The Impact of AR Characteristics on Purchase Intention of Location-based AR Navigation Systems

Abstract

As new AR supported products such as location-based AR navigation systems become available in the consumer market, it is particularly important to understand how characteristics of AR can be optimized to enhance customer satisfaction and increase purchase intention of these products. However, little research has addressed this gap in the literature so far. Therefore, this study developed a theoretical framework including AR characteristics, experience, satisfaction and purchase intention employing experience economy theory. This study's main theoretical contribution is that three characteristics of AR – spatial ability (sensory domain), sense of presence (feeling domain), and conceptual understanding (cognitive domain) – were found to be key antecedents of consumers' intention to purchase location-based AR navigation systems through the mediation of educational, entertainment, aesthetic, and escape experience. The findings have important implications for future development of location-based AR systems.

Keywords: Experience economy theory; augmented reality; empirical study; user satisfaction; user purchase intention

1. Introduction

Augmented reality (AR) refers to technologies that enhance the user's sense of reality through the coexistence of digital and real environments (Azuma et al., 2001), whilst virtual reality (VR) refers to a computer-simulated environment with and within which people interact (Diemer, Alpers, Peperkorn, Shiban, & Mühlberger, 2015; Schuemie, Van Der Straaten, Krijn, & Van Der Mast, 2001). Interest in the applicability of AR and AR-enhanced experiences has been significantly increasing in recent years especially in the context of learning by demonstration. With the stabilization of AR technology, it has become useful in the contexts of education and training service development. For example, it serves as a tool for schools to improve their gamification training programs (González et al., 2016) and in educational settings, the most reported advantage is that it promotes enhanced learning achievement (Akçayir & Akçayir, 2017).

With the increase in its applicability, research on AR has also increased. For instance, studies on topics such as technological development (Höllerer & Feiner, 2004; Van Krevelen & Poelman, 2010; Carmigniani et al., 2011), applicability in educational settings (Kaufmann, 2003; Wu, Lee, Chang, & Liang, 2013; Cheng & Tsai, 2013), therapeutic effects (Hoffman, 2004; Arvanitis et al., 2009; Chittaro, Sioni, Crescentini, & Fabbro, 2017), customer response in retailing (Fan, Chai, Deng, & Dong, 2020; Park & Yoo, 2020), customer satisfaction and retention rates in museums and tourist venues (Jung, Chung , & Leue, 2015; Jung & tom Dieck; 2017; Sylaiou, Mania, Karoulis, & White, 2010; tom Dieck, Jung, & tom Dieck, 2018) have been published. Most studies, however, provide limited information, as they focus more on the technological viability and applicability of AR rather than its characteristics.

AR provides increased visual, tactile, and perceptual sensory experiences (Mehmetoglu & Engen, 2011). The characteristics of AR can be categorized as spatial ability (sensory domain) (Huisingh, McGwin, & Owsley, 2016), sense of presence (feeling domain) (Cummings & Bailenson, 2016), and conceptual understanding (cognitive domain) (Geveke, Steenbeek, Doornenbal, & Van Geert, 2016). Despite the potential of AR to provide a new and unique experience to users, to the best of the authors' knowledge, no previous studies have considered the impact of the characteristics of AR technology on user satisfaction and purchase intention including in the context of location-based AR navigation systems. However, as new AR products become available in the consumer market, it is important to understand how ARs characteristics can be optimized to enhance customer satisfaction and increase purchase intention of these products. In particular, this study aims to answer the following research question: "What influence does sense of presence, conceptual understanding, and spatial ability have on intention to purchase location-based AR navigation systems among drivers in Korea?". Therefore, the objective of this study is to investigate the antecedents (i.e., sense of presence, conceptual understanding, and spatial ability) of intention to purchase location-based AR navigation systems among drivers in Korea. Currently, there are limited AR navigation systems on the consumer market as further testing and research is required for confirm their safety. Due to this, the main limitation of this study is the limited ability to facilitate a real driving scenario, which was out of scope of the current research project. We herein identify factors that may affect user satisfaction and purchase intention with AR experiences. More specifically, we examine how and through which paths the characteristics of AR technology (sense of presence, conceptual understanding, and spatial ability) influence users' experience, subsequently influencing satisfaction and purchase intention during exposure to an AR-based demonstration.

The paper is structured as follows: section 2 reviews the concepts and related literature; section 3 introduces the research model and related hypotheses; section 4 presents the results; and section 5 concludes with a discussion of the limitations and implications of our findings. This study contributes new findings to the field of AR by identifying three antecedents (sense of presence, conceptual understanding, and spatial ability) that impact on drivers' intention to purchase location-based AR navigation systems. This is the first study to investigate these specific factors and provide empirical evidence to support the outcome in this context.

2. Theoretical Background

2.1 Augmented Reality and Consumer Behavior

Augmented reality (AR) offers firms new possibilities in delivering content to consumers (McLean & Wilson, 2019) by superimposing virtual 3D objects on the actual visible world that register and interact with virtual images in real time (Azuma et al., 2001). In the last decade, AR has seen a boom in commercial applications since smartphone and mobile devices have become ubiquitous as a means of searching for information (Loureiro et al. 2019). Consumers can have endless interaction with enhanced 3D product information, are able to better perform tasks and appreciate the functionality of the product more, which increases their satisfaction and willingness to buy (Poushneh & Vasquez-Parraga, 2017). The quality of the augmentation has been found to lead to positive evaluations of the AR application leading to changes in brand attitude (Rauschnabel, Felix, & Hinsch, 2019). The applicability of AR technology has expanded from image-based AR (i.e. the utilization of markers) to the current form of location-based AR systems (Höllerer & Feiner, 2004; Dünser, Grasset, & Billinghurst, 2008; Bower, Howe, McCredie, Robinson, & Grover, 2014), which uses GPS (global positioning system) information to superimpose virtual information on a moving, real world (Stoyanova, Brito, Georgieva, & Milanova, 2015). AR technology is effective in improving users' spatial ability (Shamsuddin & Din, 2016), conceptual understanding (Yoon, Anderson, Lin, & Elinich, 2017), cognitive ability (Chen, Lee, & Lin, 2016; Cunha, Brandão, Vasconcelos, Soares, & Carvalho, 2016; Ochs et al., 2018), emotional control (Chen, Lee, & Lin, 2016; Harley, Lajoie, Tressel, & Jarrell, 2018), and willingness to purchase (Stoyanova, Brito, Georgieva, & Milanova, 2015). For instance, Cheng and Tsai (2013) concluded that students' spatial ability, practical skills and conceptual understanding are often afforded by image-based AR whereas location-based AR tends to support inquiry-based activities. Additionally, application of AR has a positive effect on spatial ability in contexts aiming to improve the spatial awareness of engineering students (Martin-Gutierrez et al., 2010). Studies of various AR applications support that electromechanical practice facilitates improvement of spatial ability and affects learning and student motivation positively (McMahan, Bowman, Zielinski, & Brady, 2012). Previous studies also revealed that AR content strongly influences cognition, emotions, and attention regardless of the type of AR device (Javornik et al., 2019) and behavioral changes can be achieved via AR experiences (Riva, Baños, Botella, Mantovani, & Gaggioli, 2016).

When using AR to shop, the cognitive processing required by consumers may be reduced as they no longer have to imagine what the product looks like as instead, they are presented with a clear, detailed representation of the image with minimal effort (McLean & Wilson, 2019). Hence, McLean and Wilson (2019) found that three AR attributes (interactivity, vividness and novelty) influence perceived ease of use of the AR application thereby aiding in consumer's decision-making. Similarly, Rauschnabel, Felix, and Hinsch (2019) found that utilitarian benefits (e.g. its usefulness) of an AR application are important in shaping consumers' evaluations while hedonic benefits (e.g. enjoyment and aesthetic appeal) drive inspiration. Flow, social norms and social image have been found to drive purchases through AR applications within the Pokémon Go game (Rauschnabel, Rossmann, & tom Dieck, 2017). Recognizing how AR can influence consumer satisfaction and purchase intention is important for retailers and AR developers to collaborate in developing effective marketing strategies that enrich and enhance consumers shopping experience (Poushneh & Vasquez-Parraga, 2017; Scholz & Duffy, 2018). However, empirical studies analyzing the influence of AR on consumers' satisfaction (Jung, Chung & Leue, 2015), attitudes toward brands (van Esch et al., 2019) and willingness to purchase (Poushneh & Vasquez-Parraga, 2017; Pantano & Servidio, 2012) lack consideration of experiential factors, which are important given the experiential nature of AR technology. In this study, we rectify this research gap by exploring the influence of characteristics of AR technology on customer satisfaction using experience economy theory in the context of training and education.

In traditional marketing frameworks, consumers learn about products through direct and indirect experiences (Alcañiz, Bigné, & Guixeres, 2019). Direct experience is the physical interaction of the consumer with objects (e.g. products) and subjects (e.g. sellers) whereby communication often involves a rich multisensory interaction with products and sellers (Alcañiz, Bigné, & Guixeres, 2019). With AR, directly supported experiences may consist of using an AR device to view superimposed digital information on a point of interest in a physical environment (Flavián, Ibáñez-Sánchez, & Orús, 2019). In comparison, indirect experience may involve technological devices (e.g. smartphones, computers), digital media, and mass-media advertisements (e.g. billboards) (Alcañiz, Bigné, & Guixeres, 2019). Indirect communication channels consist of TV and 2D websites displayed on computers or smartphones with accompanying sensory-rich contextual information, which provide indirect interactivity through clicking and pressing keys that transform these actions into activities shown on the screen (Flavián, Ibáñez-Sánchez, & Orús, 2019; Alcañiz, Bigné, & Guixeres, 2019). Channels offering indirect consumer experience have been effective in the past at encouraging purchase intentions depending on various factors. For example, to improve consumers online purchase intention, service providers should provide service with empathy and enhance customer's trust (Sam & Tahir, 2009), and focus on website quality (Hasanov & Khalid, 2015) and visual aesthetics (Tseng & Lee, 2019) given their impact on purchase intention through mediation of customer satisfaction. Retailers may use AR to create engaging product experiences online by enabling increased interaction not possible in the online environment therefore decreasing returns and increasing conversions (Richter & Raška, 2017). Virtual (indirect) experiences provide a richer experience where new consumer-product and consumer-context interactions can be created that may not be possible in the real world (Alcañiz, Bigné, & Guixeres, 2019). An example of indirect AR experience is using AR triggers to access informative YouTube videos at a physical point of interest (e.g. attraction), or encouraging people to share their experiences in social networks post-experience (Flavián, Ibáñez-Sánchez, & Orús, 2019).

2.2 Experience Economy Theory

Pine and Gilmore (1998, 1999) introduced experience economy theory based on behavioral economics, explaining that consumers' spending is strongly linked to the value of their experience. In other words, consumers are willing to pay more for products and services if they are provided with a valuable and worthy consumption experience. Experience economy theory addresses four types of experience: entertainment, education, aesthetic, and escape, as shown in Figure 1. In the figure, the horizontal axis displays active versus passive participation, while the vertical axis represents absorption versus immersion. The importance of the designated experience is represented by the "sweet spot", a zone that intersects all four factors at which satisfaction and a memorable experience co-occur. Although experience economy theory was originally applied in a business context, AR, given its impact on the five senses, is also considered as an appropriate tool with which to create meaningful user experiences (Azuma et al., 2001). AR can be instantly perceived and felt through visual stimuli that are intensely related to the *aesthetic experience* (Poushneh & Vasquez-Parraga, 2017). The vividness of the AR experience combines the sensory experience of actual objects with the non-sensory experience of imaginary objects to create a clear image in the consumer's mind (McLean & Wilson, 2019). In this case, the products and experiences are reflected in the mental images generated by the AR experience, which is an important skill during the consumer decision-making process (McLean & Wilson, 2019). *Educational experience* can be achieved through AR-based simulation (Cabero & Barroso, 2016) and this technology has long been considered as an entertainment medium

(MacIntyre & Hannigan, 2003), that can provide *entertainment experiences* during consumption situations in various industries (e.g. automotive, entertainment, retail) (Flavián, Ibáñez-Sánchez, & Orús, 2019). While no study has considered *escape experience* in the context of AR, prior research (Andreassen et al., 2016) indicates that people use other media (e.g. TV, games, social media) and immersive technology (e.g. virtual reality) (Han & tom Dieck, 2019) as a form of escape into an alternative virtual world therefore indicating that AR could also provide an indirect escape experience.

Studies measuring experience economy factors are becoming more prevalent. In a festival context, Manthiou, Lee, Tang, and Chiang (2014) identified four experience realms implicated in an optimal festival experience that influence vividity and loyalty. Furthermore, it is possible to provide creative experiences by differentiating tourist destinations based on experiential economic factors (Rivera, Semrad, & Croes, 2015). Consideration of experiential economic factors was also confirmed in a study on the effects of VR and AR technology on museum visits (Jung, tom Dieck, Lee, & Chung, 2016). In a recent study by Lee, Jung, tom Dieck, and Chung (2019), it was found that absorptive experience (education, entertainment) influences immersive experience (escapism, esthetic), overall museum VR tour experience and intention to visit a museum. In the retail context, shopping malls are well known to stimulate senses, cognition, and emotions and some studies have called for further developments to improve the consumer experience at the mall as not merely a place where products and services are provided (Gilboa, Vilnai-Yavetz, & Chebat, 2016). Tourism researchers have explored the effect of the experience economy on place attachment and behavioural intentions through emotions and memory and the results show that an excited, pleased guest is more likely to remember the experience (Loureiro, 2014). In another study related to rural tourism experiences, education and esthetics was found to positively predict rural tourists' arousal and escapism and esthetics determined memorability (Kastenholz et al., 2018). All these studies have led to active discussion as to what constitutes "worthwhile experience" (Kukk & Leppiman, 2016). Notably, there are few previous studies on user experience of AR. In one study, a positive effect of AR experience on science festival visitors' engagement was found (tom Dieck, Jung, & Rauschnabel, 2018) and in another study, art gallery visitors' learning experience was enhanced via AR (tom Dieck, Jung, & tom Dieck, 2018). However, research exploring AR enhanced driving experiences from the experience economy perspective has not yet been explored but is important given that industry developments are being made and related products offering experiential AR experiences are becoming increasingly available to the consumer market.

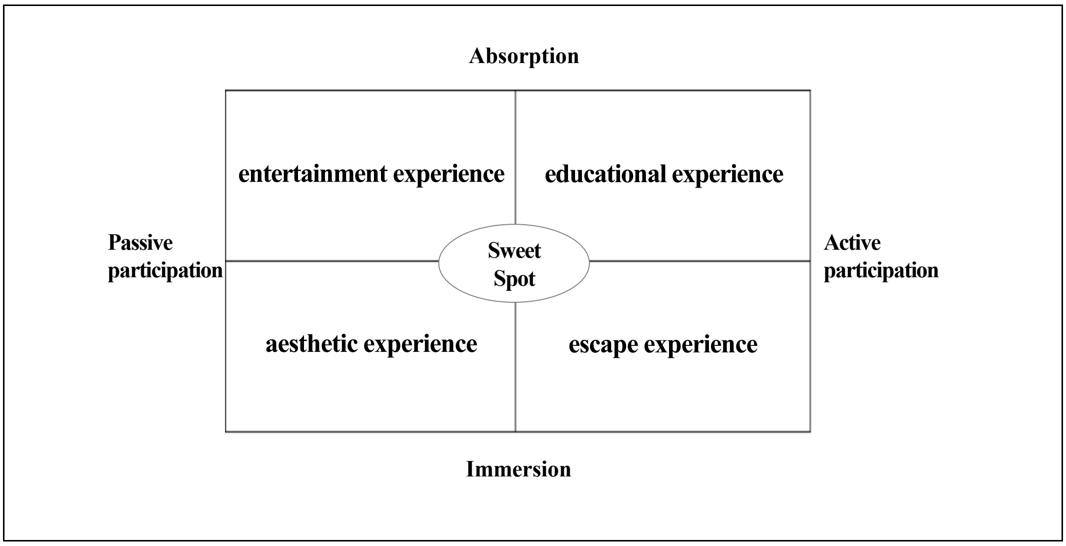

Fig. 1. User experience and AR (Pine & Gilmore, 1998, adapted)

3. Hypotheses

In this study, we propose a research model based on experience economy theory to investigate users' perceptions of the characteristics of AR and their effects on user satisfaction (see Fig. 2). Presence of feeling, conceptual understanding, and spatial ability are considered as the characteristics of AR. Rather than focusing on the direct effects of these characteristics on user satisfaction, the model focuses on the contribution of various experiential factors. This research enriches our understanding of how the user's perception of the characteristics of AR is associated with user experience, and to what extent user experience is associated with satisfaction and, eventually, purchase intention.

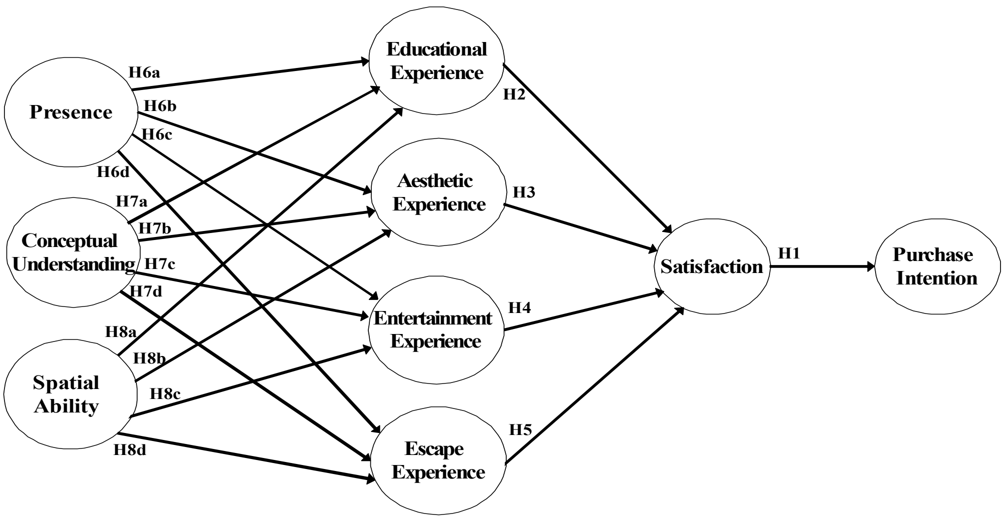

Fig. 2. Research model

3.1 Sense of Presence

AR technology has advanced to enhance the sense of presence for users (North & North, 2016). Presence refers to the extent to which an individual is immersed in a virtual environment such as an online game (Jeong, Kim, Yum, & Hwang, 2016) and has also been described as the feeling of "being there" (Heeter, 1992). Watching a film provokes a richer visual experience and reading a book provokes a richer imaginative experience. Presence in the context of AR is experienced both cognitively and emotionally when a subject feels that he or she exists within a situation through stimulation of the senses and full participation (North & North, 2016). Presence is linked with environmental and psychological factors that impel the subject's experience of immersion (Witmer & Singer, 1998). Research on the relationship between presence and immersion in the application of VR to the treatment of acrophobia revealed presence to be connected to the subject's experience of immersion in the VR situation (Krijn et al., 2004). With the aforementioned in mind, this study defines presence as the degree to which the subject is convinced that he or she exists or is truly present in the AR space.

Using spatial presence as a parameter (Hilken, de Ruyter, Chylinski, Mahr, & Keeling, 2017), researchers confirmed that the application of AR in online services has a positive effect on customer value perceptions. Spatial presence, the degree to which the customer perceives his or her real existence within the shopping space, provides the customer with decision comfort. Presence in AR differs from the telepresence of VR and is linked to a broader and more complex experience because AR coexists with the real environment (Wagner et al., 2009). Several media tools provide the experience of presence, and various simulation technologies are being developed to influence sense of presence. Psychological factors must also be taken into account. Finally, content is just as, if not more, influential than the screening technology (Baños et al., 2004).

Sense of presence enriches trainees' experience in several ways. First, sense of presence in educational and training settings enhances skills acquisition and transfer of knowledge through experiential learning in virtual environments (Romano & Brna, 2001; Lecon & Herkersdorf, 2014). In addition, the VR classroom environment influences the level of immersion and sense of presence, which in turn affects the thinking skills of the trainee (Stavroulia, Baka, Lanitis & Magnenat-Thalmann, 2018). Another study by Lackey, Salcedo, Szalma, and Hancock (2016) showed that positive VR experience in terms of greater presence was associated with lower stress and smaller workload when performing the live version of a task. In this study, we posit that presence in AR will similarly affect educational experience positively.

Second, sense of presence in the VR environment can engage the senses, especially vision and hearing. Sense of presence, coupled with emotional involvement, is aroused by multimedia such as vocal sound and can enhance the aesthetic experience of the listener within a space (Wingstedt, 2018). In the AR setting, sense of presence while using AR devices will make the experience more attractive and immersive, more aesthetically pleasing.

Third, Hartmann, Klimmt, and Vorderer (2010) demonstrated that a sense of presence may directly enhance users' entertainment experience in computer-mediated environments. For example, games that produce a heightened sense of presence or the feeling of "being there" in an artificial world are known to be highly entertaining (Alison, 2003). We posit that this will also be true in AR settings.

Finally, activities such as shopping or being trained can be stressful, especially in a crowded place or harsh environment; positive and relaxing emotions resulting from an AR experience can lower the level of perceived arousal (Robert & John, 1982). In a study on the effects of VR on various emotions such as excitement, relaxation, and anxiety, depending on the context (Riva, Baños, Botella, Mantovani, & Gaggioli, 2016), the immersive aspect of VR was shown to aid shoppers and trainees in dealing with or avoiding stress. VR experiences at the mall temporarily allow consumers to escape from their surroundings (Van Kerrebroeck, Brengman, & Willems, 2017). A sense of presence during training improves the ability to absorb the provided information. The more a sense of presence is felt, the more likely it becomes that the subject will want to continue the experience, and the more likely it is that an escape experience will occur.

Thus, we posit that presence experienced through AR will positively affect educational, aesthetic, entertainment, and escape experience. Therefore, we present the following hypotheses:

H1a. *Presence in AR will positively affect educational experience.*
H1b. *Presence in AR will positively affect aesthetic experience.*
H1c. *Presence in AR will positively affect entertainment experience.*
H1d. *Presence in AR will positively affect escape experience.*

3.2 Conceptual Understanding

According to early research, conceptual understanding refers to deep, complex knowledge related to core understanding (Ohlsson et al., 2000) and may be described as the identification of a phenomenon and its outcome through connection with acquired knowledge (Cai, Chiang, & Wang, 2013). In the educational setting, it is the degree of understanding, learning, and assimilation of the information received through AR experiences and in this case, AR technology is expected to help users improve conceptual understanding. For example, in a shopping mall where consumers interact directly with products, AR can provide additional nutritional information about food on the shelf, display reviews linked to various products, and allow consumers to make an informed decision (Javornik, 2016). In the field of education, where the number of applications of AR is increasing, interest in the development of technology and content suitable for educational application is growing (Cabero & Barroso, 2016; Lin, Hsieh, Wang, Sie, & Chang, 2011).

Analysis of AR usage in the field of education reveals that AR can help ensure learning outcomes, motivate students, and facilitate interaction and collaboration. However, its limitations include maintenance of superimposed information as well as over-attention to virtual information (Bacca, Baldiris, Fabregat, & Graf, 2014). Learning outcomes related to conceptual understanding differ for each study. In one study conducted in a medical setting, conceptual understanding was confirmed through practical training using AR, which led to qualitative improvements in the training program (Kamphuis, Barsom, Schijven, & Christoph, 2014). On the other hand, in a study of the application of AR in a physics course, though there was a learning effect initially, there was no difference in learning between the experimental and control groups as the course progressed (Cai, Chiang, & Wang, 2013). In addition, in a study involving elementary school students solving fraction problems in mathematics using VR based on the hypothesis that the interactive element would affect learning outcomes, there was no difference between the experimental and control groups when testing for effects on conceptual understanding (Roussou, Oliver, & Slater, 2006). In another study, applying AR led to cognitive overload due to excess amounts of information and the complexity of the equipment to be implemented (Van Krevelen & Poelman, 2010; Wu, Lee, Chang, & Liang, 2013; Dunleavy, Dede, & Mitchell, 2009).

AR technology can enhance conceptual understanding, which is connected with educational experience (Lin, Duh, Li, Wang, & Tsai, 2013; Ibáñez & Delgado-Kloosm, 2018). Conceptual understanding, when associated with aesthetic experience, can be realized through a variety of sensory approaches (Joy & Sherry Jr, 2003). Aesthetic experience in science education, for example, can change one's view of the world and foster conceptual understanding of new and powerful content (Girod, Twyman, & Wojcikiewicz, 2010). Like the emergence of edutainment, the application of AR can provide an enjoyable learning experience and promote use of new technologies (Addis, 2005). The greater the conceptual understanding, the more a user will enjoy him or herself and the more likely he or she is to have an escape experience (Di Serio, Ibáñez, & Kloos, 2013; Ibáñez, Di Serio, Villarán, & Kloos, 2014). We therefore posit that presence experienced in this way positively affects educational, aesthetic, entertainment, and escape experience. Therefore, we present the following hypotheses:

H2a. *Conceptual understanding of AR will positively affect educational experience.*
H2b. *Conceptual understanding of AR will positively affect aesthetic experience.*
H2c. *Conceptual understanding of AR will positively affect entertainment experience.*
H2d. *Conceptual understanding of AR will positively affect escape experience.*

3.3 Spatial Ability

Spatial ability refers to the ability to understand and move around in space through AR, the ability to recognize the spaces between objects and users, and the ability to utilize space. AR enables users to interact with physical space and digital space simultaneously (Rekimoto, Ayatsuka, & Hayashi, 1998); it also helps develop spatial visualization. Spatial ability in the AR context may involve discovering a route in a geographic space or revealing the relationships between spatial entities using concepts such as relative position, direction, and distance (Shelton & Hedley, 2004).

AR is a useful tool through which researchers and practitioners may increase spatial ability in a variety of domains. For example, in medical education, it is difficult to understand the structures and organs of the body through two-dimensional images; AR technology may overcome this problem in practical subjects like anatomy (Moro, Štromberga, Raikos, & Stirling, 2017). In addition, AR has been proven to improve spatial ability and maximize the learning curve as a tool to learn geometry in mathematics classes (Kaufmann & Schmalstieg, 2003). In an urban design context, students can have impressively concrete experiences, performing physical actions that improve spatial ability using AR (Chen & Wang, 2008).

AR can help spatial ability by altering the user's view of space. Improvement of spatial ability using AR is even applicable to entertainment experience, which gives people enjoyment. Also, AR in the context of educational experience, in which improvement of spatial ability may be part of the curriculum, may improve educational outcomes and increase satisfaction. One study suggested its applicability in practical training settings; the results showed how focusing on aesthetic experience in scientific education helps students to understand space in science and the aesthetic in art (Girod, Twyman, & Wojcikiewicz, 2010). Development of spatial ability using AR in the context of escape experience involves immersion in the activity (Lee, Wong, & Fung, 2009; Lee & Wong, 2014). In all these contexts, we posit that spatial ability will have a positive effect on satisfaction. Thus, we hypothesize:

H3a. *AR related to spatial ability will have a positive effect on educational experience.*
H3b. *AR related to spatial ability will have a positive effect on aesthetic experience.*
H3c. *AR related to spatial ability will have a positive effect on entertainment experience.*
H3d. *AR related to spatial ability will have a positive effect on escape experience.*

3.4 Educational Experience and Satisfaction

Educational experience refers to learning through experience; it requires learners' curiosity and a willingness to learn (Hughes, Stapleton, Hughes, & Smith, 2005). This can be achieved through AR-based simulation (Cabero & Barroso, 2016). Considerable research on educational experience has been conducted in various areas. Educational experience in tourism is achieved by exploring the historical background associated with the place being visited for the purpose of conveying knowledge (Oh, Fiore, & Jeoung, 2007; Mahdzar et al., 2017; tom Dieck, Jung, & tom Dieck, 2018). In addition, AR can enhance children's experiential learning in museums (Moorhouse, tom Dieck, & Jung, 2019). E-sport, another type of educational experience, also provides experience in order to cultivate knowledge of a given game. Users try to improve their outcomes by sharing strategies and tactics of the game; in the gaming industry, this improves player satisfaction with the game (Seo, 2013). In the film festival context, the effect of education on tourist satisfaction has been demonstrated (Park, Oh, & Park, 2010). Another study by Quadri-Felitti and Fiore (2013) showed a strong effect of educational experience on customer satisfaction within the tourism context. In addition, causality has also been demonstrated in the context of edutainment (tom Dieck, Jung, & Rauschnabel, 2018). Therefore, we posit that educational experience with an AR-based demonstration will also positively affect user satisfaction. We hypothesize as follows:

H4. *Educational experience through AR content will have a positive effect on satisfaction.*

3.5 Aesthetic Experience and Satisfaction

Aesthetic experience is a harmonious sensation acquired through experiences that appeal to the senses. A beautiful arrangement of historical relics in a museum is an example (Ali, Hussain, & Omar, 2016). Experiences with both functional and emotional value have a positive impact on customer satisfaction. Aesthetic experience influences emotional value, whereas educational experience affects functional value. For example, in an edutainment setting, research has shown that aesthetic experience has a positive effect on emotional value, which eventually results in higher customer satisfaction (Song, Lee, Park, Hwang, & Reisinger, 2015). As previously mentioned, AR can be instantly perceived and felt through visual stimuli that are intensely related to the aesthetic experience (Poushneh & Vasquez-Parraga, 2017). Experimentation with the relationship between AR and aesthetic experience has progressed quite significantly. For example, in a tourism context, aesthetic experience was an important factor in the evaluation of tourist experiences (Hosany & Witham, 2010; Quadri-Felitti & Fiore, 2012). People attend various events for the aesthetic experience; in such contexts, aesthetic experience is the main means by which user satisfaction is achieved. Therefore, we posit that aesthetic experience through AR-based demonstration will positively affect user satisfaction. We hypothesize as follows:

H5. *Aesthetic experience through AR content will have a positive effect on satisfaction.*

3.6 Entertainment Experience and Satisfaction

Entertainment experience refers to the pleasure (Oliver & Raney, 2011), excitement (Rieger, Reinecke, Frischlich, & Bente, 2014), and enjoyment (Vorderer, Klimmt, & Ritterfeld, 2004) gained from various experiences. Since enjoyment is a key motivational factor in seeking entertainment (Vorderer, Klimmt, & Ritterfeld, 2004), entertainment experience may be considered as the oldest experimental economic element to be examined in a business environment (Pine & Gilmore, 1999). The focus of entertainment experience is customer pleasure and enjoyment. Examples include the pleasure of attending a local music festival (Tanford & Jung, 2017; tom Dieck, Jung, & Rauschnabel, 2018), travelling to a new place (Tan, 2017), or passively participating in other people's activities or performances. Entertainment experience is present in most tourist destinations, where experience is paramount (Oh, Fiore, & Jeoung, 2007). While on vacation, consumers increase the value of their experiences by seeking enjoyment through entertainment, illusions, arousal, and sensory stimulation (Hosany & Witham, 2010). In another example, playing an e-sport online game may lead to consumption of other media, such as TV, and attending sports events (Seo, 2013). Fantasy, emotions, and pleasure are all parts of entertainment experience that increase consumption (Holbrook & Hirschman, 1982). Similarly, AR has long been considered an entertainment medium (MacIntyre & Hannigan, 2003) that can provide exciting and engaging consumption situations (Flavián, Ibáñez-Sánchez, & Orús, 2019). For example, consumers may use AR to foresee how their living would look with new decoration or how clothes would look on them before purchasing (Flavián, Ibáñez-Sánchez, & Orús, 2019). For this reason, we posit that usage of AR-based demonstration as part of entertainment experience will have a positive effect on satisfaction. We hypothesize as follows:

H6. *Entertainment experience through AR content will have a positive effect on satisfaction.*

3.7 Escape Experience and Satisfaction

"Escape" or "escapist" experience involves escaping from daily life or at least forgetting it for a while. The escape experience has been defined as the extent to which an individual is completely engrossed and absorbed in a given activity (Hosany & Witham, 2010). Escapist experience influences customers' emotions, and hence satisfaction levels, especially when the experience is exciting and enjoyable (Mehmetoglu & Engen, 2011; Ali, Hussain, & Omar, 2016; Thanh & Kirova, 2018). For example, a scary ride in an amusement park, gambling, and extreme sports are examples of escape experiences in which user satisfaction can be evaluated (Isada, Lin, & Isada, 2017). In addition, people may become immersed in watching movies and playing games to the extent they may be tempted to avoid daily life and continue with those activities. In the case of tourism, people may travel to a specific destination to escape from daily life or to participate actively in specific activities (Oh, Fiore, & Jeoung, 2007; Isada, Lin, & Isada, 2017). Another escape experience occurs when people want to deviate from their normal work routine and engage in leisure activities.

However, interestingly, some studies argued that escape experience does not affect satisfaction. For example, the results of one museum experience survey indicated that latent factors related to all types of experience (except escape experience) affected overall satisfaction (Radder & Han, 2015). It may be that escape experience involving AR is influenced by other situations and environmental factors, not the AR content *per se*. Unfortunately, no previous research has been conducted on escape experience in the context of AR. However, given that studies have pointed to relations between escapism and other media types including immersive virtual reality (Han & tom Dieck, 2019), it is anticipated that AR could also provide indirect escape experience, therefore, we establish the following hypothesis in order to investigate this phenomenon.

H7. *Escape experience through AR content will positively affect satisfaction.*

3.8 Satisfaction and Purchase Intention

Satisfaction is subjective assessment of a product experienced by a user (Westbrook, 1980). Customer satisfaction is related to quality of service (Taylor & Baker, 1994); for example, studies showed that when customers are purchasing uniforms, quality, fitting conditions, and satisfaction with the current uniform affect the intention to purchase new uniforms (Perry & Lee, 2017). Furthermore, satisfaction is the key factor influencing purchase intention (Taylor & Baker, 1994). One study on consumer decision-making styles conducted in a shopping mall confirmed the differences between hedonic and utilitarian attributes (Alavi, Rezaei, Valaei, & Wan Ismail, 2016). Recently, VR roller coasters have been installed in theme parks, and researchers have found that the experience of social presence positively affects willingness to pay (Jung et al., 2018). In the AR context, Poushneh and Vasquez-Parraga (2017) found that AR-enriched user experiences produce higher user satisfaction and willingness to purchase. Similarly, other research suggested that shopping-oriented AR applications are perceived as highly enjoyable, useful, and evoke high purchase intentions (Richter and Raška, 2017). Therefore, we posit that the AR experience will affect user satisfaction and, ultimately, intention to purchase a location-based AR navigation system. Based on the findings in previous literature, we present the following hypothesis:

H8. *Satisfaction through the experience of AR content will have a positive effect on purchase intention.*

4. Methods

4.1 Study Context

This study focuses on location-based AR navigation for driving experiences. Most drivers use navigation systems to help them while driving and it is expected that the use of navigation systems in Korea will increase in proportion to the increase in vehicle production in the future. Most information provided by navigation systems is represented on a map. AR navigation, on the other hand, combines the necessary information on a screen showing actual road surfaces, which is a more intuitive presentation. In this study, we examine AR navigation for drivers in Korea, as it is capable of simultaneously enhancing both spatial ability and conceptual understanding.

4.2 Data Collection

Due to the fact that this study investigates specific consumer purchasing behavior of AR enhanced products, it is considered that online surveys are appropriate for use as data collection method (Huang et al., 2016; Kim, Lee, & Jung, 2020). Data were collected online between 3–9 March 2017 by a survey company in Korea. The total number of surveys sent was 1,217,151, and follow-up emails were sent to 2,625 panel members (0.2% of all respondents) who were willing to participate in the survey. The total number of customers who accessed the survey emails was 512 (corresponding to 19.5% of emails sent), and the number of recipients who actually responded was 353, comprising 68.4% of the users accessing the email. Respondents received a $3 reward. Prior to completing the online survey, each participant was required to experience an indirect driving scenario using location-based AR by watching a short (1:09) demo of AR navigation systems available on YouTube (https://www.youtube.com/watch?v=RlUmFebVMGY), as shown in Figure 3. Driving use a traditional navigation system is an indirect experience, therefore, this video of the AR driving scenario was considered a suitable method for showing how AR could be used in this context. The AR content in the video, which was created by EyeNavi™ (full model name: EyeNavi X1 Extreme AR), is regarded as one of the first AR-based car navigation systems (EyeNavi™, 2014). Unlike conventional navigation, the AR-based car navigation system used in the study is updated by receiving real-time location information on the actual necessary information on the screen of the road. The information of the road, such as straight, right turn, left turn, and curve, is accurately guided by superimposing a large direction image on the road for navigation. In addition, information such as the remaining distance, arrival time, average speed, and average fuel economy is superimposed on the image on the road in AR navigation, and information is displayed in real time while moving. For drivers, direction is the most important part for accurate driving as well as reaching a destination, and AR navigation is characterized by overcoming the limitations of expressing the direction provided in the existing navigation and providing it accurately. Meanwhile, the company that produced the AR navigation used in this experiment is a very well-known company with the No. 1 market share, and this product is also a well-known product.

In this study, we considered the bias avoidance method used by Pannucci and Wilkins (2010). First, in order to avoid pre-trial bias, all panels of Korea were collected as respondents, taking into account the panel's selection bias and channeling bias. In addition, a recall bias may occur after a long time after the respondent watched the video. So, in this experiment, participants were allowed to respond immediately after watching the video. In addition, taking into account the transfer bias, respondents were asked to respond to the questionnaire on their own.

In total, 353 surveys were collected, of which 300 surveys were used in the final analysis. The remaining 53 surveys were excluded due to inappropriate answers to the reverse-coded questions. SPSS 23.0 was used for demographic analysis. All 300 participants were exposed to the indirect AR driving experience before completing the survey. The survey was originally designed and completed in Korean and later transcribed to English by two professionals who are proficient in both languages. The English version was then translated back to Korean and any discrepancies between the two languages was rectified. Finally, exploratory factor and reliability analyses were conducted and the results applied to smartPLS 3.0 (partial least squares software).

There could be a bias caused by AR product makers or brands. Hence, the logo of the AR company was removed in the demonstration video. In addition, a bias was expected due to the difference in prior knowledge about AR navigation. Hence, before participating in the experiment, the authors gave a full explanation of AR Navigation (the questionnaire was to proceed within a minimum time of 90 seconds to read the information on the driving situation). Therefore, we tried to reduce the difference due to the difference in conditions when respondents take the survey in advance.

Fig. 3. Demo scene of location-based AR navigation systems

5. Results

5.1 Participant Profiles

Table 1 shows the demographic characteristics of respondents. According to the responses to the questionnaire, 28.7% (n = 86) had experience using AR and 71.3% (n = 214) had no experience. There was an almost even distribution of male (51.3%) and female (48.7%) participants whom varied fairly evenly across the age categories. The majority of participants were employed (61%) followed by homemakers (16%), students (12%) and practitioners (11%).

Table 1.

Demographic characteristics of respondents

Category		**n (%)**
Gender	Male	154 (51.3)
	Female	146 (48.7)
Age	20s	75 (25.0)
	30s	75 (25.0)
	40s	74 (24.7)
	50s	76 (25.3)
Previous AR Experience	Yes	86 (28.7)
	No	214 (71.3)

Category		**n (%)**
Education	High school graduate	66 (22.0)
	College graduate	205 (68.3)
	Graduate student or above	29 (9.7)
Profession	Student	36 (12.0)
	Employee	183 (61.0)
	Homemaker	48 (16.0)
	Practitioner	33 (11.0)

n=300

5.2 Measurement of Variables

For the measurement of variables in this study, a questionnaire was distributed, as shown in the Appendix. Questionnaire items concerned special features of AR and its relation to conceptual understanding, spatial ability, experiential economic factors, educational experience, aesthetic experience, entertainment experience, escape experience, satisfaction, and purchase intention. In the questionnaire, 27 items were analyzed by exploratory factor analysis and the Varimax rotation method. The factor analysis revealed that commonality exceeded 0.785, and nine factors were revealed, with no multiple loading items for only one factor of 0.6 or more. The results of the exploratory factor analysis also revealed that the KMO (Kaiser-Meyer-Olkin) value for the sample was 0.948, which confirms that the data set is valid for the purposes of factor analysis. In addition, the sphere formation test value for the sample was $x^2 = 9284.722$ (df = 351, p < .001), and the cumulative total variance of the factors was 88.56%, which is judged to be suitable for the purposes of factor analysis. Reliability of the eight identified factors was confirmed by Cronbach's α coefficient, which was higher than 0.879, thus indicating high credibility. Appendix A presents the results of the exploratory factor and reliability analyses.

5.3 Validation

5.3.1 Validity and feasibility of the measurement model

The validity and appropriateness of the measurement model were determined before testing the hypotheses. First, as shown in Table 2, the AVE (average variance extracted) exceeds 0.803, which indicates acceptable convergent validity (Bagozzi & Yi, 1988). Composite reliability (CR), which is an index that measures the feasibility of a measurement model, exceeds 0.924, indicating reliability. The Cronbach's α value resulting from the PLS algorithm was 0.880. Except for escape experience and conceptual understanding, internal consistency of questionnaire items was indicated by a high reliability of 0.9 or higher on all factors (Bagozzi & Yi, 1988; Hair, Sarstedt, Ringle, & Mena, 2012). Furthermore, the communality value measuring the quality of the measurement model exceeded 0.803, indicating its suitability for our purposes.

Table 2.

Overall model fit

Variable	AVE	CR	R^2	Cronbach's α	Communality	Redundancy
Presence	0.874	0.954		0.928	0.874	
Conceptual Understanding	0.809	0.927		0.881	0.809	
Spatial Ability	0.870	0.952		0.925	0.870	
Educational Experience	0.902	0.965	0.527	0.945	0.902	0.157
Aesthetic Experience	0.854	0.946	0.565	0.914	0.854	0.041
Entertainment Experience	0.859	0.948	0.536	0.918	0.859	0.129
Escape Experience	0.803	0.924	0.279	0.880	0.803	-0.007
Satisfaction	0.929	0.975	0.723	0.962	0.929	0.251
Purchase Intention	0.934	0.977	0.471	0.965	0.934	0.439

(Goodness-of-Fit)	AR (LB) = 0.671 *Quality: high (>0.36), medium (0.25~0.36), low (0.1~0.25) (Tenenhaus, Vinzi, Chatelin, & Lauro, 2005)

AVE: Average Variance Extracted, CR: Composite Reliability

In order to ensure discriminant validity, the square root of AVE for each factor should be greater than the correlation coefficients between variables (Fornell & Larcker, 1981; Wong, 2013). The results in Table 3 show that the model satisfies this condition. In addition, the cross-loading results in Table 4 show that all factor loading values exceed 0.839, confirming the discriminant validity of each factor.

Table 3.

Correlations among constructs

Constructs	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Presence	4.71	1.30	**.935**								
(2) Conceptual Understanding	4.83	1.09	.539**	**.899**							
(3) Spatial Ability	4.71	1.14	.638**	.742**	**.933**						
(4) Educational Experience	4.13	1.35	.614**	.596**	.676**	**.949**					
(5) Aesthetic Experience	4.35	1.25	.688**	.547**	.671**	.765**	**.924**				
(6) Entertainment Experience	4.64	1.28	.586**	.597**	.698**	.692**	.715**	**.927**			
(7) Escape Experience	3.31	1.28	.478**	.346**	.442**	.610**	.579**	.496**	**.896**		
(8) Satisfaction	4.31	1.33	.665**	.618**	.710**	.750**	.777**	.757**	.596**	**.964**	
(9) Purchase Intention	3.49	1.49	.545**	.504**	.567**	.716**	.677**	.623**	.638**	.685**	**.967**

Note 1: Values on the diagonal indicate the square root of AVE for each construct.

Note 2: * p < 0.05, ** p < 0.01

Table 4.

Cross-loading analysis

Item	Presence	Conceptual Understanding	Spatial Ability	Educational Experience	Aesthetic Experience	Entertainment Experience	Escape Experience	Satisfaction	Purchase Intention
V01	**0.929**	0.543	0.605	0.585	0.644	0.589	0.453	0.637	0.505
V02	**0.945**	0.524	0.603	0.586	0.646	0.551	0.490	0.614	0.529
V03	**0.931**	0.473	0.584	0.555	0.638	0.525	0.447	0.616	0.498
V04	0.545	**0.918**	0.727	0.581	0.520	0.590	0.323	0.564	0.517
V05	0.552	**0.938**	0.719	0.569	0.554	0.555	0.360	0.589	0.494
V06	0.367	**0.839**	0.559	0.463	0.406	0.473	0.285	0.514	0.353
V07	0.560	0.707	**0.938**	0.610	0.597	0.659	0.383	0.622	0.511
V08	0.617	0.724	**0.939**	0.635	0.644	0.621	0.437	0.670	0.525
V09	0.610	0.664	**0.920**	0.648	0.635	0.679	0.454	0.693	0.552
V10	0.534	0.533	0.620	**0.935**	0.691	0.614	0.587	0.660	0.662
V11	0.593	0.572	0.642	**0.959**	0.745	0.664	0.601	0.723	0.696
V12	0.623	0.604	0.664	**0.955**	0.742	0.701	0.583	0.752	0.683

V13	0.648	0.501	0.616	0.756	**0.928**	0.683	0.574	0.722	0.692
V14	0.618	0.501	0.630	0.712	**0.939**	0.663	0.564	0.725	0.660
V15	0.640	0.532	0.615	0.653	**0.905**	0.655	0.510	0.708	0.526
V16	0.590	0.586	0.656	0.663	0.715	**0.950**	0.528	0.738	0.601
V17	0.595	0.578	0.694	0.681	0.710	**0.945**	0.530	0.745	0.616
V18	0.456	0.507	0.592	0.586	0.571	**0.885**	0.372	0.627	0.522
V19	0.540	0.396	0.488	0.629	0.627	0.552	**0.899**	0.651	0.571
V20	0.306	0.228	0.296	0.467	0.407	0.350	**0.875**	0.414	0.564
V21	0.435	0.307	0.399	0.540	0.515	0.449	**0.913**	0.530	0.583
V22	0.639	0.588	0.694	0.711	0.731	0.740	0.578	**0.961**	0.654
V23	0.624	0.580	0.696	0.744	0.740	0.737	0.602	**0.972**	0.680
V24	0.662	0.622	0.665	0.718	0.776	0.725	0.592	**0.957**	0.649
V25	0.548	0.527	0.583	0.734	0.674	0.634	0.613	0.690	**0.972**
V26	0.494	0.460	0.523	0.663	0.639	0.589	0.612	0.635	**0.959**
V27	0.541	0.495	0.541	0.680	0.651	0.596	0.627	0.662	**0.969**

Note: For each item, the cross-loadings are higher than those for other constructs. Bold values indicate values above the recommended limit of 0.5 (Fornell & Larcker, 1981; Alavi, Rezaei, Valaei, & Wan Ismail, 2016).

Additionally, the heterotrait-monotrait ratio of correlations (HTMT) was calculated in order to confirm discriminant validity (Ab Hamid, Sami, & Sidek, 2017; Hair, Matthews, Matthews, & Sarstedt, 2017) and it was confirmed that there is discriminant validity with an HTMT value of 0.85 criterions or less as shown in Table 5.

Table 5.

HTMT Results

Constructs	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
(1) Presence	-								
(2) Conceptual Understanding	0.599	-							
(3) Spatial Ability	0.689	0.823	-						
(4) Educational Experience	0.656	0.654	0.723	-					
(5) Aesthetic Experience	0.747	0.611	0.729	0.822	-				
(6) Entertainment Experience	0.639	0.665	0.758	0.744	0.784	-			
(7) Escape Experience	0.525	0.391	0.486	0.666	0.641	0.552	-		
(8) Satisfaction	0.705	0.672	0.753	0.786	0.829	0.808	0.643	-	
(9) Purchase Intention	0.577	0.548	0.600	0.749	0.721	0.664	0.692	0.712	-

5.3.2 Fit of structural model

In this study, all values were positive except that for the deviation experience factor of location-based AR. Predictability exists when all values for all path coefficients are positive. However, it is reasonable to assume that the path coefficients for deviation experience may be rejected, since it appeared as a negative number (Tenenhaus, Vinzi, Chatelin, & Lauro, 2005). Also, goodness-of-fit in the PLS path model is regarded as acceptable if the value is 0.36 or larger; the value for location-based AR was 0.671, thus showing high goodness-of-fit (Tenenhaus, Vinzi, Chatelin, & Lauro, 2005). And we present an acceptable fit of SRMR (Standardized root-mean-square residual) = 0.049 (cutoff value 0.08) (Hu & Bentler, 1998; 1999).

5.4 Hypothesis Testing

The hypotheses in this study were tested through path counting and the valence of each path coefficient was confirmed by setting 5,000 bootstrapping specimens (Hair, Ringle, & Sarstedt, 2011; Wong, 2013). The significance of individual paths is summarized in Figure 4. Fifteen out of 17 paths exhibited a p-value less than 0.05. The explanatory power of the research model is also shown. The adjusted R-squared value shows that the constructs in the model together accounted for 72.3% of user satisfaction in experiencing AR.

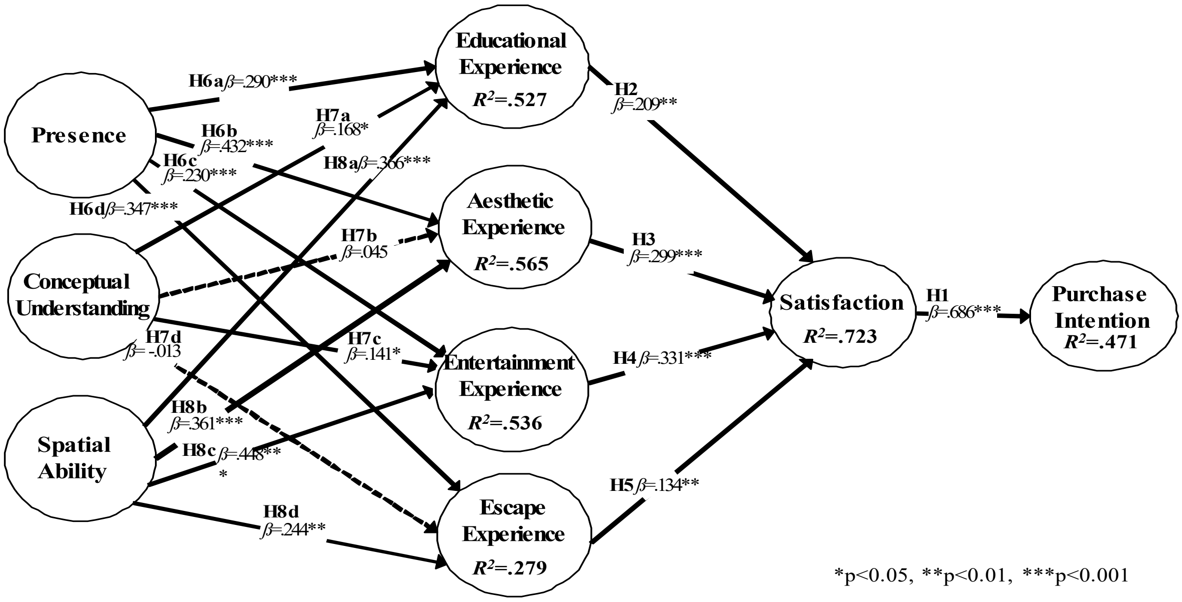

Fig. 4. Hypothesis test results

First, users' sense of presence when engaging with location-based AR systems was significantly associated with all constructs from experience economy theory: educational experience (β = 0.290, t = 3.725; H1a was supported), aesthetic experience (β = 0.432, t = 5.40; H1b was supported), entertainment experience (β = 0.230, t = 3.911; H1c was supported), and escape experience (β = 0.347, t = 4.484; H1d was supported). Second, values for conceptual understanding through AR-based experience were significantly associated with educational experience (β = 0.168, t = 2.141; H2a was supported) and entertainment experience (β = 0.141, t = 2.137; H2c was supported). However, conceptual understanding was not significantly associated with aesthetic experience (β = 0.045, t = 0.646; H2b was rejected) nor escape experience (β = -0.013, t = 0.166; H2d was rejected).

Furthermore, sense of presence and spatial ability when engaging with location-based AR systems were significantly associated with all constructs from experience economy theory: educational experience (β = 0.366, t = 4.055; H3a was supported), aesthetic experience (β = 0.361, t = 4.239; H3b was supported), entertainment experience (β = 0.448, t = 5.663; H3c was supported), and escape experience (β = 0.244, t = 2.779; H3d was supported).

Fourth, values for all constructs gleaned from experience economy theory, namely educational experience (β = 0.209, t = 2.768; H4 was supported), aesthetic experience (β = 0.299, t = 4.161; H5 was supported), entertainment experience (β = 0.331, t = 4.986; H6 was supported), and escape experience (β = 0.134, t = 2.802; H7 was supported), were significantly associated with satisfaction. This indicates that experience economy theory can be successfully used to explain satisfaction with location-based AR systems.

Finally, satisfaction was significantly associated with purchase intention (β = 0.686, t = 17.411; H8 was supported). This means that satisfaction with the AR experience had a positive effect on the intention to purchase. Table 6 summarizes the results of hypothesis testing.

Table 6.

Path coefficients and results of hypothesis testing by bootstrapping

	Path name	**Original Sample (O)**	**Sample Mean (M)**	**Standard Deviation (STDEV)**	**Standard Error (STERR)**	**T Statistics (|O/STERR|)**	**Accepted /Rejected**
H1a	Presence → Educational Experience	0.290	0.288	0.078	0.078	3.725***	Accepted
H1b	Presence → Aesthetic Experience	0.432	0.429	0.080	0.080	5.401***	Accepted
H1c	Presence → Entertainment Experience	0.230	0.234	0.059	0.059	3.911***	Accepted
H1d	Presence → Escape Experience	0.347	0.346	0.077	0.077	4.484***	Accepted
H2a	Conceptual Understanding → Educational Experience	0.168	0.174	0.079	0.079	2.141*	Accepted
H2b	Conceptual Understanding → Aesthetic Experience	0.045	0.047	0.070	0.070	0.646	Rejected
H2c	Conceptual Understanding → Entertainment Experience	0.141	0.144	0.066	0.066	2.137*	Accepted
H2d	Conceptual Understanding → Escape Experience	-0.013	-0.011	0.079	0.079	0.166	Rejected
H3a	Spatial Ability → Educational Experience	0.366	0.362	0.090	0.090	4.055***	Accepted
H3b	Spatial Ability → Aesthetic Experience	0.361	0.363	0.085	0.085	4.239***	Accepted
H3c	Spatial Ability → Entertainment Experience	0.448	0.441	0.079	0.079	5.663***	Accepted
H3d	Spatial Ability → Escape Experience	0.244	0.243	0.088	0.088	2.779**	Accepted
H4	Educational Experience → Satisfaction	0.209	0.210	0.076	0.076	2.768 **	Accepted
H5	Aesthetic Experience → Satisfaction	0.299	0.299	0.072	0.072	4.161***	Accepted
H6	Entertainment Experience → Satisfaction	0.331	0.330	0.066	0.066	4.986***	Accepted
H7	Escape Experience → Satisfaction	0.134	0.135	0.048	0.048	2.802**	Accepted
H8	Satisfaction → Purchase Intention	0.686	0.687	0.039	0.039	17.411***	Accepted

Note: $^{***}p < 0.001$ ($t > 3.30$), $^{**}p < 0.01$ ($t > 2.58$), $^{*}p < 0.05$ ($t > 1.96$)

5.5 Mediating Effect

SEM was performed to estimate the mediating roles of the experience economy and satisfaction in the effect of AR navigation characteristics on change in purchase intention (Preacher & Hayes, 2008). Path analysis based on the bootstrap method was performed to test both direct and indirect relationships among variables in the model (Table 7) (Preacher & Hayes, 2004; Wang & Berens, 2015). As a result, we found significant mediating effect in all paths except “CU → EDU → SAT →PI”, “CU → ENT → SAT → PI” and “SA → ESC → SAT → PI”. In addition, it was confirmed that the p value of indirect effects was not significant in “CU → EDU → SAT →PI”, “CU → ENT → SAT → PI” and “SA → ESC → SAT → PI” as shown in Table 7 below, but it was confirmed that it meant a significant path in the 95% confidence interval (Carrión, Nitzl, & Roldán, 2017; Preacher & Hayes, 2008).

Table 7.

Bootstrapping results for mediation effects

Construct	**Product of coefficient**		**95% Bootstrap CI**			
	Point estimate	***SE***	**Lower**	**Upper**	**R^2**	***p***
Standardized total effects						
PR → PI	.214	.038	.141	.291	.471	.000
CU → PI	.064	.035	-.002	.133	-	.070
SA → PI	.251	.046	.161	.340	-	.000
Standardized direct effects						
PR → EDU	.290	.077	.140	.444	.527	.000
PR → AES	.432	.081	.271	.586	.565	.000
PR → ENT	.230	.058	.123	.349	.536	.000
PR → ESC	.347	.077	.193	.496	.279	.000
CU → EDU	.168	.079	.019	.333	-	.034
CU → AES	.045	.069	-.091	.180	-	.515
CU → ENT	.141	.064	.016	.268	-	.029
CU → ESC	-.013	.079	-.164	.145	-	.868
SA → EDU	.366	.089	.181	.530	-	.000
SA → AES	.361	.086	.198	.531	-	.000
SA → ENT	.448	.077	.285	.590	-	.000
SA → ESC	.244	.089	.062	.415	-	.006
EDU → SAT	.209	.077	.061	.361	.723	.007
AES → SAT	.299	.072	.155	.437	-	.000
ENT → SAT	.331	.066	.195	.452	-	.000
ESC → SAT	.134	.047	.044	.233	-	.005
SAT → PI	.686	.040	.602	.756	-	.000
Standardized indirect effects						
PR → EDU → SAT → PI	.042	.020	.013	.092	-	.034
PR → AES → SAT → PI	.089	.026	.043	.143	-	.001
PR → ENT → SAT → PI	.052	.018	.023	.094	-	.004
PR → ESC → SAT → PI	.032	.014	.010	.068	-	.028
CU → EDU → SAT → PI	.024	.017	.002	.069	-	.152
CU → AES → SAT → PI	.009	.015	-.017	.042	-	.529
CU → ENT → SAT → PI	.032	.017	.005	.071	-	.055
CU → ESC → SAT → PI	-.001	.008	-.018	.014	-	.877
SA → EDU → SAT → PI	.053	.023	.016	.108	-	.021
SA → AES → SAT → PI	.074	.028	.031	.141	-	.007
SA → ENT → SAT → PI	.102	.028	.055	.163	-	.000
SA → ESC → SAT → PI	.022	.012	.005	.055	-	.071

Note: CI = confidence interval; PR: presence, CU: conceptual understanding, SA: spatial ability, EDU: education experience, AES: aesthetic experience, ENT: entertainment experience, ESC: escape experience, SAT: satisfaction, PI: purchase intention

5.6 Multi-group Analysis

As an additional analysis, a multi-group analysis (MGA) was performed to confirm significant differences for the group-specific model estimations according to previous AR experience (Henseler et al., 2009; Sarstedt, Henseler, & Ringle, 2011). Table **7** shows that as a result of MGA according to the experience of using AR in advance, it was confirmed that the two paths, "*Conceptual understanding* → *Aesthetic experience*" and "*Education experience* → *Satisfaction*", had more influence in the group without actual use experience. This means that AR Navigation has a novelty effect, a phenomenon commonly observed in consumer evaluation of products that adopt new technologies. In other paths, meanwhile, no significant modulatory effect of AR experience was observed.

Table 8.

Multi-group analysis according to "Previous AR Experience"

Hyp.	Path name	Path Coefficients-diff (|Previous AR Use Yes - Previous AR Use No|)	p-Value (Previous AR Use (Yes) vs Previous AR Use (No))
H1a	Presence → Educational Experience	0.054	**0.763**
H1b	Presence → Aesthetic Experience	0.082	**0.628**
H1c	Presence → Entertainment Experience	-0.046	**0.693**
H1d	Presence → Escape Experience	-0.013	**0.952**
H2a	Conceptual Understanding → Educational Experience	-0.116	**0.518**
H2b	Conceptual Understanding → Aesthetic Experience	-0.316	**0.037***
H2c	Conceptual Understanding → Entertainment Experience	-0.123	**0.412**
H2d	Conceptual Understanding → Escape Experience	0.006	**0.974**
H3a	Spatial Ability → Educational Experience	-0.066	**0.759**
H3b	Spatial Ability → Aesthetic Experience	0.104	**0.600**
H3c	Spatial Ability → Entertainment Experience	0.086	**0.592**
H3d	Spatial Ability → Escape Experience	-0.019	**0.928**
H4	Educational Experience → Satisfaction	-0.328	**0.031***
H5	Aesthetic Experience → Satisfaction	0.193	**0.214**
H6	Entertainment Experience → Satisfaction	0.051	**0.683**
H7	Escape Experience → Satisfaction	0.128	**0.212**
H8	Satisfaction → Purchase Intention	0.017	**0.804**

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

6. Discussion

6.1 General Discussion

Although there are several papers on AR and experience economy theory (e.g. Lee, Jung, tom Dieck, & Chung, 2019; Jung, tom Dieck, Lee, & Chung, 2016; Manthiou, Lee, Tang, & Chiang, 2014), this is the first study to investigate the antecedents (i.e., sense of presence, conceptual understanding, and spatial ability) of intention to purchase location-based AR navigation systems among drivers. Therefore, this research provides valuable insight into our understanding of AR in this context while extending research on AR and purchase intention (e.g. Rauschnabel et al., 2017; Stoyanova et al., Milanova, 2015). A previous study suggested that customer satisfaction with store experience factors (store assortment, aesthetics, and store convenience) positively effects purchase intention (Peng, Hassan, & Simple, 2018) and these findings are consistent with the current study suggesting satisfaction through the AR-based experience positively influences purchase intention of location-based AR navigation systems. These findings begin to bridge the knowledge gap on how ARs characteristics can be optimized to enhance customer satisfaction and increase purchase intention of these products, which enriches our understanding of the extent to which the user experience is associated with these outcome factors. As previously mentioned, recognizing how AR can influence consumer satisfaction and purchase intention is important for retailers and AR developers to collaborate in developing effective marketing strategies that enrich and enhance customers experience (Poushneh & Vasquez-Parraga, 2017).

Furthermore, AR-based educational, aesthetic, entertainment, and escape experience in the context of driving positively influenced user satisfaction and intention to purchase location-based AR systems. The mediating effect of satisfaction between AR-based experience and intention to purchase location-based AR navigation systems further supports that emotional experience has a positive effect on purchase intention via satisfaction (Nasermoadeli, Ling, & Maghnati, 2013). This reinforces the importance of generating an emotional connection between consumers and AR technology through the AR experience to generate desired positive outcomes (e.g. satisfaction, purchase intention). Given that experience factors were found to positively affect purchase intention, our findings contribute to previous research indicating that some factors from experience economy theory have positive effects on loyalty intention via satisfaction in the context of wine tourism (Quadri-Felitti & Fiore, 2013) and that AR increases purchase intention (Rauschnabel, Rossmann, & tom Dieck, 2017; Stoyanova, Brito, Georgieva, & Milanova, 2015) while providing context-specific evidence to the use of AR for navigation. Moreover, these results also support that aesthetic experience is an important factor in tourism, science, and art education (Girod, Twyman, & Wojcikiewicz, 2010) and should therefore be considered in the future development of such experiences. Not only that, but as AR becomes increasingly used to provide new experiences in museums, tourist destinations and cultural heritage attractions, consideration to the aesthetic experience should be considered to enhance visitor satisfaction.

Given that educational experience using AR had a static effect on satisfaction, this suggests that AR can be useful in providing useful information via text or images of virtual objects and enhancing overall functional value. In the field of tourism, learning and experiencing places and special events by going to new tourist attractions has the same effect as educational experience in terms of satisfaction (Hosany & Witham, 2010; Quadri-Felitti & Fiore, 2012), hence, when AR is actively applied in education, it is appropriate for advancing various educational goals (e.g. enhanced learning achievement, Akçayir & Akçayir, 2017) and entertainment experiences (Flavián et al., 2019). However, in the difference between groups according to whether the previous AR experience was found, it was observed that the education experience had a greater influence on satisfaction in the group without previous AR experience than in the group with experience. These results are consistent with other related studies that previous experience was positive for first-time users in satisfaction with art education programs at museums (Araujo, 2018).

Finally, AR experience mediates the relationships among presence, conceptual understanding, spatial ability, and user satisfaction, and, eventually, intention to purchase location-based AR systems. Although two characteristics of AR technology (presence and spatial ability) exerted strong positive effects on AR-based experience (educational, aesthetic, entertainment, and escape), conceptual understanding (one of the characteristics of AR technology) strongly influenced only two factors related to absorption (i.e., educational experience and entertainment experience), but was not significantly associated with immersive experience (i.e., aesthetic experience and escape experience) (Pine & Gilmore, 1998, 1999). This suggests that when the goal is to enhance conceptual understanding, focus on incorporating entertaining yet educational factors should be prioritized over the visual aesthetics and the immersion and ability to provide escapism. Similar to a tourism study (Quadri-Felitti & Fiore, 2013), sense of presence, conceptual understanding, and spatial ability had the greatest effects on aesthetic experience among the experiential economic factors, which emphasizes that incorporating these factors into the visual AR experience should be prioritized in the design and development of AR applications. Also, in this particular order, entertainment experience, aesthetic experience, educational experience, and escapist experience influenced user satisfaction therefore indicating that user satisfaction with AR can be explained by our results and that AR gives more satisfaction when it involves active rather than passive participation and also immersion rather than absorption (Pine & Gilmore, 1998, 1999). Hence, to ensure a positive AR experience and improve user satisfaction, AR should incorporate immersive, interactive and engaging experiences that require active, hands-on participation from the user, prioritized over passive activities such as watching or listening.

6.2 Theoretical Implications

This study makes several theoretical contributions to the limited research on AR-based navigation and driving experience. First, the main contribution of this study is that three characteristics of AR technology (sense of presence, conceptual understanding, and spatial ability) were found to be key antecedents of drivers' intention to purchase location-based AR navigation systems through the mediation of educational, entertainment, aesthetic, and escape experience. This research is unique as we examined these three different characteristics of AR technology, which have not previously been examined in the context of AR-based navigation and driving experience. Therefore, this study provides a starting point for researchers to continue research in this area. Second, although previous studies (Jung et al., 2016; Lee et al., 2019) have explored immersive technologies through the lens of the experience economy, to the best of the authors' knowledge, this is one of the first studies to investigate the specific characteristics of AR technology from an experience economy viewpoint. Third, this study confirms that conceptual understanding, one of the key characteristics of AR technology (Geveke et al., 2016), strongly influences experience economy factors related to absorption (i.e., educational experience and entertainment experience) in the context of indirect experience of AR navigation systems. Finally, this study is one of the first to explore presence, conceptual understanding, and spatial ability as antecedents of customers' intention to purchase location-based AR systems.

6.3 Practical Implications

There are several practical implications from this study. First, for developers of location-based AR systems and service providers, these findings provide useful and important implications for future development. For instance, AR content should be designed to improve drivers' sense of presence, conceptual understanding, and spatial ability and to enhance learner drivers' location-based AR navigation experience. Second, as conceptual understanding has a positive influence on educational and entertainment experience (absorptive experience) but a negative influence on aesthetic and escape experience (immersive experience), developers of location-based AR systems should pay particular attention to systems that enhance drivers' absorptive experience (education and entertainment). Third, sense of presence had less influence on educational experience and understanding the content was more important than feeling a sense of reality in the AR-based activity. Therefore, AR systems that not only enhance the sense of presence but offer an effective educational design that facilitates understanding of content is required.

Edutainment developers can also make use of AR-based content, however, one consideration is the extent to which drivers should be immersed and absorbed by the AR system's characteristics to ensure it does not become too distracting. Indeed, the augmentation and potential of sensory, cognitive and information overload are considered challenges associated with AR in e-learning contexts (Alzahrani, 2020) and could therefore be potential drawbacks of using AR for driving. Therefore, software developers should take into consideration cognitive and physical overload when developing these systems or consider features such as eye-tracking, which may be one way to overcome such shortfalls. The results for testing of the linkage between AR characteristics and user satisfaction suggested that applying AR in educational settings can improve spatial ability. Since spatial ability contains characteristics of entertainment experience and aesthetic experience, both of which had strong positive effects on user satisfaction, we can conclude that AR featuring spatial ability will increase enjoyment and user satisfaction. Since AR is a core technology that overlaps virtual objects on the real world, it is necessary to pay attention to its ability to improve spatial awareness in users. Furthermore, AR content developers should consider spatial ability in their development of AR and virtual objects (Shamsuddin & Din, 2016; Martin-Gutierrez et al., 2010). The application of AR is especially important in education, where the design of the lesson is vital for effective conceptual understanding. In addition, as can be seen from the results of the MGA analysis, the difference in paths was confirmed according to previous AR experience. This is in line with the previous study that showed the moderating effect difference according to the previous experience (Dedeoglu, Bilgihan, Ye, Buonincontri, & Okumus, 2018), and it implies that a marketing strategy that considers previous experience is needed to improve purchase intention for future customers. Finally, the findings indicate that indirect AR experience through the use of video could increase purchase intention of actual location-based AR navigation systems, which could provide important insights for the promotion of such products to the consumer market.

6.4 Limitations and Future Research

There are five limitations of this study as well as suggestions for future research. The study featured a driving scenario using indirect AR experience via location-based AR navigation systems rather than direct experience. In this initial study, a video was employed to provide participants with insight into a driving experience using an AR location-based navigation system and to ensure the health and safety of participants. Facilitating a real driving scenario was out of scope of the current research project and although this is noted as a limitation, it is important to highlight that prior research indicates that indirect experiences can enhance purchase intention mediated by satisfaction and triggered by visual quality (Hasanov & Khalid, 2015) and aesthetics (Tseng & Lee, 2019). Nevertheless, the next phase of research aims to focus on responses from drivers who have direct driving experience using location-based AR navigation systems, which will allow for a comparison of the findings with the current study. Additional research could also include a similar study using a different location-based AR video to increase generalisability. Moreover, AR devices could be reduced to small contact lenses in the future as companies and researchers continue to work on such developments (Loureiro et al. 2020), which would benefit the AR navigation market. Second, data were collected from drivers in Korea, which limits the generalizability of the findings to other contexts. Future research could be conducted in different contexts to detect any differences based on cultural factors. Third, the current study did not distinguish between novice drivers and skilled drivers in terms of experience with location-based AR navigation systems. Perceptions and views about location-based AR systems may differ according to the number of years of actual driving experience; therefore, it would be meaningful to examine differences between novice drivers and skilled drivers in future research. Fourth, this study investigated the influence of characteristics of AR on intention to purchase location-based AR systems only. In the current market, there are other types of navigation systems such as non-AR navigation systems as well as more advanced AR holographic navigation systems. A comparative analysis could investigate key antecedents of purchase intention among non-AR location-based systems, location-based AR navigation systems, and AR holographic navigation systems. As this study did not employ a control group, a comparative analysis could not be made. The next steps of this research is to employ an experiment group (using a real driving scenario) and a control group consisting of drivers using no AR navigation system in order to strengthen the current findings. Next, with improved methods of measurement in recent brain science research, more studies have been conducted using data of brain activity. Further research using psycho-physiological methodology could verify the tenets of experience economy theory by confirming any clear differences in brain activity data when AR is applied. Finally, considering that many drivers listen to music while driving, there was no separate control over the background music reflected in the AR navigation demonstration video. However, background music may affect the participants' subjective experiences, especially entertainment experience and escape experience. Therefore, caution is needed when generalizing the results of the analysis on the effects of AR navigation on experiences.

Appendix A. Constructs and Items

Constructs	Items	Factor Loadings									Commonality	Eigenvalue	Explained Variance (%)	Confidence Coefficient	References
		1	2	3	4	5	6	7	8	9					
Presence (3)	While experiencing the AR content, I felt like the world in the AR activity seemed real.	**.823**	.163	.127	.200	.116	.102	.132	.194	.197	.878	3.271	12.113	.927	McMahan, Bowman, Zielinski, & Brady (2012), revised
	While experiencing the AR content, I felt like my body was actually at the scene.	**.818**	.175	.187	.192	.139	.178	.153	.187	.109	.893				Slater, Usoh, & Steed (1994) , revised
	While experiencing the AR content, I felt that I was in the world of the activity.	**.793**	.153	.128	.196	.227	.181	.169	.155	.139	.864				
Purchase Intention (3)	I will consider buying the AR content as a priority in the future.	.156	**.809**	.295	.152	.189	.113	.185	.179	.144	.924	3.104	11.496	.965	Lu, Chang, & Chang (2014), revised
	I intend to buy the AR content in the future.	.209	**.794**	.299	.138	.177	.156	.193	.159	.172	.930				
	I intend to purchase the AR content in the future.	.195	**.775**	.263	.177	.214	.163	.268	.152	.181	.939				Nam, Dong, & Lee (2017), revised
Escape Experience (3)	I wanted to stay in the experience and did not want to go back to everyday life.	.051	.290	**.880**	.062	.067	.040	.127	.052	.025	.891	2.844	10.532	.879	McMahan, Bowman, Zielinski, & Brady (2012), revised
	I felt that I was living in a world away from reality.	.164	.223	**.840**	.103	.123	.071	.133	.122	.128	.861				Oh, Fiore, & Jeoung (2007); Hosany & Witham (2010); Quadri-Felitti & Fiore (2013), revised
	While experiencing the AR content, I forgot my daily life for a while.	.261	.115	**.678**	.116	.164	.105	.228	.250	.280	.785				
Spatial Ability (3)	While engaging with the AR content, I became aware of the clear and intuitive structure of the space.	.207	.162	.095	**.767**	.280	.299	.175	.149	.105	.898	2.740	10.147	.914	Martin-Gutierrez et al. (2010), revised
	While engaging with the AR content, I became more aware of the space.	.269	.149	.137	**.729**	.146	.329	.184	.218	.188	.891				
	While engaging with the AR content, I understood the natural connection between the AR space and the real space.	.265	.171	.143	**.678**	.275	.229	.193	.145	.262	.835				Witmer & Singer (1998), revised
	The experience was not fun. (R)	.136	.210	.063	.219	**.810**	.156	.206	.097	.156	.871	2.720	10.074	.925	Oh, Fiore, & Jeoung (2007); Hosany & Witham

Entertainment Experience (3)	It was fun experiencing the AR content.	.237	.197	.224	.194	**.706**	.242	.151	.292	.202	.888				(2010); Mehmetoglu & Engen (2011); Quadri-Felitti & Fiore (2013), revised
	While experiencing the AR activity, I was interested in the content.	.242	.207	.199	.274	**.683**	.185	.186	.253	.234	.871				Quadri-Felitti & Fiore (2013) , revised
Conceptual Understanding (3)	While engaging in the AR activity, it was not difficult to understand what the content meant.	.069	.045	.097	.135	.157	**.857**	.127	.082	.227	.868	2.577	9.543	.915	Created
	While engaging in the AR activity, I was able to understand the concepts of the content quite well.	.259	.195	.075	.374	.129	**.734**	.136	.181	.079	.863				Andujar, Mejías, & Márquez (2011) revise
	While engaging in the AR activity, I was able to learn the concepts of the content quite well.	.260	.256	.021	.427	.236	**.654**	.187	.065	.004	.838				
Educational Experience (3)	I learned something new through the AR activity.	.174	.277	.266	.244	.184	.165	**.738**	.208	.127	.902	2.408	8.919	.880	Oh, Fiore, & Jeoung (2007); Hosany & Witham (2010); Quadri-Felitti & Fiore (2013), revised
	I was curious to learn more about the AR content.	.230	.292	.241	.192	.221	.207	**.698**	.245	.208	.915				
	It was a great experience to learn from the AR activity.	.264	.267	.213	.205	.279	.231	**.665**	.209	.242	.904				
Aesthetic Experience (3)	The AR activity made me feel alive.	.323	.101	.171	.176	.238	.224	.186	**.704**	.250	.874	2.209	8.181	.945	Hosany & Witham (2010); Mehmetoglu & Engen (2011) revise
	The AR content is well coordinated.	.252	.322	.208	.256	.221	.094	.246	**.672**	.187	.881				Oh, Fiore, & Jeoung (2007);; Hosany & Witham (2010); Mehmetoglu & Engen (2011); Quadri-Felitti & Fiore (2013) revise
	The AR content design is attractive to me.	.295	.351	.206	.186	.250	.106	.338	**.606**	.152	.866				
Satisfaction (3)	I am satisfied with my experience of the AR content.	.242	.288	.228	.265	.294	.187	.263	.214	**.665**	.943	2.040	7.555	.962	Hosany & Witham (2010); Mehmetoglu & Engen (2011); Quadri-Felitti & Fiore (2013)
	My experience of the AR content was satisfactory compared to expectations.	.275	.267	.208	.272	.308	.196	.208	.215	**.660**	.921				Mehmetoglu & Engen (2011) , revised
	Overall, I am satisfied with my experience of the AR content.	.302	.241	.222	.170	.271	.292	.206	.324	**.619**	.917				Oh, Fiore, & Jeoung (2007); Quadri-Felitti & Fiore (2013)

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