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Research Paper

The Determinants of Recommendations to Use Augmented Reality Technologies: The Case of a Korean Theme Park

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ABSTRACT:

The increased availability of smartphone and mobile gadgets has transformed the tourism industry and will continue to enhance the ways in which tourists access information while traveling. Augmented reality has grown in popularity because of its enhanced mobile capabilities. In tourism research, few attempts have been made to assess user satisfaction with augmented reality applications and the behavioral intention to recommended them. This study uses a quality model to test users' satisfaction and intention to recommend marker-based augmented reality applications. By applying process theory, this study also investigates the differences in these constructs between high- and low-innovativeness groups visiting a theme park in Jeju Island, South Korea. Questionnaires administered to 241 theme park visitors revealed that content, personalized service, and system quality affect users' satisfaction and intention to recommend augmented reality applications. In addition, personal innovativeness was found to reinforce the relationships among content quality, personalized service quality, system quality, and satisfaction with augmented reality.

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The Determinants of Recommendations to Use Augmented Reality Technologies: The Case of a Korean Theme Park

Abstract

The increased availability of smartphone and mobile gadgets has transformed the tourism industry and will continue to enhance the ways in which tourists access information while traveling. Augmented reality has grown in popularity because of its enhanced mobile capabilities. In tourism research, few attempts have been made to assess user satisfaction with augmented reality applications and the behavioral intention to recommended them. This study uses a quality model to test users' satisfaction and intention to recommend marker-based augmented reality applications. By applying process theory, this study also investigates the differences in these constructs between high- and low-innovativeness groups visiting a theme park in Jeju Island, South Korea. Questionnaires administered to 241 theme park visitors revealed that content, personalized service, and system quality affect users' satisfaction and intention to recommend augmented reality applications. In addition, personal innovativeness was found to reinforce the relationships among content quality, personalized service quality, system quality, and satisfaction with augmented reality.

Keywords: augmented reality, smartphone, process theory, DeLone and McLean model, satisfaction, personal innovativeness

I. Introduction

The development of mainstream computers and laptops into mobile gadgets and the transformation of surfaces and physical unconnected items into "displays" and interaction interfaces have been pushed by intense research over the last 20 years (Olsson et al., 2013). Stationary desk-based computer interaction through single-screen environments with little connectivity has been replaced by mobile multi-screen and multi-connectivity-enabled devices, providing an "always on" ubiquitous computing experience (Olsson et al., 2013). Recently, significant attention has been directed to the potential of augmented reality (AR) to change users' view of their environment (Wang et al., 2013; Wasko, 2013). Within the tourism industry, enhanced mobile and smartphone capabilities have changed the ways in which tourists gather and access information while on vacation. Traditionally, orientation at a destination was given by tour guides, directional signs, or online maps. However, the popularity of smartphones with built-in cameras, global positioning system (GPS), and Internet connections has increased the availability of AR applications that enable destinations to construct a personal and context-aware tourism experience (Chou & ChanLin, 2012; Yovcheva et al., 2013). AR is particularly valuable to the tourism industry because it can create an interactive online environment in which tourists who have little knowledge of the area can realistically and naturally experience unfamiliar places (von der Pütten et al., 2012). However, introducing AR applications at tourism destinations and attractions does not automatically bring positive experiences (Yovcheva et al., 2013).

Haugstvedt and Krogstie (2012) concluded that little research has been conducted to identify the extent to which users are willing to accept AR applications. Snyder and Elinich (2010) explored AR within science museum exhibitions and discovered that the usage of site-based AR can overcome some of the key barriers associated with AR. Site-based AR is developed on computers; therefore, visitors are not required to use their own smartphone or glass devices, further enhancing the ease of use of site-based AR (Snyder & Elinich, 2010). In addition, Snyder and Elinich (2010) found that users with limited technological experience can use site-based AR. According to Mascioni (2012), several theme parks including Walt Disney World's Magic Kingdom in Orlando have integrated mobile devices. At the same time, some theme parks have started to incorporate on-site AR into their indoor attraction rides by projecting pictures or ghosts

onto what looks like a mirror (a computer screen) in front of the visitors. The animations enter the visitors' real space and enhance their experience (Mascioni, 2012). Nevertheless, there is limited research on indoor theme park visitors' satisfaction with the quality of site-based AR and their intention to continue using and recommending it. Thus, the aim of this research is to examine the relationship between the perceived quality (content, system, and personalized service) of AR applications and tourist satisfaction to predict tourists' behavioral intentions to recommend AR application. Furthermore, personal innovativeness is considered an important determinant of users' willingness to accept or reject the usage of new technologies such as AR (Mazman & Usluel, 2009). Therefore, this research will explore how personal innovativeness moderates the relationship between perceived quality and AR satisfaction.

II. Literature Review

2.1 AR in Tourism

Danado et al. (2005, p. 1) defined AR as "a technology that allows the superimposition of synthetic images over real images, providing augmented knowledge about the environment in the user's vicinity which makes the task more pleasant and effective for the user, since the required information is spatially superimposed over real information related to it." Consequently, the emergence of AR applications has changed the way tourists can experience a destination, leading to more interactive and diversified experiences (Fritz et al., 2005). Due to enhanced smartphone capabilities such as integrated GPS, Internet connections, and cameras, tourism destinations and businesses can deliver tourists an enjoyable, personalized, and context-aware tourism experience (Chou & ChanLin, 2012). The capability to superimpose images enables tourism destinations to present tourists with historic buildings or events, making the entire tourism experience more interesting and enjoyable. In addition, destinations can differentiate themselves from each other (Tsiotsou, 2012). According to Martínez-Graña et al. (2013), AR applications are particularly valuable for the tourism industry because they increase social awareness of the immediate surroundings and unknown territory. In addition, AR applications help tourists gain a deeper understanding of the origins of geological heritage (Martínez-Graña et al., 2013). Casella and Coelho (2013) acknowledged that AR has become a popular tool for the education of museum

visitors due to the availability of applications such as Layar. Benyon et al. (2013) agreed that AR applications have become popular ways to present historic events and introduce tourism destinations. They also concluded that AR will be used by the mass market, making it even more likely that the tourism industry will engage with these new and developing applications.

AR is considered a tool to provide content and enhance tourists' and theme park visitors' experience (Casella & Coelho, 2013; Martínez-Graña et al., 2013). However, AR could also become the main reason to visit theme parks and experience new and innovative technologies. Dong et al. (2011) examined the popularity of AR based-games as theme park attractions and reviewed an AR game that has become an interactive tourist attraction in the Chinese theme park "Joy Land." In addition, Disney theme parks are investing in the development of projection-based AR attractions to offer this novel experience to their visitors. The creators of the Walt Disney attraction aimed to bring old movies to life by augmenting their characters, thus providing visitors with a unique experience (Mine et al., 2012). These examples show that AR can be used to enhance existing attractions through the overlaying of content and that theme park attractions can be created around an AR experience.

2.2 Marker-Based AR Applications

AR applications can be classified into marker-less and marker-based. Cheng and Tsai (2013, p. 451) stated that marker-based AR "requires specific labels to register the position of 3D objects on the real-world image." A specific marker such as a QR code is used to overlay an object onto scenery (Lee et al., 2013). According to Siltanen (2012, p. 39), marker-based AR adds an "easily detectable predefined sign in the environment and uses computer vision techniques to detect it." As a result, marker-based applications are ideally applied indoors. In contrast, marker-less AR applications do not require codes; they can detect specific features from the area-based GPS locations and can thus be used in outdoor environments. In addition, marker-less applications are considered more interactive than static marker-based applications, which depend on a certain object (Lee et al., 2013; Patkar et al., 2013). Jung et al. (2013) acknowledged that marker-less AR applications are resource-intensive and that marker-based applications are expected to perform and recognize objects more accurately, particularly within indoor environments. This

was confirmed by Kapoor et al. (2013, p. 604), who acknowledged that "marker-based capture systems are quite popular due to efficiency and accuracy but are highly costly, require laboratory setup and restrict the movement of the actor." As a result, much future research and development will focus on using marker-less AR applications. Nonetheless, for the current state of technology, marker-based applications are considered more reliable and are therefore often used to enhance the visitors' experience within indoor theme parks.

2.3 Perceived Quality

The importance of perceived quality was confirmed within the DeLone and McLean information system success model in 1992. DeLone and McLean concluded that information system success can be measured through "the system quality, the output information quality, consumption (use) of the output, the user's response (user satisfaction), the effect of the IS on the behavior of the user (individual impact), and the effect of the IS on organizational performance (organizational impact)" (Wu & Wang, 2006, p. 729). Later on, an updated model of information system success introduced three perceived quality constructs: system, service, and content/information quality (DeLone & McLean, 2003). According to Bigné et al. (2001, p. 608), perceived quality is defined as an "overall judgment made by the consumer regarding the excellence of a service." This was supported by Parasuraman et al. (1988), who revealed that product and service quality are highly dependent on personal perceptions of the product or service. Previous research has shown that perceived quality affects the intention to reuse technological innovations (Ansari et al., 2013; Bayraktar et al., 2012; Koo et al., 2013; Wang & Chen, 2011; Zhao et al., 2012). Petrick (2004, p. 405) investigated quality, satisfaction and repurchase intention dimensions in the cruise tourism context and revealed that "future research should therefore include other independent variables to aid in the determination of what combination of variables most accurately and parsimoniously predicts intentions to repurchase". Ahamed and Mohideen (2015) asserted that within the tourism and hospitality research field, few scholars have included quality dimensions as an antecedent of consumer satisfaction and intention to revisit or reuse. However, those studies that used constructs concerning perceived quality supported the strong relationship between quality constructs such as content, system, or service quality and the satisfaction and intention to use or repurchase (Ahamed & Mohideen 2015; Petrick, 2004).

In previous AR and mobile service research, scholars have acknowledged the importance of the three quality constructs for tourists' AR usage. Within the mobile service acceptance context, many researchers have confirmed the effect of content quality on users' acceptance (Chae et al., 2002; Kuo et al., 2009; Lee & Chung, 2009; Wang & Chen, 2011). In terms of system quality, Wang and Chen (2011) investigated consumers' perception of mobile services and found that system quality had strong direct effects on both satisfaction and the intention to use. In addition, the construct of service quality has been used in AR research. Bayraktar (2012) and Kim and Hwang (2012) pointed out that service quality has important implications for users' continued usage. Furthermore, Leue et al. (2014, p. 3) proposed that information (content) quality influences tourists' acceptance of AR applications, acknowledging that "AR adopters desire rich and high quality information that is contextually relevant".

2.4 Satisfaction

Satisfaction is a critical measure of information system success and effectiveness (Zviran et al., 2006). It can be defined as "the degree to which one believes that an experience evokes positive feelings" (Chen & Chen, 2010, p. 30). According to Zhao et al. (2012), the psychological process behind satisfaction is highly complex and requires a differentiation between transaction-specific satisfaction and cumulative satisfaction. Transaction-specific satisfaction is the judgment of an experienced service encounter at a specific point in time, whereas cumulative satisfaction is the result of "the overall evaluation of all services encountered over time" (Zhao et al., 2012, p. 646). Johnson (2001) stated that these two types of satisfaction complement each other, as consumers have to experience services and products over a period to create cumulative satisfaction. Zhao et al. (2012) argued that the majority of research is unable to differentiate between these two types of satisfaction. However, the difference between the two is important to acknowledge, as intentions to use differ between these two types of satisfaction. The present study decided to focus on transaction-specific satisfaction because the research aimed to evaluate theme parks visitors' intention to recommend marker-based AR at one point in time. In addition, due to the novelty factor of AR, visitors have not had an opportunity to build upon previous

experience and create cumulative satisfaction. Therefore, the level of satisfaction examined in the present study refers to the level of satisfaction with a specific task.

III. Theoretical Framework and Hypotheses Development

3.1 Research Model

A process theory is a commonly used form of behavioral research in which events or occurrences are the result of certain input states leading to a certain outcome state, following a set of processes. In behavioral research, the process theory explains "how" something happens, whereas a variance theory describes "why" something happens (Chiles, 2003). We adopted the process theory approach to explain the effect of the features of marker-based AR applications (content quality, system quality, and personalized service quality) on the intention to recommend marker-based AR applications. In our model (Figure 1), AR satisfaction is used as an intervening construct on the causal chain between marker-based AR application functions and the intention to recommend marker-based AR applications.

Our model thus emphasizes three basic processes of relationship impact on marker-based AR application functions (content quality, system quality, and personalized service quality as "input"), relationship-formation processes (satisfaction as "process"), and relationship outcome (intention to recommend marker-based AR applications as "outcome"). The model shows how to enhance the understanding of marker-based AR application functions that affect the intention to recommend marker-based AR applications through satisfaction. Our research model was developed based on the process theory (Chiles, 2003), in which marker-based AR application functions are the antecedent of satisfaction, and satisfaction affects the intention to recommend marker-based AR applications.

Insert Figure 1 about here.

3.2 Hypotheses Development

3.2.1 Content Quality

Several studies on mobile service satisfaction have incorporated the construct of content quality (Chae et al., 2002; Kuo et al., 2009; Lee & Chung, 2009; Wang & Chen, 2011). DeLone and McLean (2003) reviewed studies that used the content quality construct in their information system success research and found that all studies confirmed the importance and relevance of content quality. Previous research examined content quality in relation to job effectiveness, quality of work, accuracy, consistency, relevance, timeliness, and completeness (DeLone & McLean, 2003; Wixom & Watson, 2001; Wu & Wang, 2006). Lai (2013) confirmed the importance of information (content) quality in the behavioral intention to use app-based mobile tour guides. Lee et al. (2014) acknowledged that the quality of online content influences active community participation and acceptance. In addition, high-quality content can influence the popularity and increase the social value of websites, networks, or applications (Lee et al., 2014). In the study of Lee et al. (2014), online communities that uploaded high-quality information or pictures had much greater success in acquiring and retaining new community members due to the attractiveness of engaging with the network. This is relevant to the present study because it shows how a high-quality context can influence satisfaction and the overall intention to recommend AR application. Based on previous research, we expect that content quality will positively affect AR satisfaction. This formed the basis of the following hypothesis:

H_1: AR content quality has a positive effect on AR satisfaction.

3.2.2 System Quality

The importance of system quality has been thoroughly investigated in previous research (Jun et al., 2004; Lee & Chung, 2009; Wang & Chen, 2011; Wixom & Watson, 2001; Wu & Wang, 2006). Chen (2013, p. 27) defined system quality as "a system wherein the desired characteristics of both mobile devices and web browsing services are believed to be available to users." According to DeLone and McLean (2003, p. 13), system quality has a strong effect on information system success, being "measured in terms of ease of use, functionality, reliability, flexibility, data quality, portability, integration, and importance." Wang and Chen (2011)

investigated consumers' perception of mobile broadband services in Taiwan using the information system success model by DeLone and McLean. They discovered that system quality had strong direct effects on satisfaction and intention to use. Zhu et al. (2013) also integrated the three service dimensions into their e-learning acceptance research and found that information (content) and service quality both influence satisfaction; however, the influence of system quality on satisfaction was not established. Chen (2013) researched the intention to use mobile shopping and concluded that all three quality dimensions, including system quality, influence the behavioral intention. Based on previous research, we expect that system quality will positively affect AR satisfaction. This formed the basis of the following hypothesis:

H_2: AR system quality has a positive effect on AR satisfaction.

3.2.3 Personalized Service Quality

Service quality was the last addition to the DeLone and McLean information system success model in 2003. Zhao et al. (2012) stated that service quality is an important determinant of an information system's effectiveness. However, the concept of personalized service quality in the context of AR is different from the service quality construct by DeLone and McLean (2003) which relates to the efficient operation of systems. The concept of personalized service quality within the AR context refers to the ability to provide personalized information, understand needs and preferences as well as personalized interaction. Personalized information enables visitors to choose exactly what they want to see and explore based on their preferences, wants and needs. This is supported by Ghose and Huang (2009), who identified that the increased availability of modern technologies enables businesses to facilitate quality enhancement through a personalization of services and products, increasing the value for customers and benefiting business through improved satisfaction rates. Kim and Hwang (2012) pointed out that the satisfaction with mobiles and service quality has important implications for users' continued usage. This was supported by Bayraktar et al. (2012, p. 105), who revealed that mobile service providers have to improve their "service quality so that they can improve customers' experiences with mobile phones and by doing so improve overall customer loyalty". In addition, Cronin et al. (2000) found that favorable service perception leads to higher satisfaction rates. Meanwhile, Lee

et al. (2007) studied the effects of users' perception of threatened freedom and degree of personalization on the intention to recommended services. They found that high personalization can be a major motivation for users to accept recommendation systems. Kim et al. (2006, p. 899) aimed to identify the determinants of Chinese visitors' e-satisfaction and purchase intentions and found that "information needs is the most important factor for e-satisfaction". Thus, the effect of personalized service quality on satisfaction is expected to be positive and significant, forming the basis of the following hypothesis:

H_3: AR personalized service quality has a positive effect on AR satisfaction.

3.2.4 AR Satisfaction and Intention to Recommend AR

According to Wang and Chen (2011, p. 8), customer satisfaction is "viewed as the most crucial indicator" when investigating consumers' perception of reusing mobile services. This was supported by Luarn and Lin (2003) and Vranakis et al. (2012), who concluded that satisfaction is among the most influential factors in loyalty within the mobile service context. Zeithaml (2000) acknowledged that high satisfaction rates result in returning visitors and higher profits. Several researchers (Almossawi, 2012; Bayraktar et al., 2012; Garin-Munoz et al., 2012; Vranakis et al., 2012) have found that perceived quality has a strong influence on satisfaction within the mobile service context. Thus, to develop long-lasting relationships and customer loyalty, businesses have to ensure high satisfaction rates by offering a high level of quality (Bigné, 1997).

Choi et al. (2011) examined users' intention to reuse mobile services and found that a high level of customer satisfaction leads to the decision to continuously reuse services. Fishbein and Manfredo (1992) stated that post-purchase intentions are a result of consumers' satisfaction. Furthermore, Choi et al. (2011, p. 191) concluded that "if the users are satisfied with mobile tour services, the possibility to reuse these services will be high." Satisfied visitors who are willing to return to a theme park are likely to spread positive word of mouth. It is crucial for tourism attractions and businesses to ensure high satisfaction rates, since word-of-mouth is considered the most trustworthy source of information within the intangible tourism industry (Ayeh et al., 2013). This was supported by Harrisson-Walker (2001), who reported that uninformed consumers rely heavily on others' experiences to form an opinion. Thus, AR satisfaction is likely

to positively affect the intention to recommend marker-based AR applications. This leads to the following hypothesis:

H_4: AR satisfaction has a positive effect on the intention to recommend AR applications.

3.2.5 Moderating Effect of Personal Innovativeness

The construct of personal innovativeness has its origin in the diffusion of innovation theory. It defines an individual's willingness to try new services and products (Agarwal & Prasad, 1998; Rogers, 1962). According to Mazman and Usluel (2009, p. 406), personal innovativeness explains "why some people adapt an innovation while some others reject to use it." Recent research has considered it an important determinant of overall acceptance behavior. Consequently, it has been increasingly used within technology acceptance research, particularly with the emergence of new technologies such as biometric hotel systems (Morosan, 2012) and mobile marketing and services (Gao et al., 2012; Han et al., 2013; Kuo & Yen, 2009, Zarmpou et al., 2012). According to Agarwald and Prasad (1998), personal innovativeness is also considered a mediator in the decision to accept or reject a new technology. Within the tourism context, Choi et al. (2011) included personal innovativeness in their research on travelers' acceptance of mobile services. Lee et al. (2007) integrated personal innovativeness into their research on online travel shopping. Using the factor of innovativeness is particularly valuable within marketing research and market segmentation, as high innovators can be distinguished from low innovators (Morosan, 2012). Lee et al. (2007, p. 886) concluded that "less innovative travelers rely on both attitude and the referral's opinions to reduce uncertainty inherent in online transactions."

Furthermore, while innovative consumers positively accept risks and uncertainty and attempt explorative purchasing, less innovative consumers avoid risks or uncertainty regardless of whether something easily accessible is more important for them (Rogers, 1962). Particularly with AR, less innovative consumers may place more importance on content quality (the non-system aspect) than on system or service quality because becoming acquainted with an AR application requires an initial mental and temporal effort. The high-innovativeness group appeared to have more recognizable AR quality (system and service quality) than the low-innovativeness group

because they enjoy using new technology, taking risks, and playing the role of opinion leaders in spreading new technologies.

We can therefore infer that system and service quality have greater influence on the intention to accept information technology among the high-innovativeness group, and that content quality will be more important to the low-innovativeness group. Hence, the following hypotheses are proposed:

H_{1a}: The relationship between AR content quality and AR satisfaction is stronger in the low-innovativeness group than in the high-innovativeness group.

H_{2a}: The relationship between AR system quality and AR satisfaction is stronger in the high-innovativeness group than in the low-innovativeness group.

H_{3a}: The relationship between AR personalized service quality and AR satisfaction is stronger in the high-innovativeness group than in the low-innovativeness group.

IV. Methods

This study uses site-based AR, using an on-site computerized book that overlays 3D character animations into visitors' real world. This study is designed to compare high-innovativeness and low-innovativeness groups of marker-based AR applications and users' processing of their perceptions of marker-based AR applications functions. In addition, this study will examine how personal innovativeness moderates the relationship between marker-based AR applications functions, satisfaction, and recommendation. We used the process theory to develop a research framework. A field survey method was employed to test the proposed model and hypotheses. Additionally, we designed a questionnaire using constructs that had been previously used and validated.

4.1 Study Site

The study took place in Characworld theme park on Jeju Island, South Korea. Jeju Island is located south of South Korea's main land and is one of the most popular destinations for Korean

tourists (KTO, 2014). Jeju Island offers its visitors natural waterfalls, museums and numerous theme parks. Its latest addition (March 2011) is the Characworld theme park which shows its visitors famous movie and cartoon characters (Shain, 2011). In the theme park, visitors can engage in virtual horseracing, play video and computer games and tour illusion studios (Shain, 2011). Right in the middle of all these attractions, Characworld has designed and integrated an interactive AR experience in order to test a marker-based AR application with the potential to enhance the visitor experience. In a showroom, virtual characters are overlayed using marker-based AR technologies into the real environment. Visitors interact with the characters using a marker-based AR book that sets a 3D animation in a TV screen in motion, telling original tales from Jeju Island. By moving the book, the 3D character corresponds to the movement and therefore makes the AR experience real and interactive (Figure 2).

Insert Figure 2 about here

4.2 Measurements

The model consisted of six constructs which were measured using scales from previous researchers. These scales were modified to fit the context of the present study. The questionnaire included sections about content quality (Kuo et al., 2009; Yang et al., 2005), system quality (Aladwania & Palvia, 2002; Rivard et al., 1997), personalized service quality (Aladwania & Palvia, 2002; Yang et al., 2005), satisfaction (Choi et al., 2011; Kuo et al., 2009; Yang et al., 2005), intention to recommend (Choi et al., 2011; Kuo et al., 2009; Zhao et al., 2012) and personal innovativeness (Agarwal & Prasad, 1998; Goldsmith & Hofacker, 1991; Roehrich, 2004) which were measured by three to four measurement items. All items used a five point Likert-scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Questions included "The Marker-based AR application provides relevant information of traditional tales" (content quality); "The Marker-based AR application is easy to use" (system quality); "The Marker-based AR application has the ability to understand my needs and preferences" (personalized service quality); "I am satisfied with using the marker-based AR application" (satisfaction) or "When I return home, I will positively promote this marker-based AR application" (intention to recommendation). In addition, questions about personal innovativeness included "I like to experiment with new information technologies". Furthermore, the questionnaire gathered

demographic information about the respondents' gender, age, education, occupation and smartphone usage.

4.3 Data Collection

The data were collected at Characworld theme park in Jeju Island, South Korea from visitors who used the marker-based AR application in the AR experience center from 1 to 30 November 2012. Random sampling was used and 241 usable responses were collected. According to Shenton (2004), random sampling has the advantage of representing the opinion of a general population instead of a selected sample. All visitors were considered part of the study population; however children under 18 were excluded. Even though children are an important market for Characworld theme park, the views of parents or companions are equally important as this attraction is for both family and children. Therefore, within the present study, we focused on parents and companions. The researcher approached visitors as part of the random sampling technique. According to Newman and McNeil (1998), random sampling is a common sampling technique that allows the gathering of data from an unbiased sample which represented the intended study population. Visitors were informed about the nature of the research project and asked to participate in the study. If they agreed, participants were handed the questionnaire and asked to fill it in after trying out the AR application. The respondents were introduced with marker-based AR before they took part in the experiment and survey. Terms used in the original questionnaire in Korean was easy to understand and match the 'ordinary respondent' level of knowledge. These terms have been used a number of previous Information System research focusing on information quality, system quality, service quality, satisfaction and intention to use (e.g. Kuo et al., 2009; Yang et al., 2005).

4.4 Respondents' Profile

By using random sampling method, a total of 241 responses were collected from the field survey and coded for analysis. As shown in Table 1, the respondents were similarly distributed between males (57.7%) and females (42.3%). The largest percentage of respondents (43.6%) was aged 30 to 39, followed by those under 29 (26.6%) and 40 to 49 (23.2%). Most respondents were highly educated (43.2% completed university; 29.9% completed 2 year college). The largest category of

respondents was office workers (17.0%). More than half (55.2%) of respondents had used the smartphone for more than a year. Table 1 shows the subjects' demographic information in terms of gender, age, education, occupation and smartphone usage.

4.5 Grouping Check

The respondents were divided into two groups: low personal innovativeness and high- personal innovativeness. This distinction was based on median personal innovativeness construct scores (3.333) (Renkl, 1997; Yi & La, 2004). The low personal innovativeness group (n = 106) had a mean personal innovativeness level of 2.544 and a standard deviation of 0.597, while the high personal innovativeness group (n = 135) had a mean personal innovativeness level of 3.780 and a standard deviation of 0.439.

V. Analysis and Results

To analyze our data, PLS-Graph Version 3.0 was used to analyze the measurement and structural models. PLS has been widely used in theory testing and confirmation. It is also an appropriate approach for examining whether relationships might or might not exist and thus is useful in suggesting propositions for later testing (Fornell & Larcker, 1981). Moreover, PLS regression makes few assumptions about measurement scale, sample size, and distribution (Ahuja & Thatcher, 2005). Before conducting any analyses, we first calculated the constructs' z-scores for skewness and kurtosis (see Table 3), in order to check their normality (Tabachnick and Fidell, 2007). Z-scores for skewness and kurtosis values ranged from -0.317 to 0.235 and from 0.627 to 1.165, respectively. As shown in Table 3, the mean scores of all variables are close to neutral and these results are as expected because there appears to be some uncertainty or even hesitancy with regards to the use of AR applications within the theme park context which may can related to the novelty factor of AR applications. A similar outcome was found by Kyalo and Hopkins (2013) in the e-learning context. Considering that the items were approximately normally distributed, we estimated the measurement and structural model.

5.1 Measurement Model

The measurement model was assessed separately for the group as a whole and for each subgroup. To validate our measurement model, we undertook validity assessments of content, discriminant, and convergent validity. The content validity of our survey was established from the existing literature, and our measures were constructed by adopting constructs validated by other researchers. According to Nunnally (1967), all constructs in the model satisfied reliability requirements (with composite reliability greater than 0.70) and discriminant validity requirements (with average variance extracted greater than 0.50), the square root of average variance extracted (AVE) "greater than each correlation coefficient" (Bhattacherjee & Sanford, 2006, p. 815), and Cronbach's α greater than 0.70. We also examined the discriminant and convergent validity of each indicator (Chin, 1998). The results presented in Tables 2 and 3 demonstrate adequate discriminant and convergent validity.

Insert Table 2 about here

Insert Table 3 about here

5.2 PLS analysis and moderating effect of personal innovativeness

We estimated three separate models in PLS: models for the overall group, the low personal innovativeness group, and the high personal innovativeness group. We then tested for differences across all three models using the test for differences. The size of the bootstrapping sample that was used in the PLS analyses was 500. Before hypothesis testing, three models were tested. Model 1 contained only AR content quality. In model 2, additional one independent variable, AR system quality was included, while the Model 3 included remaining variable, AR personalized service quality. Table 4 presents the standardized regression coefficient, R^2, change in R^2 (ΔR^2), and effect size. AR content quality account for about 32.4% of the variance explained for AR satisfaction. Model 2 accounts for 41.2% of the variance in AR satisfaction. The effect size and significance of the change in variance explained between models were measured by an f^2 statistic, formulated as $(R^2_2-R^2_1)/(1- R^2_2)$, where f^2 of 0.02, 0.15, and 0.35 have been suggested to pertain to small, moderate, and large effect sizes, respectively (Cohen, 1988). By adding one variable, R^2 of model 2 increases 8.8% in variance explained. R^2 increases significantly (f^2=0.150),

suggesting that AR system quality plays an important role in explaining AR satisfaction. Also, adding AR personalized service quality construct, R^2 of model 3 increases 8.2% in variance explained. R^2 increases significantly (f^2=0.162).

With regard to hypothesis testing, figure 3 and Table 5 present the results of the hypothesis tests for the overall group. All direct paths in the model (H_1 - H_4) were supported at $p<0.05$. Tests for hypotheses H_1, H_2, and H_3 indicate that AR satisfaction was significantly influenced by AR contents quality (β=0.314, t=3.787), AR system quality (β=0.167, t=2.072), and AR personalized service quality (β=0.368, t=5.324). The test for H_4 also indicates that intention to recommendation was significantly affected by AR satisfaction (β=0.768, t=22.226).

Insert Figure 3 here

Insert Table 5 here

In order to examine the potential moderating effect of personal innovativeness, we conducted a multi-group analysis using PLS by comparing differences in the coefficients of the corresponding structural paths for the low personal innovativeness group and high personal innovativeness group models (Chin, 1998; Keil et al., 2000). As shown in Figure 4 and Table 6, the results indicate that the coefficients from each path for AR contents quality and AR system quality were significantly different between low personal innovativeness group and high personal innovativeness group except AR personalized service quality (see also Figure 4 and Table 6). Tests for hypotheses H_{1a} and H_{2a} demonstrate that the impact of AR contents quality (low personal innovativeness: 0.429 > high personal innovativeness: 0.169, Δt=1.978) and AR system quality (low personal innovativeness: 0.050 < high personal innovativeness: 0.303, Δ t=1.832), were statistically different between low personal innovativeness group and high personal innovativeness group. However, hypothesis H_{3a} was not statistically significant different between low personal innovativeness group and high personal innovativeness group.

Insert Figure 4 here

Insert Table 6 here

5.3 Testing mediation effects

In order to drill down deeper into the mediation implied by the PLS analysis, we conducted a regression analysis following Baron and Kenny's (1986) widely accepted approach. According to Baron and Kenny (1986), a mediator must affect the direction or strength of the relationship between the independent variable and the dependent variable. Following Baron and Kenny's (1986) approach, we conducted the mediation analysis using a three-step process. First, the mediator was regressed on the independent variable(s). Second, the dependent variable was regressed on the independent variables. Third, the dependent variable was regressed on the independent variables and the mediator. As shown in Table 7, Step 1 revealed that all of the marker-based AR applications functions (AR content, system and personalized quality) were significant variables in the first regression. Step 2 revealed that marker-based augmented reality applications functions are significant variables in the second regression. Finally, Step 3 of the analysis revealed that even when we controlled for the mediator, only AR system quality had a significant effect on intention to recommend augmented reality applications. As expected, the AR system's quality effect on intention to recommend augmented reality applications is partially mediated by AR satisfaction. In case of AR content quality and AR personalized service quality, the effect of completion on intention to recommendation was fully mediated by AR satisfaction.

Insert Table 7 about here

VI. Discussion and Conclusions

6.1 Discussion

The aim of this study was to examine the relationship between tourist satisfaction and the perceived quality (content, system, and personalized service) of AR applications to predict tourists' behavioral intentions to recommend AR applications. The study also aimed to explore how personal innovativeness moderates the relationship between perceived quality and AR satisfaction.

This study revealed that all three quality dimensions (content quality, system quality, and personalized service quality) positively influenced visitors' satisfaction. These findings support previous research by confirming the effects of content quality, system quality, and personalized service quality on satisfaction and the intention to recommend (Chen, 2013; Wang & Chen, 2011; Zhao et al., 2012). In addition, these findings partially support those of Zhu et al. (2013), who identified a positive effect of content quality and service quality on satisfaction but failed to find a significant effect of system quality on satisfaction. The findings of the present study are also supported by those of Chen (2013), who concluded that all three quality dimensions, including system quality, influence the behavioral intention to use mobiles for online shopping. Kim et al. (2013), who studied the intention to adopt a ubiquitous tour information service, also indicated that system quality and information quality are important. Thus, system quality is important not only in the general business environment but also in the tourism environment.

The present study found that content quality and personalized service quality had a stronger effect on satisfaction than system quality. Chen (2013) reported a similar outcome whereby system quality had the weakest effect among the three quality dimensions. This shows that within the online environment, users are more concerned with high-quality content and a good degree of personalized service. System design and functionalities play a role in users' overall satisfaction; however, AR application developers should focus primarily on the interaction and on personalized information, pictures, and videos. In particular, when AR applications are regarded as a technique that can be used for preserving heritage sites, personalized information, pictures, and videos become important along with content quality and system quality.

Furthermore, this study found a positive effect of satisfaction on the intention to recommend marker-based AR. This confirms previous research findings in the mobile tourism context that tourists who are satisfied with the usage of innovative technologies tend to have a behavioral intention to use it (Choi et al., 2011). This study also confirms Hosany and Witham's (2010) research on tourists' cruise experience, which showed the strong influence of satisfaction on the behavioral intention to recommend AR applications. The present study indicates that satisfied theme park visitors are more likely to spread positive word of mouth about the theme park and the AR application, which is consistent with previous study findings (Almossawi, 2012; Ayeh et

al., 2013). This finding is important in the tourism context, as uninformed tourists and visitors strongly depend on experiences of previous visitors to form their opinion on whether to visit a destination or theme park (Harrisson-Walker, 2001). Ayeh et al. (2013) called word of mouth the most trustworthy source of information within the tourism context; therefore, it is particularly important for theme parks to ensure high satisfaction rates.

In their cross-cultural study of American and Korean Internet users, Park and Jun (2003, p. 548) stated that "Korean Internet users tend to be innovative in using IT communication tools (e.g. mobile phones, PDAs, instant messaging, and virtual communities)." They also reported that Korean users had a higher degree of personal innovativeness than their American counterparts. However, Steenkamp et al. (1999) revealed that innovativeness differs not only among countries and cultures but also among consumers, as confirmed by the present study. A closer inspection of the moderating effect of personal innovativeness shows a significant difference between the high personal innovativeness and low personal innovativeness groups regarding the effects of information quality and system quality on satisfaction. While content quality had stronger effects on low personal innovativeness users' satisfaction, system quality had a higher impact within the high personal innovativeness group. This shows that less innovative users prefer to have AR applications that provide relevant, clear, and easy-to-understand information of the traditional tales of Jeju Island. In contrast, highly innovative users require easy-to-use, visually appealing AR applications that allow easy access to relevant information.

6.2 Theoretical and Practical Implications

One of the key theoretical contributions of this study is an extension of the quality dimension by including personalized service quality, system quality, and content quality to account for the full spectrum of the quality construct (DeLone & McLean, 2003). This research contributes to the gap in the literature on moderating effects within AR research by testing the moderating effects of personal innovativeness (Mazman & Usluel, 2009). This study shows that personalized service quality is equally important in the decision to recommend AR applications within the low personal innovativeness group and the high personal innovativeness group; this confirms the importance of using this construct within AR application quality research.

Moreover, even though this study used proven theoretical framework, a significant contribution of this study is that it reflected the characteristics of AR by proposing new constructs such as AR personalized service quality, which was not explored in other studies. The concept of personalized service quality in the context of AR is different from 'service quality' construct by DeLone and McLean (2003) and it refers to the ability to provide personalized information, understand needs and preferences as well as personalized interaction. The concept of personalization in the context of the AR experience in the theme park is particularly relevant as visitors experience in the attraction using a marker-based and interactive 3D book which allows visitors obtain personalized and interactive information to bring the experience to life. Visitors have the options to choose content and have it displayed to them as well as engage with the content through the 3D book which adds to the personalization and interactivity. Another unique strength of this study is that it conducted multi-group analysis using personal innovativeness.

For destination marketing practitioners, this study shows that tourist attraction theme parks are a future market for AR applications. The results highlight the importance of identifying the needs and wants of the target market in relation to application design and functionalities; while highly innovative users require high-quality systems within an application, less innovative users look for high-quality content to enhance their tourism experience. As Agarwald and Prasad (1998) stated, personal innovativeness is an important factor in rejecting or accepting a technology. Considering the novelty factor of AR and the recent adoption of AR within theme parks, this study provides important indications for academia and industry in regard to overall satisfaction with the technology and the ultimate intention to recommend AR applications. This was confirmed by Steenkamp et al. (1999, p. 65), who concluded that "innovativeness is a key variable in new product adoption, affecting the rate of diffusion of new products." Furthermore, Park and Jun (2003) noted that Korea is a highly innovative country; therefore, the intention to recommend and accept AR in Korea will be stronger than in "countries whose national culture is less conducive to fostering innovativeness in its citizens" (Steenkamp et al., 1999, p. 65).

6.3 Limitations and Future Research Directions

The present study has some limitations. First, a larger sample than 241 would have enhanced the possibility of generalizing the findings to a wider population. However, using PLS-Graph as a data analysis tool overcomes this limitation, as PLS is known for producing generalizable results with a very small sample size (Wixom & Watson, 2001). Second, the study was conducted in Characworld Theme Park in Jeju Island, South Korea. Therefore, the extent to which the findings can be applied to other theme parks in and out of South Korea is questionable. Third, the present study focused on a marker-based AR application that has been tested only within a controlled indoor environment. With increased technological capabilities, marker-less AR applications are expected to rise in popularity; therefore, similar research within the outdoor environment based on GPS-enabled AR applications is recommended. Fourth, this study adopted a quantitative research strategy; however, qualitative methodology using focus groups or interviews could reveal additional factors (quality- or non-quality-related) that influence users' satisfaction and intention to recommend the marker-based AR application. Finally, as discussed in the methodology section, the present study focused solely on visitors aged eighteen years and over. Taking into account the importance of children for the theme park, future research has to be conducted from the children's point of view. Focusing on both markets, adult and children, within one study would have been problematic as the questionnaire is difficult for children to complete and therefore it would have been challenging to get valid data. Designing a children-friendly easier to understand questionnaire to evaluate children's point of view is therefore considered an important step for future research.

Wierenga and Oude Ophuis (1997) investigated the implementation success of innovative technologies and identified adoption as a mediating variable in examining system usage and satisfaction. Future research could include adoption as the intention to recommend marker-based AR in the theme park context. In addition, a comparison of tourists' acceptance of marker-based and marker-less AR applications could advance the development of future applications.

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Table 1. Demographic Characteristics of Respondents

Characteristics		Overall Group			High-Personal Innovativeness Group		Low- Personal Innovativeness Group	
		n	%		n	%	n	%
Gender	Male	139	57.7		84	62.2	55	51.9
	Female	102	42.3		51	37.8	51	48.1
Age	Under 29	64	26.6		32	23.7	32	30.2
	30 ~ 39	105	43.6		58	43.0	47	44.3
	40 ~ 49	56	23.2		36	26.7	20	18.9
	Over 50	16	6.6		9	6.6	7	6.6
Education Attained	Middle and high school	57	23.7		32	23.7	25	23.6
	2-year college	72	29.9		41	30.4	31	29.2
	University	104	43.2		58	43.0	46	43.4
	Graduate school	6	2.5		2	1.5	4	3.8
	Non-response	2	0.8		2	1.5	-	-
Occupation	Public servant	11	4.6		6	4.4	5	4.7
	Business person	20	8.3		11	8.1	9	8.5
	Office worker	41	17.0		24	17.8	17	16.0
	Sales/Services	36	14.9		20	14.8	16	15.1
	Professional	22	9.1		14	10.4	8	7.5
	Student	35	14.5		19	14.1	16	15.1
	Production/technical	28	11.6		12	8.9	16	15.1
	Unemployed	1	0.4		-	-	1	0.9
	Agriculture and fisheries	7	2.9		5	3.7	2	1.9
	Housewife	26	10.8		11	8.1	15	14.2
	Other	14	5.8		13	9.6	1	0.9
Smartphone usage period	Less than 6 months	13	5.4		7	5.2	6	5.7
	6 months - less than 1 year	58	24.1		37	27.4	21	19.8
	1 year – less than 1.5 years	74	30.7		38	28.1	36	34.0
	1.5 years – less than 2 years	45	18.7		27	20.0	18	17.0
	Over 2 years	14	5.8		8	5.9	6	5.7
	Non-response	37	15.4		18	13.3	19	17.9
Total		241	100		135	100	106	100

Table 2. Reliability and Cross-Loadings (Overall Group)

Constructs	Measured items	Cross loading	t-value	CR[a]	AVE[b]	α
AR contents quality	The Marker-based AR application provides relevant information of traditional tales	0.792	22.307	0.890	0.670	0.833
	The Marker-based AR application provides easy to understand information of traditional tales.	0.889	52.763			
	The information of traditional tales from the marker-based AR application is clear.	0.819	34.579			
	The Marker-based AR application presents the information of traditional tales in an appropriate format.	0.770	22.125			
AR system quality	The Marker-based AR application is easy to use.	0.759	22.956	0.856	0.598	0.778
	The Marker-based AR application is convenient to see.	0.763	16.862			
	The Marker-based AR application has visually appealing materials.	0.803	27.559			
	The Marker-based AR application allows to access relevant information.	0.768	22.747			
AR personalized service quality	The Marker-based AR application provides personalized information.	0.763	15.865	0.837	0.632	0.709
	The Marker-based AR application has the ability to understand my needs and preferences.	0.805	24.831			
	The Marker-based AR application is interactive to me.	0.817	25.910			
AR satisfaction	I am satisfied with using the marker-based AR application	0.809	23.628	0.890	0.669	0.835
	I am satisfied with using the marker-based AR application functions	0.802	28.599			
	I am satisfied with the contents of the marker-based AR application	0.828	32.042			
	Overall, I am satisfied with the marker-based AR application	0.833	32.865			
Intention to Recommendation	I will recommend this marker-based AR application to my friends and relatives	0.863	46.076	0.887	0.723	0.809
	When I return home, I will positively promote this marker-based AR application	0.840	33.462			
	I will strongly recommend others to use this marker-based AR application	0.849	32.427			
Personal Innovativeness	I like to experiment with new information technologies.	0.883	45.553	0.908	0.767	0.849
	If I heard about a new information technology, I would look for ways to experiment with it.	0.883	49.155			
	Among my peers, I am usually the first to try out new information technologies.	0.846	25.927			

[a] Composite reliability
[b] Average variance extracted

Table 3. Correlation and Discriminant Validity

Construct	Correlation of constructs					Mean	S.D.	Skewness	Kurtosis
	1	2	3	4	5				
1. Contents quality	**0.819**					3.214	0.735	-0.317	0.710
2. System quality	0.469**	**0.773**				3.357	0.650	0.235	0.754
3. Personalized service quality	0.463**	0.582**	**0.795**			3.261	0.666	0.083	0.627
4. AR satisfaction	0.564**	0.525**	0.612**	**0.818**		3.272	0.685	-0.147	1.165
5. Intention to recommendation	0.524**	0.521**	0.561**	0.765**	**0.850**	3.216	0.727	-0.303	0.936

Note: Leading diagonal shows the square root of AVE of each construct." Do not needs **.

Table 4. Effect Size of Effect of Each Construct on AR Satisfaction

Structural path	Model 1		Model 2		Model 3	
	Estimates	**t-value**	**Estimates**	**t-value**	**Estimates**	**t-value**
AR content quality ☐ AR satisfaction	0.570	10.740	0.407	5.392	0.314	3.787
AR system quality ☐ AR satisfaction			0.338	4.505	0.167	2.072
AR personalized service quality ☐ AR satisfaction					0.368	5.324
R^2	0.324		0.412		0.494	
Difference of R^2			0.088		0.082	
f^2			0.150		0.162	
Effect size			Moderate		Moderate	

Table 5. Standardized Structural Estimates and Tests of Main Hypotheses

Hypotheses	Path			Estimates	t-value	Results
H_1	AR contents quality	□	AR satisfaction	0.314	3.787	Supported
H_2	AR system quality	□	AR satisfaction	0.167	2.072	Supported
H_3	AR personalized service quality	□	AR satisfaction	0.368	5.324	Supported
H_4	AR satisfaction	□	Intention to recommendation	0.768	22.226	Supported

R^2

AR satisfaction: 0.494 (49.4%)

Intention to recommendation: 0.590 (59.0%)

Table 6. Comparison of the Path Coefficients between High Personal Innovativeness Group and Low Personal Innovativeness Group

Hypotheses	Path	High Personal Innovativeness Group (A)	Low Personal Innovativeness Group (B)	t-value (A-B)	Test of hypothesis
H_{1a}	AR contents quality □ AR satisfaction	0.169	0.429	-1.978 (-0.260)	Supported
H_{2a}	AR system quality □ AR satisfaction	0.303	0.050	1.832 (0.253)	Supported
H_{3a}	AR personalized service quality □ AR satisfaction	0.366	0.353	0.108 (0.013)	Not supported

Table 7. Mediation analysis following the Baron & Kenny (1986) approach

Step	Independent variables	Mediator	Standardized coefficient	Standardized error	R^2	Comments
Step 1	AR content quality	AR satisfaction	0.317***	0.051	0.491	-
	AR system quality		0.160***	0.063		
	AR personalized service quality		0.373***	0.061		

Step	Independent variables	Dependent variables	Standardized coefficient	Standardized error	R^2	Comments
Step2	AR content quality	Intention to recommendation	0.284***	0.057	0.431	-
	AR system quality		0.209***	0.070		
	AR personalized service quality		0.309***	0.068		

Step	Independent variables & Mediator	Dependent variables	Standardized coefficient	Standardized error	R^2	Comments
Step3	AR content quality	Intention to recommendation	0.093	0.050	0.615	Full mediation
	AR system quality		0.113*	0.059		Partial mediation
	AR personalized service quality		0.085	0.061		Full mediation
	AR satisfaction		0.601***	0.060		-

* $p<0.05$, ** $p < 0.01$, *** $p < 0.001$

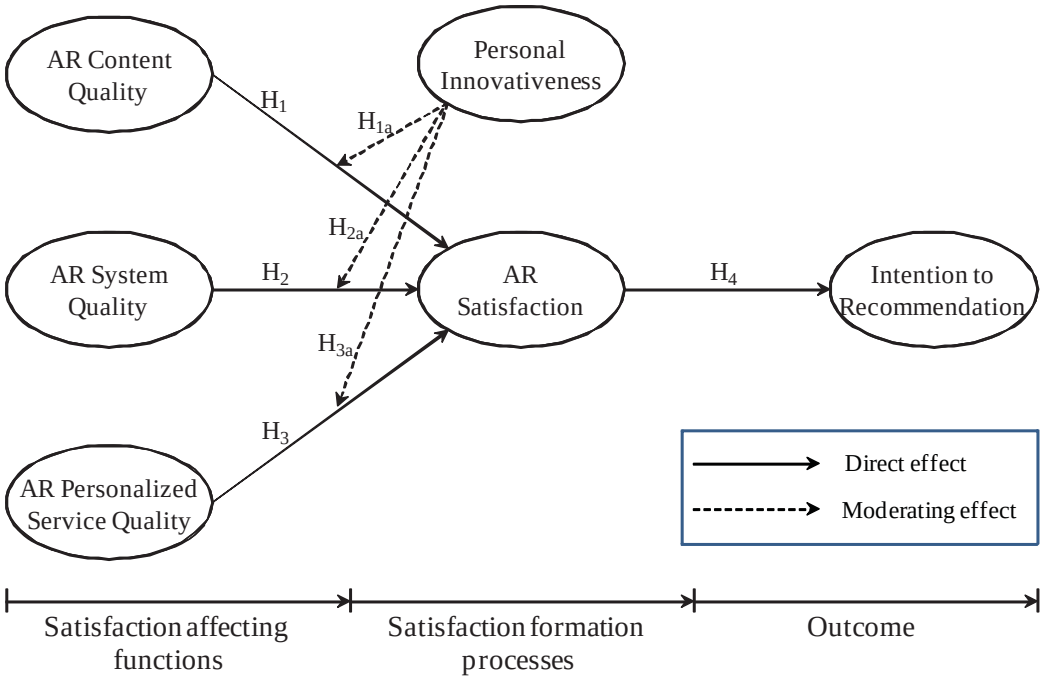


Fig. 1 Proposed Research Model

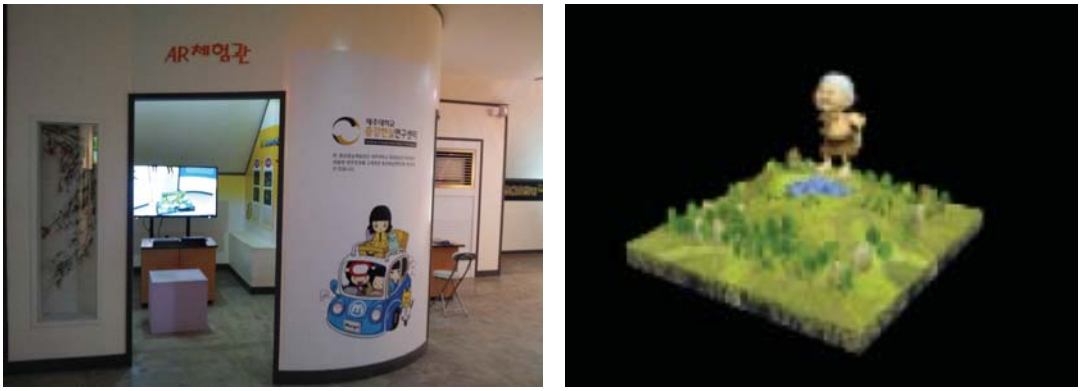


Fig. 2 Snapshot of marker-based AR application in Jeju island

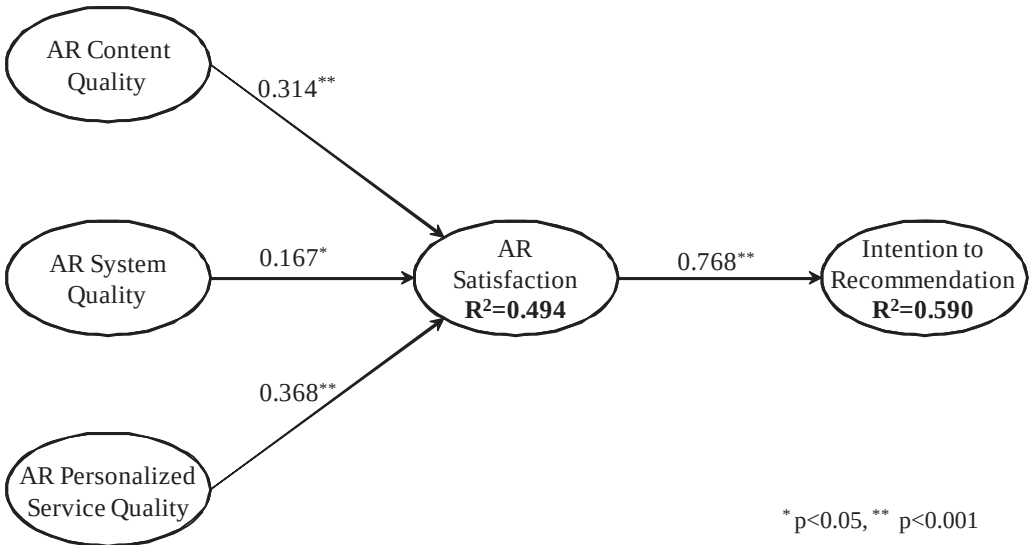
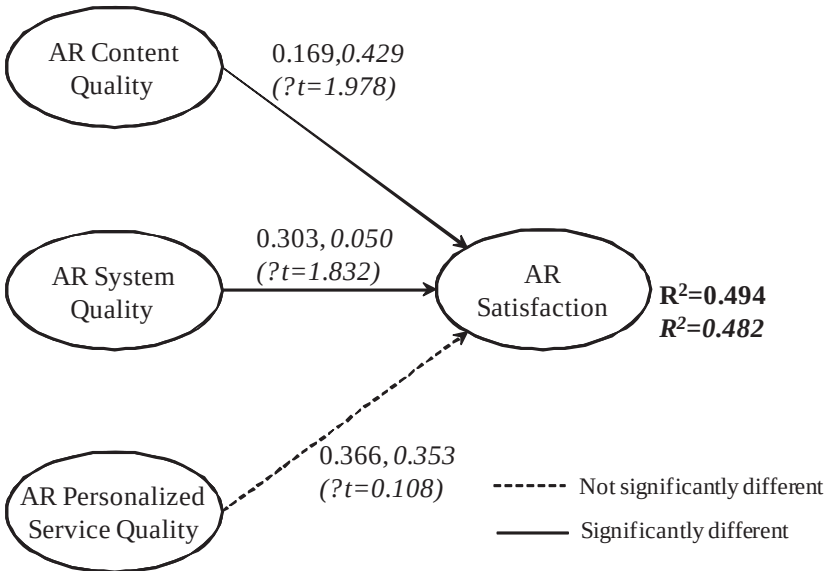


Fig. 3 Overall Model: Path Estimates by PLS Analysis



Note. *Italic* coefficients denote the low-innovativeness group and *non-italic* coefficients denote high-innovativeness group.

Fig. 4 Path Estimates by PLS Analysis Comparing High Personal Innovativeness Group and Low Personal Innovativeness Group