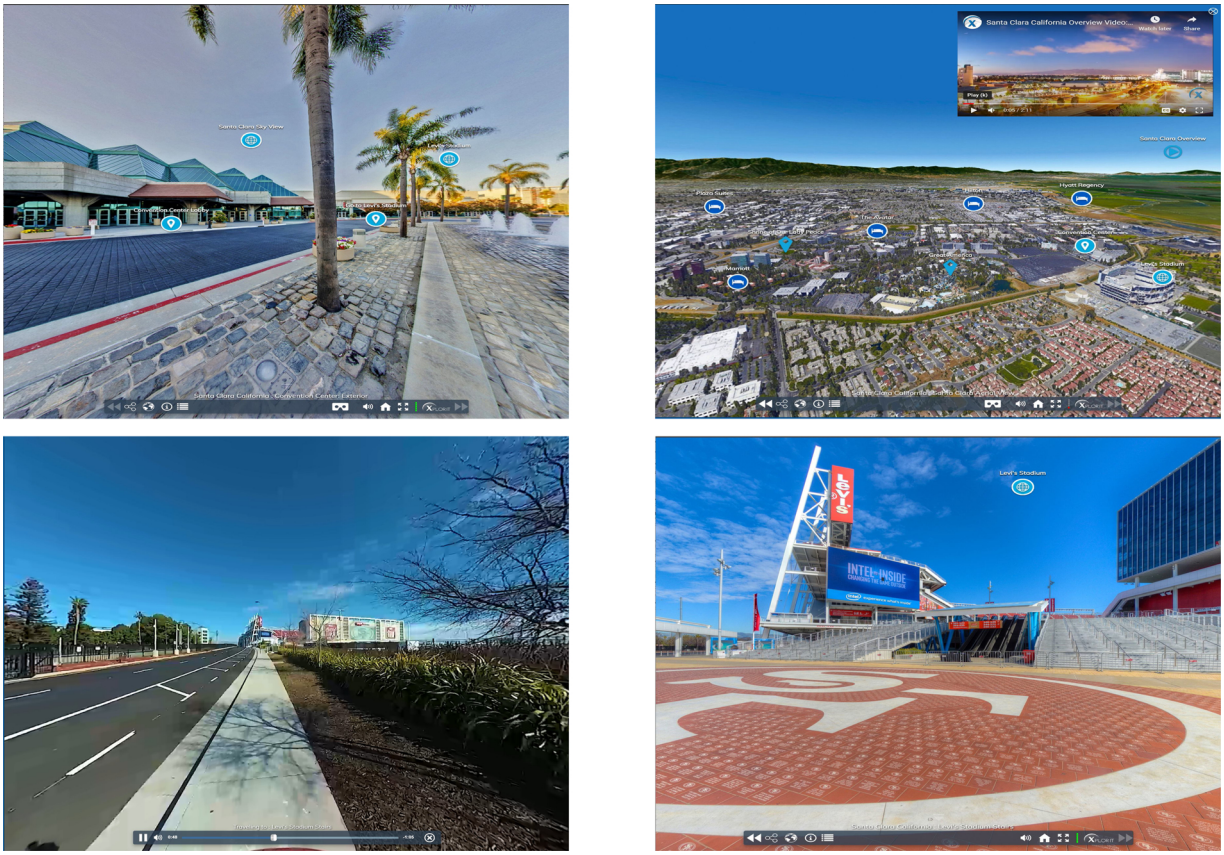

Fig. 1. An example of VR-based tour service on the Santa Clara official website (www.santaclara.org).

expectations at the same time whether it fulfills their virtual desires by being fully immersed in the place for their future trips.

Despite the industry's skyrocketing adoption of VR for customer engagement and its marketing efforts (Flavián et al., 2019), research in VR's roles, its quality assessment, and users' psychological acceptance of VR in the hospitality and tourism context is still at its infancy. Identifying and responding to issues related to VR, this study attempts (1) to examine customers' perceived importance of VR as a promotional marketing platform for their travel destination selection, (2) to evaluate VR by the pre-defined quality measurements for developing realistic and experiential VR from customers' perspectives, (3) to assess effects of VR on customers' behavioral intentions to visit the destination, and (4) to develop a quality-driven VR framework to increase the VR usage by both customers and industry.

2. Literature review

2.1. Virtual reality (VR) technology

With the technological advancement, customers easily engage in virtual environments. With affordable VR-support device (e.g., Google Cardboard) or available VR contents (e.g., 3D maps or contents, web- or mobile-based applications), customers are able to experience virtual tours from anywhere in the world by experiencing realistic presentations of the cities, hotels, restaurants, and other attractions (Tussyadiah et al., 2018). According to Barnes (2016, 4), "virtual reality affords marketers the opportunity to provide potential consumers with the most realistic experience of a product, service or place yet without necessary physical co-location." Using VR devices or VR contents, a customer can experience the virtual environment as if he or she were there. VR enables customers to retrieve information in multi-sensory modalities, utilizing visual, auditory, and 3D images (Tussyadiah et al., 2018).

With its extensive and practical features, VR has significant impacts on various industry sectors including healthcare (Keller et al., 2017), education (Merchant et al., 2014), museum (Jung et al., 2016), retails (Van Kerrebroeck et al., 2017), hotels (Israel et al., 2019; Zeng et al., 2020), and tourism (Guttentag, 2010; Tussyadiah et al., 2018). In particular, the idea of VR has been extensively applied in the hospitality and tourism industry. For instance, Zeng et al. (2020) examined how VR applications influenced the relationship between online reviews and behavioral intention in the context of the hotel booking. The VR enhanced customers' processing of online reviews when they make the hotel booking. Based on the surplus of VR research in the hospitality and tourism industry, Loureiro et al. (2020) analyzed previous VR and Augmented Reality (AR) research in the tourism context. They identified the most important topics of VR and AR, based on the review of 56 journal papers. The most researched topic in the VR and AR was atmospheric design recommendations, followed by cultural heritage and smart cities, seminal and trend papers, location-based information and image quality, mobile uses for sustainable tourism, tourism destination marketing, technology acceptance model, telepresence, case study, and AR.

Served as one of the major promotional channels in the hospitality and tourism industry (Huang et al., 2013), VR lowered customers' perceived risk of intangible hospitality and tourism services, since it encouraged customers to imagine their future trip through immersive, interactive, and enriched experiences (Rebelo et al., 2012). VR also provided easy accessibility to potential audiences, broadening global interactions among customers and enriching customers' consumption enjoyment (Huang et al., 2013). Customers could experience fun and hedonic entertainment while searching for information (Healy et al., 2016).

Prior VR research in the hospitality and tourism industry

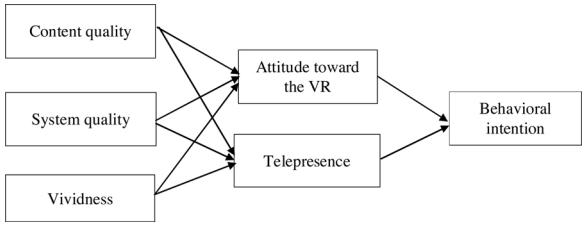

Fig. 2. A conceptual model.

investigated what factors influenced customers' VR acceptance and how VR technology shaped their experiences. For instance, Huang et al. (2013) investigated customers' acceptance of 3D virtual worlds. They identified the importance of perceived ease of use and perceived usefulness onto customers' enjoyment, emotions, involvement, and flow experience, based on the virtual world of Second Life. Tussyadiah et al. (2018) also identified how customers changed their attitude and visit intention reflected by VR experiences in the context of tourism destinations. Their study investigated tourists' VR experiences in both Hong Kong and the United Kingdom. In their study, VR presence and VR enjoyment captured customers' VR experience. In addition, Bogicevic et al. (2019) investigated the positive role of VR on customers' mental imagery, which then led to a sense of presence and hospitality and tourism brand experience in the context of the hotel stay. Moreover, Yeh et al. (2017) examined the role of VR on tourists' attention, interest, desire, and action. Their study compared information presentation modes including VR versus picture, to investigate the effectiveness of the information presentation mode when presenting the tourism attraction, such as Fort San Domingo, a building initially constructed by the Spanish in the late 1620s.

2.2. Information System (IS) success model

DeLone and McLean (1992) proposed an IS success model and identified six factors that attributed to IS success, including (1) system quality, (2) information quality, (3) use, (4) user satisfaction, (5) individual impact, and (6) organizational impact. System quality captured the technical level of communication, while information quality described the semantic level of communication (DeLone and McLean, 1992). The IS success model explained system quality and information quality influenced both IS use and user satisfaction, which then influenced both individual and organizational impacts.

Later, DeLone and McLean (2004) modified the IS success model to address limitations of the originally proposed model. DeLone and McLean (2004) developed an updated model by including service quality. Service quality was included in the IS success model due to the constantly changing nature of the IS environment. They recommended weighing three determinants- system quality, information quality, and service quality- differently, depending on the context when applying the IS success model (DeLone and McLean, 2004). In addition, individual and organizational impacts were replaced with net benefits. With these modifications, the IS success model enabled researchers to expand at any level of analysis depending upon the context and purpose of the research, including both organizations and individuals (Petter and McLean, 2009).

The IS success model has been applied to various contexts, explaining a user's adoption of various information systems. Those applications included a website (Rizal et al., 2018), an online shopping (Wang et al., 2018), a mobile application (Wang et al., 2019), an online learning (Aldholay et al., 2018), and an augmented reality (Kim and Hyun, 2016). In the hospitality and tourism industry, Gao et al. (2017) applied the IS success model and flow theory in examining the role of virtual travel community. They examined relationships among system quality, information quality, flow, satisfaction, stickiness, and word-of-mouth. Taking the IS success model as a theoretical background, Kim and Hyun (2016) investigated the effects of smartphone-based AR on usefulness, telepresence, and AR reuse intention. Telepresence is the sense of being present in the remote environment (Steuer, 1992, 75) and explained immersive experience through AR. They identified system quality, information quality, and service quality as key determinants of customers' usefulness or telepresence perceptions when using smartphone-based AR.

The IS success model has been extensively used to explore customers' IS adoption behavior and recently used to examine customers' adoption of digital technology such as AR (DeLone and McLean, 2004; Kim and Hyun, 2016; Rizal et al., 2018); however, its application has been underexplored in the context of VR in the hospitality and tourism industry. This study examined the effects of VR on customers' attitudinal and behavioral responses based on the IS success model and attitude-behavior theory as theoretical backgrounds. Extending the IS success model, the present study proposed the following conceptual framework (see Fig. 2).

3. Hypotheses development

3.1. Important features of VR as a destination marketing tool

Hospitality and tourism marketers develop innovative ways to promote a destination and increase customers' visit intentions (Baker and Cameron, 2008). VR enriches hospitality and tourism experiences (Bonetti et al., 2018) through a facilitation of immersive, engaging virtual environment (Jung et al., 2018). Based on prior VR research, the current study investigated the role of content quality, system quality, and vividness of VR on customers' attitudinal and behavioral responses in the context of the destination marketing.

Content quality refers to the quality of the information provided by VR. It explains content accuracy, completeness, and content presentation format (Nelson et al., 2005). DeLone and McLean (2003) emphasized the importance and relevance of content quality in the IS success research. Content quality was further emphasized in various technological applications. Jung, Chung, and Leue (2015) investigated the importance of content quality in the context of augmented reality technology and Lai (2015) identified the importance of content quality in the context of app-based mobile tour guides. Referring to the prior research that identified the positive effects of content quality in different technological contexts, it was predicted that when customers perceived content quality in VR, they developed favorable responses toward the VR. Thus, the following hypotheses are proposed.

H1. Content quality of VR positively influences customers' attitudes toward the VR.

H2. Content quality of VR positively influences telepresence.

System quality refers to "a system wherein the desired characteristics of both mobile devices and web browsing services are believed to be available to users" (Chen, 2013, 27). System quality explains reliability, convenience of access, response time, and system flexibility (DeLone and McLean, 2003). Previous research confirmed the importance of system quality in various technological application, including mobile broadband services (Wang and Chen, 2011), mobile shopping (Chen, 2013), and augmented reality (Jung et al., 2015). Adopting the DeLone and McLean's IS model, Jung et al. (2015) stressed the effects of system quality on customers' responses and identify the importance of system quality on customers' satisfaction and loyalty when they interact with the augmented reality technologies. System quality also enhances customers' experiences, enabling them to feel there. For instance, Kim and Hyun (2016) demonstrated that there were significant relationships among system quality, information quality, service quality, telepresence, and augmented reality reuse intention based on the Technology Acceptance Model (Davis et al., 1989). Thus, this study proposes following hypotheses.

H3. System quality of VR positively influences customers' attitudes toward the VR.

H4. System quality of VR positively influences telepresence.

Vividness refers to "the representational richness of a mediated environment as defined by its formal features; that is, the way in which an environment presents information to the senses" (Steuer, 1992, 81). Enriching depth and breadth enhances the level of vividness. Depth explains the quality of the represented information as perceived by media users and breath refers to the number of sensory dimensions a communication medium can provide (Li et al., 2002). In the context of e-commerce, vividness was related to the quality of product presentations that stimulated customers' cognitive elaboration processes (Jiang and Benbasat, 2007). For instance, rich media that include video, audio, and animation foster vividness on the destination's website. When customers were exposed to a vivid website, they tended to develop favorable attitudes toward the product (Coyle and Thorson, 2001). Vividness also contributed to customers' telepresence (Steuer 1992). Yim, Chu, and Sauer (2017) identified the importance of vividness in the augmented reality technology in enhancing customers' immersion experience in the context of e-commerce. When destination information was described in a rich manner, a high level of telepresence was expected. Thus, the following hypotheses are proposed.

H5. Vividness of VR positively influences customers' attitudes toward the VR.

H6. Vividness of VR positively influences telepresence.

3.2. Outcomes of customers' VR experience

Prior VR research identified how VR experience led to customers' positive responses, such as enriched experiences (Yim et al., 2017), brand recognition (Kim and Biocca, 1997), favorable attitude (Chung et al., 2015), satisfaction (Jung et al., 2015), and behavioral intentions (Huang et al., 2013). Attitudes toward the VR are based on customers' subjective evaluations of the overall VR experience. Derived from the definition of the attitude toward an advertising, attitude toward the VR refers to "a pre-disposition to respond in a favorable or unfavorable manner to stimulus" on the VR (Lutz, 1985, 46). Attitudes toward the VR were viewed as important predictors of customers' behavioral intentions, which referred to customers' likelihood to visit the destination. Ajzen's (1991) theory of planned behavior advocated the importance of intentions that led to the actual behaviors. Based on the well-established relationship between attitude and behavioral intention, the following hypothesis is proposed.

H7. Customers' attitudes toward the VR positively influence their behavioral intention to visit the destination.

VR serves as a powerful hospitality and tourism marketing tool because it offers vivid imagery of hospitality and tourism destinations and the immersive experience to potential customers (Huang et al., 2016). Immersive experience explains telepresence, which refers to the sense of being present in the virtual environment (Steuer, 1992, 75). Telepresence plays a critical role in the hospitality and tourism industry because customers have limited access to evaluate their future travel experience before they visit the destination. Intangible components of the travel consumption cannot be evaluated until customers experience them; thus, inherent risks of the hospitality and tourism experiences are higher than those of the tangible products (Nelson, 1970).

Customers are virtually immersed to the destination via the interactive and immersive characteristics of VR experiences (Spielmann and Mantonakis, 2018). By immersing to the virtual environment, customers might develop their visit intentions to the destination. Prior research (i.e., Lee, 2018) identified the positive relationship between telepresence and behavioral intention. Lee (2018) demonstrated the positive relationship between telepresence and customers' visit intentions in the context of the hotel industry. Willems et al. (2019) also investigated the positive influence of telepresence on purchase intentions targeting millennials. Their study investigated effects of VR, interactivity, and vividness on telepresence in the travel destination, New York City. Thus, it is predicted when customers have telepresence, they develop strong visit intentions to the destination, proposing the following hypothesis.

H8. Telepresence positively influences customers' behavioral intention to visit the destination.

4. Methodology

The current study used the website-based VR services provided by Santa Clara's official DMO to measure customers' perceptions toward VR and assess their impact on attitudes toward the VR and behavioral intention. We applied the IS success model to propose the structured research framework and empirically test it by using a field survey method. A survey questionnaire was developed by adapting construct measures that have been previously used and validated.

4.1. Study context

In order to examine customers' perceptions of VR, this study used one of the website-based VR services, Santa Clara Virtual Tour, introducing Santa Clara hotels and attractions on the official Visit Santa Clara website (www.santaclara.org). Visit Santa Clara is Santa Clara's official DMO website in CA, USA and partly funded by the Santa Clara Tourism Improvement District. The website offers various information and tools allowing potential customers to plan their trips to Santa Clara as shown in Fig. 1. One of the interactive website-based services is "Santa Clara Virtual Tour" (https://www.xplorit.com/santa-clara-california). This VR-based service enables potential customers to take a virtual tour around Santa Clara, showing Santa Clara's attractions and hotels with interactive videos and diverse aerial views on the Visit Santa Clara website. It offers dynamic (inside and outside) views of attractions and hotels, social sharing tools, 3D maps, detailed local information with videos, audios, and photos, interconnected 3D travel transitions. Browsing the interactive online map, the potential customers have the real and interactive VR experience and explore the city, attractions, and hotels, allowing them to plan their trip to the destination in advance.

4.2. Survey design

An online self-administered field survey was performed, hosted on Qualtrics, by using a convenient sampling method. A convenience sample of 247 U.S. adults who have used VR, was recruited from an online survey company, Qualtrics. Survey participants were required to browse the virtual tour of Santa Clara for at least 3 min on its official DMO website (www.santaclara.org) to make a travel plan for their conference in a week. Then they had to answer the following three verification questions: (1) How many minutes did you take a virtual tour of Santa Clara before you stopped watching?; (2) Please check the attractions you have visited; and (3) Which social media is the virtual tour site connected? Those who properly verified their virtual tour activity proceeded to answer the online survey.

The survey has three sections: the first section contains items asking respondents about their familiarity with the destination (i.e., Santa Clara in California) and advanced technology (e.g., virtual technology, mobile devices, etc.); the second section asks questions on six measurement constructs (i.e., content quality, service quality, vividness, telepresence, attitude, and behavioral intention); and, the last section asks questions related to respondents' socio-demographic information. All measurement constructs are operationalized with multi-items on a

5-point Likert-type scale, ranging from 1: strongly disagree to 5: strongly agree, except for the two constructs, vividness and attitude, which are measured with a 5-point semantic differential scale. Each measurement construct is adopted from well-developed prior research with some minor wording changes to fit in this study's context of virtual reality.

4.3. Measurements

All measurement items have been adopted from previous research, for example, three items of content quality (Jung, Chung, and Leue 2015; Yang et al., 2005), three items of system quality (Jung, Chung, and Leue 2015; Rivard et al., 1997), three items of telepresence (Jung, Chung, and Leue 2015; Rivard et al., 1997), six items of vividness (Yim et al., 2017), three items of attitude towards virtual tour (Muehling, 1987), and three items of behavioral intention (Phillips et al., 2013). Before launching the actual online survey with participants, a pilot test with students majoring in hospitality and tourism management at midwestern, southeastern, and southern universities in the U.S., respectively. In addition, expert reviews were conducted with three hospitality researchers after the measurement items were revised. The detailed measurement items are shown in Table 1.

5. Results

A descriptive analysis was conducted to identify the characteristics of the respondents' socio-demographic profile and to obtain the mean values of the items in each measurement construct. For both the measurement and the structural model analyses, this study conducted partial least squares SEM (PLS-SEM) analyses in light of the fact that the PLS-SEM approach can be used to develop theories further by focusing on the variance in the dependent variables in exploratory research (Hair et al., 2016). Moreover, this approach mainly focuses on sophisticated models in order to predict key target constructs or to perform theory testing (Hair et al., 2004, Hair et al., 2019). PLS-SEM is a variance-based approach that evaluates the measurement and structural model results by using a set of nonparametric evaluation criteria and procedures, such as bootstrapping and blindfolding. SmartPLS 3.0 software (Ringle et al., 2015) was used to examine the conceptual framework developed in this study.

Table 2
Sample characteristics.

Characteristics	Frequency (n = 247)	Percentage (%)
Gender		
Male	127	51.4
Female	120	48.6
Age		
18 – 25 years old	31	12.6
25 – 34 years old	61	37.2
35 – 44 years old	47	19.0
45 – 54 years old	31	12.6
Over 55 years old	77	31.2
Annual household income		
Less than $50,000	108	43.7
$50,000 - $90,000	86	34.8
More than $90,000	53	21.4
Occupation		
Student	12	4.9
Employed full time	100	40.5
Employed part time	28	11.3
Unemployed	43	17.4
Retired	64	25.9
Have you been to Santa Clara?		
Yes	83	33.6
No	164	66.4

5.1. Characteristics of the sample

A total of 247 usable responses were obtained to test structural relationships. The majority of respondents were between 26 and 34 years old (24.7 %) and males (51.4 %) (see Table 2). More than half of them

Table 1
Results of the confirmatory factor analysis for the measurement model (n = 247).

Construct and measurement item	Mean (Std.)	Factor loading
Behavioral intention (Composite Reliability = 0.916; Cronbach α = 0.862; AVE = 0.784)[a]		
BI1. I will consider Santa Clara as the first choice for my trip.	3.61 (.85)	0.874
BI2. I intend to visit Santa Clara in my next trip.	3.61 (.91)	0.913
BI3. I plan to visit Santa Clara in the future.	3.94 (.83)	0.869
Telepresence (Composite Reliability = 0.881; Cronbach α = 0.798; AVE = 0.712)[a]		
TR1. I feel I am in the place.	4.10 (.79)	0.843
TR2. I want to have a realistic experience through the virtual tour.	4.17 (.71)	0.842
TR3. The virtual tour will complement a real tour.	4.04 (.80)	0.846
Attitude (Composite Reliability = 0.945; Cronbach α = 0.913; AVE = 0.851)[b]		
My attitude toward the virtual tour was:		
AT1. Bad – Good	4.52 (0.67)	0.926
AT2. Negative – Positive	4.48 (0.72)	0.906
AT3. Unfavorable – Favorable	4.48 (0.68)	0.936
Content quality (Composite Reliability = 0.889; Cronbach α = 0.814; AVE = 0.728)[a]		
CQ1. The virtual tour gave me an overview of Santa Clara.	4.20 (.71)	0.855
CQ2. The virtual tour provided relevant information of Santa Clara for my travel plans.	4.19 (.69)	0.856
CQ3. The virtual tour was helpful for me to plan my trip to Santa Clara.	4.13 (.73)	0.849
System Quality (Composite Reliability = 0.871; Cronbach α = 0.779; AVE = 0.693)[a]		
SQ1. The virtual tour was easy to maneuver or navigate.	3.85 (.94)	0.837
SQ2. The interface of the virtual tour was user friendly.	4.05 (.87)	0.851
SQ3. The virtual tour was interactive.	4.09 (.75)	0.808
Vividness (Composite Reliability = 0.930; Cronbach α = 0.910; AVE = 0.691)[b]		
VI1. The imagery of this virtual tour was unclear/clear.	4.68 (.60)	0.758
VI2. The imagery of this virtual tour was weak/strong.	4.28 (.80)	0.827
VI3. The imagery of this virtual tour was fuzzy/right.	4.36 (.82)	0.867
VI4. The imagery of this virtual tour was dull/sharp.	4.36 (.81)	0.817
VI5. The imagery of this virtual tour was hazy/vivid.	4.40 (.75)	0.861
VI6. The imagery of this virtual tour was poorly-defined/well-defined.	4.38 (.76)	0.852

[a] A 5-point Likert-type scale, 1: strongly disagree to 5: strongly agree.
[b] A 5-point semantic differential scale.

(56.3 %) reported to earn at least $50,000 for their annual household income. In terms of the previous travel experience in Santa Clara, CA, approximately 34 % of participants have been to Santa Clara before. Generally, the respondents seemedto know about Santa Clara (average of familiarity of Santa Clara = 2.8 out of 5.0).

5.2. Measurement model test

Following Anderson and Gerbing's (1988) two-step approach for the measurement model and testing, this study first checked the measurement model by eliminating the measured variables or latent factors that did not fit well, based on the initial confirmatory factor analysis (CFA). CFA is a statistical method of testing how well measured variables represent a smaller number of constructs (Hair et al., 2014a,b). In this study, CFA was used to provide a confirmatory test of a measurement model. PLS-SEM model assessement allows us to examine the reliability and validity of the measured constructs (Hair et al., 2016). Since model fit measures should be very cautiously and tentatively considered for PLS-SEM estimations (Hair et al., 2016, 2019), we used nonparametric evaluation criteria based on bootstrapping and blindfolding (Hair et al., 2016).

As shown in Table 1, this study tested the adequacy of the measurements by evaluating the reliability of the individual measures, convergent validity, and the discriminant validity of the constructs (Hulland, 1999; Hair et al., 2019). Each investigated measurement construct yielded a Cronbach's alpha value and composite reliability of greater than 0.70 as a recent study of Hair et al. (2019) recommended. The convergent validity of measurement at both the item and construct levels was examined by the item loadings and average variance extracted (AVE). All individual item loadings were greater than 0.70 (or 0.60 in exploratory research), which indicated that there were more variances with the construct measured than with error variances (Gefen et al., 2000). An AVE greater than 0.50 manifested a construct that shared more variance with its indicators than with error variance (Fornell and Larcker, 1981). Thus, all measurement items exhibited good convergent validity, as suggested. Lastly, we tested discriminant validity based on the criterion suggested by Fornell and Larcker (1981). The Fornell-Larcker criterion suggests that a construct shares more variance with its associated indicators than with other constructs in the model (Fornell and Larcker, 1981; Hair et al., 2016). This study tested discriminant validity by comparing the correlations among constructs and AVE values. All constructs showed discriminant validity since all correlations were lower than the square root of the variances extracted (Ali et al., 2018; Hair et al., 2019), showing that all indicators were better explained by their respective constructs than other constructs explaining indicators in a different construct (Henseler et al., 2015) as shown in Table 3.

We also assessed cross-loadings and check Heterotrait-Monotrait Ration (HTMT) to establish more rigorous discriminant validity (Hair et al., 2012, 2016). As shown in Table 4, each indicator's loading on the construct was considerably higher than all of its cross-loadings with the other constructs and the HTMT values are significantly different from 1. Overall, the Fornell-Larcker criterion, as well as the cross-loadings, provided strong evidence for the constructs' discriminant validity.

Table 3
Correlation matrix and discriminant validity.

	1	2	3	4	5	6
1. Content quality	**0.853**					
2. System quality	0.685	**0.833**				
3. Vividness	0.557	0.445	**0.831**			
4. Attitude	0.594	0.530	0.691	**0.923**		
5. Telepresence	0.796	0.698	0.575	0.557	**0.844**	
6. Behavioral intention	0.578	0.561	0.334	0.499	0.560	**0.886**

Note. All correlations were statistically significant at $p < 0.01$.

5.3. Common method bias

Due to the nature of this study, we examined the common method bias based on prior research (e.g., Jeong et al., 2016, Liang et al., 2007, Podsakoff et al., 2003). We performed a statistical analysis to assess the severity of common method bias by using the single-method factor approach in SmartPLS 3.0. We created a common method factor that includes all of the principal constructs' indicators and then assessed each indicator's variances substantively explained by the principal construct and the common method. The results showed that the average substantively explained the variance of the indicators is 0.742, while the average method-based variance is 0.011. The ratio of substantive variance to method variance is approximately 66:1, and most method factor loadings are not significant, indicating that there is a small magnitude and insignificance of method variance as shown in Appendix 1. Therefore, common method bias was not likely to be a serious problem in this study.

5.4. Structural model and hypothesis testing

The eight hypotheses were developed to validate the study's conceptual framework. Following the criterion suggested by Hair et al. (2019), we assessed the hypothesized relationships on the basis of the explained variance (R^2) of the dependent variables, path coefficients (β), and their levels of significance obtained from a bootstrapping re-sampling method (2470 re-samples) (Chin, 1998). As shown in Table 5, all proposed hypotheses were supported at $p < .01$. The results indicate that content quality ($\beta = 0.194$, $t = 2.499$), system quality ($\beta = 0.170$, $t = 2.825$), and vividness ($\beta = 0.509$, $t = 7.431$) were positively associated with attitude, supporting H1, H3, and H5. As proposed, content quality ($\beta = 0.518$, $t = 6.534$), system quality ($\beta = 0.272$, $t = 3.518$), and vividness ($\beta = 0.165$, $t = 3.861$) were positively associated with telepresence, supporting H2, H4, and H6. In turn, attitude ($\beta = 0.271$, $t = 4.010$) and telepresence ($\beta = 0.411$, $t = 6.534$) positively influenced behavioral intention, which resulted in both H7 and H8 being supported in this study.

In addition, our PLS-SEM analysis provides empirical support for the mediating role of attitude toward VR and telepresence on customer behavioral intention, respectively. To test multiple mediation effects, we additionally checked both specific indirect effects and total indirect effects by running a bootstrapping procedure (Hair et al., 2019). The direct relationship between content quality and behavioral intention ($\beta = 0.265$, $t = 5.570$) and the direct relationship between system quality and behavioral intention ($\beta = 0.158$, $t = 3.892$) are also significant. Similarly, the direct relationship between vividness and behavioral intention is statistically significant ($\beta = 0.206$, $t = 5.566$). As shown in Table 6, all specific indirect effects are significant. Therefore, we confirmed there exists complementary mediation (partial mediation) in this study (Hair et al., 2016; Zhao et al., 2010).

6. Discussion and implications

Building upon DeLone and McLean's IS Model (2003), this study developed a VR quality framework to measure the effects of VR quality on customers' psychological perception (i.e., attitude) and immersion (i.e., telepresence) that ultimately led to their behavioral intention. As proposed, the three VR quality measurements, content quality, system quality, and vividness, appeared to have strong positive effects on both attitude and telepresence, supporting hypotheses 1 through 6. Both attitude and telepresence were played as statistically significant mediators in the relationship between the VR quality constructs and behavioral intention, which also supported hypotheses 7 and 8. Between the two mediators, telepresence ($\beta = .411$, $p < .01$) was a much stronger predictor for respondents' behavioral intention to visit the given destination through VR than attitude ($\beta = .271$, $p < .01$). Thus, the respondents appeared to be highly immersed into the virtual destination

Table 4
Alternative discriminant validity check.

Construct	Items	1	2	3	4	5	6	HTMT confidence interval does not include 1
1. Content quality	CQ1	0.855	0.502	0.393	0.484	0.631	0.418	YES
	CQ2	0.856	0.608	0.511	0.528	0.657	0.517	
	CQ3	0.849	0.635	0.515	0.507	0.743	0.536	
2. System quality	SQ1	0.531	0.837	0.328	0.434	0.576	0.462	YES
	SQ2	0.549	0.851	0.373	0.473	0.577	0.461	
	SQ3	0.632	0.808	0.411	0.416	0.592	0.479	
3. Vividness	VI1	0.392	0.231	0.758	0.570	0.397	0.236	YES
	VI2	0.508	0.440	0.827	0.569	0.498	0.356	
	VI3	0.493	0.359	0.867	0.567	0.485	0.275	
	VI4	0.452	0.396	0.817	0.582	0.481	0.315	
	VI5	0.485	0.368	0.861	0.568	0.490	0.211	
	VI6	0.446	0.415	0.852	0.590	0.510	0.270	
4. Attitude	AT1	0.537	0.473	0.622	0.926	0.499	0.476	YES
	AT2	0.502	0.496	0.597	0.906	0.512	0.398	
	AT3	0.599	0.500	0.688	0.936	0.529	0.499	
5. Telepresence	TR1	0.652	0.577	0.510	0.452	0.843	0.456	YES
	TR2	0.677	0.617	0.509	0.463	0.842	0.396	
	TR3	0.685	0.576	0.439	0.493	0.846	0.559	
6. Behavioral intention	BI1	0.488	0.540	0.290	0.444	0.495	0.874	YES
	BI2	0.505	0.520	0.250	0.410	0.483	0.913	
	BI3	0.539	0.433	0.343	0.467	0.509	0.869	

to have a real feeling of Santa Clara (x^{-} = 4.10 at a 5-point scale) and their visit intention seemed to be more dependent upon their mental immersion (telepresence) than attitudinal feelings.

Findings of this study identified key quality factors that affected respondents' use of VR to maximize their experience and increase their future visit intention to the destination. Among the three key quality factors, content quality was the key predictor for telepresence, followed by system quality and vividness, while vividness appeared to be the most powerful predictor for attitude, followed by content quality and system quality. Thus, the VR's content quality can be a main factor that would make customers immersed in the virtual destination and have positive attitudes toward the VR, leading to a visit intention to a destination. This requires hospitality and tourism practitioners to incorporate such quality features as destination bird view, travel-specific information, and customized tour options into the VR design. In addition, VR should be developed user friendly, interactive, and vividly rich content to encourage customers feel presence in the destination and to develop positive VR experience. Respondents' positive attitudes toward the VR and their feelings of presence eventually led to their intention to visit the destination.

Findings of this study provide theoretical contributions to the field of VR in the context of hospitality and tourism consumption. First, this study extends the application of VR technology to the destination promotional tool. To the authors' best knowledge, little research has documented the quality measurement of VR and its effects on customers' attitudinal and behavioral responses. Exemplifying the virtual tour of Santa Clara, this study examined customers' perceptions of VR quality and its effects on their psychological and experiential behavior for their future travel destination.

Second, extending the IS success model, this study incorporates vividness and telepresence as important determinants of influencing customers' VR experience in the hospitality and tourism industry. Both vividness and telepresence play important roles in the tourism destination selection because these features offer customers realistic destination feelings, which potentially prevents issues caused by inseparable characteristics of hospitality and tourism offerings. Prior research (e.g., Bogicevic et al., 2019) supports the importance of triggering vivid future experience in influencing customers' decision-making process, in addition to system quality and information quality of the technology. As both content and system quality constructs have been frequently used in studies such as information system (DeLone and McLean, 2004), website quality (Rizal et al., 2018), and augmented reality (Jung et al., 2015) to identify the quality features of each system under investigation, telepresence has been uniquely added into the current study to test the effectiveness of VR usage. The telepresence construct has strengthened the study's framework, representing its stronger predictor for behavioral intention than attitude.

Third, previous scholars investigated factors that influenced

Table 5
Results of hypothesis test[a].

Structural Paths	β	S.E.	*t*-ratio	Hypothesis Testing
Content quality → Attitude (H1)	0.194	0.078	2.499**	Supported
Content quality → Telepresence (H2)	0.518	0.080	6.534**	Supported
System quality → Attitude (H3)	0.170	0.061	2.825**	Supported
System quality → Telepresence (H4)	0.272	0.076	3.518**	Supported
Vividness → Attitude (H5)	0.509	0.068	7.431**	Supported
Vividness → Telepresence (H6)	0.165	0.043	3.861**	Supported
Attitude → Behavioral intention (H7)	0.271	0.067	4.010**	Supported
Telepresence → Behavioral intention (H8)	0.411	0.063	6.534**	Supported

*$p < .05$, ** $p < .01$.
[a] R^2 for Attitude = .556[1]; R^2 for Telepresence = .697[1]; R^2 for Behavioral intention = .364[1].

Table 6
Robust analysis: Mediating role of Attitude and Telepresence.[a]

Indirect effect	β	S.E.	*t-value*	*p-value*	95 % Confidence Interval		Significance ($p < .05$)
CQ → AT → BI	0.052	0.025	2.124	0.034	[0.015	, 0.116]	Yes
SQ → AT → BI	0.046	0.020	2.287	0.022	[0.015	, 0.099]	Yes
VI→ AT → BI	0.138	0.040	3.407	0.001	[0.064	, 0.221]	Yes
CQ → TR→ BI	0.213	0.045	4.733	0.000	[0.131	, 0.309]	Yes
SQ → TR → BI	0.112	0.038	2.868	0.004	[0.051	, 0.207]	Yes
VI → TR → BI	0.067	0.020	3.470	0.001	[0.034	, 0.113]	Yes

BI: behavioral intention.
[a] CQ: content quality; SQ: service quality; VI: vividness; AT: attitude; TR: telepresence.

customers' attitude toward the VR, their VR adoption intention, and their visit intentions reflected by VR experience; yet, prior research has not investigated effects of VR from the IS success model on attitude toward the VR and behavioral intentions. Prior research suggests applying attitude-behavior relation theory (Ajzen and Fishbein, 1977) to better understand VR experiences (Kim et al., 2018). Thus, this study bridges DeLone and McLean's (1992) IS success model and attitude-behavior theory in exploring the role of VR on customers' attitudinal and behavioral responses.

Findings of the study can be implemented for tourism destination organizers or hospitality marketers to use VR for promoting and marketing destinations (e.g., attractions, restaurants, hotels). Through VR, customers will have enriched and immersed experience that they feel like they are in the destination so that they can select the best destination relevant to their needs out of several destination options. In particular, findings of the current study can benefit a destination marketing organization in promoting its destination to meeting/event planners for their future meeting/event venue. The meeting/event planners can virtually tour potential destinations for their meetings and events before conducting physical site visits for the purpose of saving time and costs related to travel and labor. For the effective use of VR for destination marketing, the hospitality and tourism industry practitioners should know what quality features the VR should have and offer their clients. Among the VR quality factors, destination organizers and hospitality marketers should pay special attention to building such destination contents as the comprehensive view of the destination along with nearby attractions, customers-tailored information about the destination, and information readability through navigation. High quality destination contents lead to visitors' full immersion of the destination through VR prior to their actual visit, which draws their attention to the destination. Addressing the importance of richness and vividness of media in implementing VR in the hospitality and tourism context, this study found that vividness of VR was a key indicator to measure respondents' attitude toward VR. Thus, the hospitality and tourism industry practitioners must consider the image of VR that should be clear, vivid, and sharp so that customers could portray a potential destination clearly.

Like other studies, this study is not free from limitations. First, findings of this study cannot be generalized about customers' perceived VR quality and their psychological and behavior responses because their virtual tour experience can be different by the device they used for the virtual tour (i.e., computer, tabloid, smartphone with VR headset, etc.). Future studies are encouraged to control the devices used for the virtual tour and compare their effects on customers' perceived VR quality. Additionally, researchers interested in this field are recommended to include multiple tourism destinations to measure the effectiveness of VR usage from customers' perspectives because they may have preconceived destination image. Second, dependent upon customers' familiarity with a destination and their prior experience with the destination, roles of VR can be different. In order to develop a comprehensive and effective VR framework, future research should include at least two or three tourism destinations with VR available and develop questions regarding destination familiarity or prior visit experience to compare customers' perceived VR quality by the degree of their destination familiarity.

Third, this study examined relationships among VR tour features and customers' responses through the survey method. When investigating effects of VR components on customers' responses, future research can employ an experimental design to investigate causal effect of VR components on the use of VR. Last, as shown in the study of Flavián, Ibáñez-Sánchez, and Orús (2019), results of this study may be different by the virtual environment respondents are accommodated such as desktop PC, mobile phones, or VR head-mounted displays. Flavian et al. stressed VR head-mounted displays generated more immersive experiences, higher sensory stimulation, more engagement, and higher behavioral intentions toward the destination than desktop PC and mobile phones. Future studies must confirm the effects of VR on customers' telepresence, attitudes, and behavioral intentions by comparing three different VR environments - desktop PC, mobile phones, and VR head-mounted displays.

In conclusion, this study developed a quality-driven VR framework by identifying key VR quality factors and their impacts on customers' behavioral intentions to visit the destination where VR has been equipped on its DMO website and made it available for potential travelers to explore their future travel destination. The three proposed VR quality factors (i.e., content quality, system quality, and vividness) had strong positive effects on both customers' psychological perception (i.e., attitude) and immersion (i.e., telepresence), which ultimately led to their behavioral intention. The VR quality factors appeared to be key motivators that affected customers' use of VR to maximize their experience and increase their future visit intention to the destination. Among the three key quality factors, content quality was the key predictor for telepresence, while vividness appeared to be the most powerful predictor for attitude. In the relationship between the VR quality factors and behavioral intention, this study found both attitude and telepresence as mediators. Between the two mediators, telepresence seemed to be a stronger predictor for customers' behavioral intention to visit the destination through VR than attitude. As far as customers were highly immersed into the virtual destination, they tended to have strong desire to visit an actual destination.

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