THE EFFECTS OF INTERACTIVE APPLICATIONS ON VISITORS' EXPERIENCE: A CASE OF GOBEKLITEPE, TURKEY[1]

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ABSTRACT

The need for preservation and flexible exploration of historical artifacts generated increasing interest in using digital technologies in the cultural heritage context. This paper presents user interaction applications of a recent digital cultural heritage conservation and exploration project concerning one of the most famous heritage site "Göbeklitepe" in Turkey that is the oldest known human-made religious structure and added to the UNESCO's World Heritage List by the year 2018 is 15 km away of northeast of the town Şanlıurfa. The project aims at enriching the visitor experience through modern digital technologies. Main modules include 3D scanning of the artifacts, information screen and mobile interaction with Augmented Reality (AR). AR has been developed to provide information about destinations and attractions. Because of the development of AR, tourists using AR can gain valuable experience without a tourist guide.

There two aims of this study: 1) is to describe acceptance of a new technology such as AR and visiting intention for visitors who use AR at a heritage destination, 2) to measure tourists' experiences of visiting historic sites. For this purpose, two scales were used for data collection. In accordance with the first aim of the study, the scale adapted by Chung, Han & Joun (2015) which is to explain visitors' acceptance of AR based on the TAM. Secondly, Lee & Smith's (2015) multiple-item scale was used to measure tourists' experiences of visiting historic sites and museums. There are three dimensions in the first scale as perceived usefulness (5 items), perceived ease of use (3 items) and visit intention (2 items) visit intention (2 items) in accordance with the purpose of the study. On the other hand, the second scale involves natively 16 items under six dimensions. The findings offer important practical implications for historic sites and museums in relation to AR and experiential marketing. The findings show that the Augmented Reality applications have an important practical usefulness for the Göbeklitepe archeological site and particularly enriching of the visitor experience. The study shows that the AR applications impact on the visit intention of the visitors. The study is revealed that applications can be applied to enhance the attractiveness of the archeological sites, as Göbeklitepe, in many destinations.

Keywords; Heritage sites, interactive applications, visitor experience, Göbeklitepe, Turkey

1. INTRODUCTION

Building an incredible visitor experience is essential to a destination's success. Augmented reality (AR) has an important part of interactive applications to play in this success as it begins to enhance real world experiences through mainstream technologies. Recently, significant attention has been directed to the potential of AR to change users' view of their environment (Wasko, 2013). Traditionally, orientation at a destination or tourist attractions 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

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has increased the availability of AR applications that enable destinations/ attractions to construct a personal and context-aware tourism experience (Yovcheva, Buhalis, & Gatzidis, 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 (Von der Pütten et al., 2012). On the other hand, introducing AR applications at tourism destinations or attractions does not automatically bring positive experiences (Yovcheva et al., 2013; Jung, Chung, & Leue, 2015).

In 2009, smartphone apps began to use AR technology to add a layer of guidance, content and entertainment to physical locations seen through the phone's camera view. For instance, *Tuscany+* was the first of these apps built specifically for tourism as an "interactive, real-time guide" intended to enhance the visitor experience (Tuscany, 2018). AR has been developed to provide information about destinations and attractions. Because of the development of AR, tourists using AR can gain valuable experience without a tour guide. Because of this, a variety of AR utilization examples can be found in the field of tourism (Fritz, Susperregui, & Linaza, 2005; Yovcheva et al., 2013; Hunter, Chung, Gretzel, & Koo, 2015; Jung et al., 2015). For example, Yovcheva et al. (2013) stated that AR will maximize tourist satisfaction based on the assumption that tourists will actively accept and use AR. However, contrary to expectations, AR is not being actively used, and, as a new phenomenon, it is appearing more slowly than expected (Chung, Han & Joun, 2015). In addition, studies related to AR in a tourism context have dealt only with the importance of AR utilization, AR characteristics, technological understanding, and AR development strategies (Han, Jung & Gibson, 2013; Chung et al., 2015).

In tourism studies, empirical studies have not yet sufficiently researched why people use AR or how its use will affect visits to tourist destinations or attractions (Chung et al., 2015). In this study, it is tried to determine that the effect of interactive applications (AR) on visitors' experience in Gobeklitepe, Turkey. In other words, the study was built on AR users may develop a positive attitude toward AR at a heritage destination or attractions or try to visit the destination or attractions again. In this context, this study conceptualizes crucial dimensions which are "*perceived usefulness*", "*perceived ease of use)*", "*destination/attraction visit intention*" and "*attractiveness & contribution to tourism*" and how these dimensions' influence visitors' AR usage intention and destination visit intention through AR technology perception (perceived usefulness and ease of use). In addition to that, it is tried to reveal whether AR applications contribute to tourism as a attractiveness.

2. THEORETICAL BACKGROUND

2.1.Augmented Reality (AR) and Cultural Tourism Experiences

Augmented Reality is a variation of virtual reality. Compared with virtual reality, AR enhances the real world instead of replacing it (Azuma, 1997). Augmented reality (AR) is one of the technologies gaining increasing interest (Zlatanova, 2002). AR as a real-time direct or indirect view of a physical real-world environment (Silva, Oliveira, & Giraldi, 2003; Kounavis, Kasimati, Zamani, & Giaglis, 2012). AR is both interactive and registered in3D as well as combines real and virtual objects (Carmigniani and Furth, 2011). Most AR systems strengthen contiguity of space and time by superimposing virtual information pertinent to physical objects and spaces (Azuma, Billinghurst, & Klinker, 2011).

AR aims to duplicate the world's environment in a computer. The system creates a composite view, which is the combination of the real scene viewed by the user and a virtual scene generated by the computer that augments the scene with additional information. (Milgram, Takemura, Utsumi & Kishino, 1995). The advance in mobile technologies such as smartphones provides new opportunities to AR systems and applications (Marimon et al., 2010: 1). In the tourism context, for instance, tourists can experience both reality and virtual realms through the innovative technologies of smartphone applications (Lee, Ryong-Lee & Ham, 2014: 60).

AR as systems that have the following characteristics: 1) combines real and virtual; 2) interactive in real time; and 3) registered in 3-D (Azuma, Baillot, Behringer, Feiner, Julier, & MacIntyre, 2001; Noh, Sunar & Pan, 2009; Mekni & Lemieux, 2014). In this context, AR has the potential to support tourism experiences through new modes of visitor servicing, storytelling and gamification based on combining real and virtual. For example, DMOs could use AR to support visitors in their native languages, offer maps and guides for specific niche audiences, offer additional historical or cultural context to an experience, show how their destinations would appear in a different season, or create educational games to learn about an area's history and wildlife or to entertain children on long drives.

AR is used within the tourism sector, aiming to improve the tourist experience. On the one hand, several examples have shown that AR can aid tourist organizations and professionals towards reaching a wider audience by serving as the delivery technology of appealing multimedia content and mobile applications, fine-tuned to various knowledge levels (Kounavis, Kasimati & Zamani, 2012). On the other hand, AR information systems can help tourists in accessing valuable information and improving their knowledge regarding a touristic attraction or a destination, while enhancing the tourist experience and offering increased levels of entertainment throughout the process (Fritz et al., 2005).

2.2. AR Applications in Tourism Sector and Historical Sites

Consumer-based mobile AR application development has grown very quickly over the past few years (Linaza, Marimon, Carrasco, Alvarez, Montesa, Aguilar, & Diez, 2012). Augmented Reality enhances a user's perception of and interaction with the real world and at least 12 distinct classes of AR application domains have been identified which are medical, military, manufacturing, visualization, entertainment and games, robotics, education, marketing, navigation and path planning, geospatial, urban planning and civil engineering and also tourism (Mekni & Lemieux, 2014). AR is useful to travellers in many ways in tourism industry. Information, inspiration, navigation, education, translation –it's all there in one application. Travellers use AR technology to choose their destinations/attractions and activities before and during their trip.

Recently, AR technology has become a well-accepted technology among scientific community and public, which used for combining of real and virtual objects and mixed it into the real environment. In virtual heritage, this technology is used for improving the visitor experience of a cultural heritage site (Noh et al., 2009; Kurkovsky, Koshy, Novak & Szul, 2012). For example, Vlahakis et al. (2002) developed "*Archeoguide*", short for augmented reality-based cultural heritage on-site guide, to bridge the gap between recreation, education, and scientific research. Archeoguide offers personalized augmented reality tours of archaeological sites. It uses outdoor tracking, mobile computing, 3D visualization, and augmented reality techniques to enhance information presentation, reconstruct ruined sites, and simulate ancient life (Vlahakis et al., 2002). In addition to that, other examples based on augmented reality in tourism sector can be given (Fritz et al., 2005);

- ✓ *Augmented walks*. In these walks, visitors are placed in the real environment and are able to view the real world and 3D reconstructions of monuments. This can be achieved by screens that receive the real scene via a camera and add the 3D models, or by HMDs so that visitors that walk through the real environment can see the virtual monuments.

- ✓ *Ename 974*. This project uses the Timeframe technology to generate the 3D models of the monuments of the archaeological sites and allows the presentation of these environments to different profiles of users. A kiosk protects the system and the visitors. The system superimposes the real scene with 3D reconstructions of monuments and displays the result on a visualization device.

- ✓ Several national parks in the US have also added AR stations to view archaeological sites on far distant cliffs and other inaccessible locations. The telescope-like device superimposes animations, virtual recreations and other information over real fossil remain

One of the ways for destinations to obtain competitive advantage is the investment and implementation of new technology (Jung & Han, 2014). While Kalawsky et al. (2000) have suggested mobile virtual experiences in the tourism industry to enhance the tourist experience, AR has evolved as the buzzword of modern technology increasing with the development of wearable computing such as the Google Glass project to be launched in 2014 (Pathkar & Joshi, 2014).

2.3. AR Acceptance of Visitors

AR can augment one's view and transform it with the help of a computer or a mobile device, and thus enhance the user's perception of reality and of the surrounding environment (Osterlund & Lawrence, 2012). Although research into the field dates back as early as the 1960s, technological limitations of all sorts have hindered the application of AR to anything beyond experimental research (Kounavis et al., 2012). AR has only emerged since the debut of modern smartphones around 2007 (Haugstvedt & Krogstie, 2012). The increased availability of AR applications provides destinations and tourism organizations with a possibility to utilize these applications in order to enhance visitor experience (Yovcheva et al., 2013; Jung et al., 2015).

The development of AR is still in its infancy and although the technological requirements for compelling use cases of AR are now starting to be met, challenges do remain in terms of usability, accuracy and end-user services (Olsson, Kärkäinen, Lagerstam, & Ventä-Olkkonen, 2012). Therefore, it is important to examine users' acceptance in order to ensure that AR applications include functionalities that are accepted by its users (Tom Dieck & Jung, 2018). In this context, Parasuraman (2000) developed optimism, innovativeness, discomfort, and insecurity as dimensions in measuring people's general beliefs about technology. These dimensions affect usage of a new technology such as AR.

Table 1. The dimensions in measuring people's general beliefs about technology

Dimensions	Definition
Optimism	A positive attitude toward technology and a belief in increased control, flexibility, and efficiency in one's life
Innovativeness	A tendency of a person to be a technology pioneer
Discomfort	A lack of control perceived by person when using a technology, and a sense of being overwhelmed by it
Insecurity	A distrust and skepticism toward a technology

Source: Parasaruman, 2000; Chung et al., 2015.

As is seen, optimism and innovativeness are enablers of new technology use, whereas discomfort and insecurity are inhibitors (Parasuraman, 2000). That is, people have both positive and negative perceptions about technology; the general belief continuum for a technology ranged from a strongly positive to a strongly negative attitude toward the technology (Lin, Shih, & Sher, 2007).

There has been significant interest in the field of AR from numerous academic scholars. While some approached the subject from a technological perspective focusing on the challenges and chances of hardware and software design (Livingston, Gabbard, Swan, Sibley, & Barrow, 2013), others focused on the acceptance of the technology and the factors influencing people to use AR (Wojciechowski & Cellary, 2013; Yussof, Ibrahim, Zaman, Ahmad, & Suhaifi, 2011). While previous research found clear indications that factors such as enjoyment (Haugstvedt & Krogstie, 2012; Wojciechowski & Cellary, 2013), innovativeness (Yussof et al., 2011), perceived benefits and information quality (Olsson et al., 2012), among others, influence the acceptance of AR, the challenges of user interface and hardware design are by no means solved or agreed on as to how they should be approached (tom Dieck & Jung, 2018). Haugstvedt and Krogstie (2012) and Leue et al. (2014) supported the importance of enjoyment as an external variable within the AR acceptance context. Within the mobile service acceptance context, personal innovativeness (Zarmpou, Saprikis, Markos, & Vlachopolou, 2012) and perceived benefits (Lopez-Nicolas, Molina-Castillo, & Bouwman, 2008) were confirmed to influence the behavioral intention to use. The above reviewed studies identified a number of external variables that are applicable to the AR acceptance context, including enjoyment (Haugstvedt & Krogstie, 2012), personal innovativeness (Zarmpou et al., 2012), perceived benefits (Olsson et al., 2012), as well as information quality (Jung et al., 2015; Olsson et al., 2012).

4. RESEARCH METHODOLOGY

4.1.Research Design and Hypotheses

This study proposes a research model in Figure 1. The model suggests that perceived usefulness and perceived ease of use are predictors of perception toward AR. In addition, AR perceived ease of use will affect perceived usefulness (H1). When it comes to H2 and H3, the model suggests that both perceived usefulness and perceived ease of use are the predictors of destination visit intention. Finally, it suggests that perception toward AR is a predictor of tourism attractiveness.
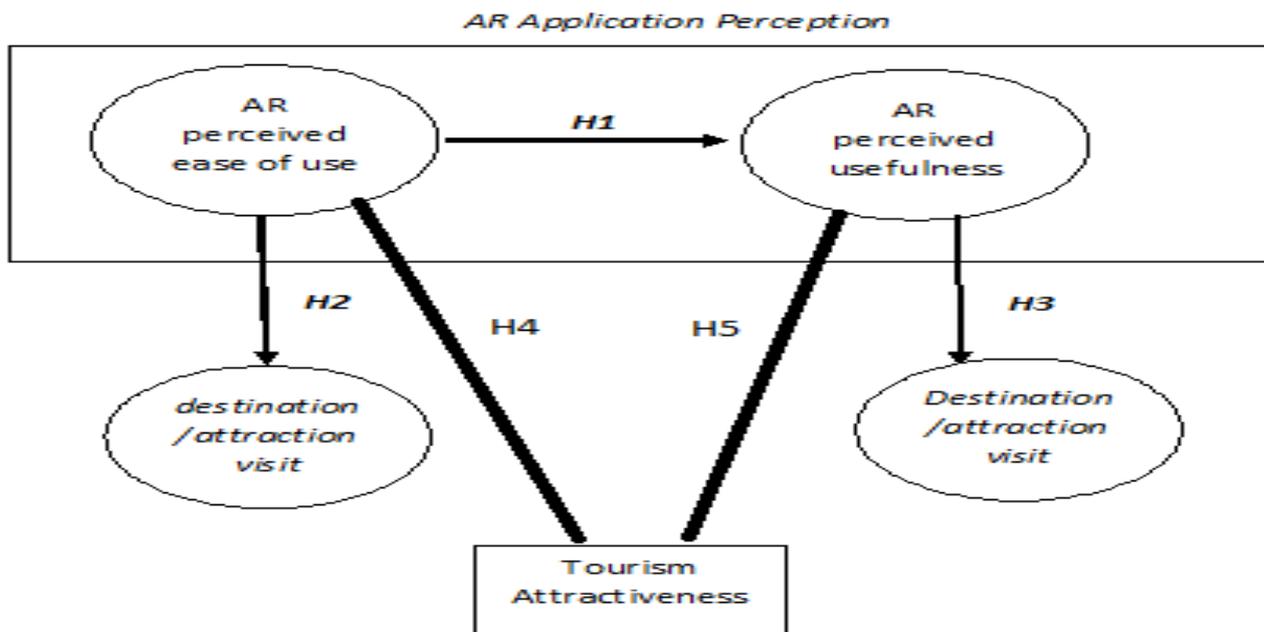
AR Application Perception

Figure 1. Research Design

Perceived usefulness and perceived ease of use are basic constructs in the technology acceptance model that constitute a significant effect on perception toward technology use (AR application perception), which in turn affects the behavioral intention (destination/attraction visit intention) to use technology (Davis, Bagozzi & Warshaw, 1989; Chung et al., 2015). On the other hand, AR application perception is an important key for contributing to tourism sector (Cranmer, tom Dieck & Jung, 2018). In this context, the following hypotheses are proposed:

H1. AR perceived ease of use has a positive effect on AR perceived usefulness.

H2. *AR perceived usefulness has a positive effect on destination/attraction visit intention.*

H3. *AR perceived ease of use has a positive effect on destination/attraction visit intention.*

H4. *AR perceived ease of use has a positive effect on tourism attractiveness.*

H5. AR *perceived usefulness has a positive effect on tourism attractiveness.*

4.2. Instrument Development

Most measurement items were adapted from prior studies. Perceived usefulness, perceived ease of use and destination visit intention were adapted from Van der Heijden (2004) and Chung et al. (2015). Our study also adopted two items based on Jun et al. (2015)' study for tourism attractiveness. A survey questionnaire was first developed in English and then translated into Turkish. Then, researchers who are fluent in English and Turkish with academic specializations in the area under study compared the translated version with the original version and did not identify any discrepancies.

4.3. Data Collection

An on-site survey was conducted of Gobeklitepe (Sanlıurfa/Turkey) domestic visitors who used the interactive AR applications. Gobeklitepe is to be appropriate to evaluate the utilization of AR and visitor's perception toward AR for cultural heritages. Therefore, in this study, we focused on the AR applications of Gobeklitepe and was chosen as the survey site. Five pollsters who majored in tourism served as field researchers to collect data during July, 2018. Totally 344 visitor questionnaires were found appropriate for the data analysis in the research.

5. DATA ANALYSIS AND RESULTS

Totally 344 valid questionnaires were analyzed to access the findings. First of all, the confirmatory factor analysis was applied via SPSS 21 on the scale and KMO value was found as, 754 that is accepted as a reliable value. The analysis has confirmed the four dimensions that are in harmony with the original scale and explain the %63,829 of the whole scale. The communalities value of all items was found higher than, 400. The Cronbach's Alpha value that stated to the reliability of the whole scale that is included 12 items, is 800. Table 1 includes the demographic characteristics of the visitors who responded to the survey. The

results indicated that the age ranges of visitors are generally in the middle ages and 31-40 range is much more than the others and the most of the visitor's have a university degree or a high school degree. The majority of the occupational status of the visitors occur employee and they prefer to travel with families or partner. Finally, it is understood that the most of the visitors had an information about Gobeklitepe through internet/social media and friends before traveling.

Table1: Demographic Results

VALID		frequency	percent
Gender	Male	218	63,4
	Female	126	36,6
Age	18-30	107	31,1
	31-40	144	41,9
	41-50	63	18,3
	51-60	21	6,1
	61 and over	9	2,6
Education	High School or below	156	45,3
	Bachelor's degree	163	47,4
	Master's/Doctorate	25	7,3
Employment Status	Employed	212	61,6
	Self-Employed	52	15,1
	Unemployed	28	8,1
	Retired	15	4,4
	Student	37	10,8
Travelling With	Alone	10	2,9
	With a partner	101	29,4
	Family/Relatives	112	32,6
	Friends	69	20,1
	Colleagues	49	14,2
	Others	3	0,9
Information about Gobeklitepe	Internet/Social Media	193	56,1
	Newspaper/Magazine	15	4,4
	Friends/Relatives	121	35,2
	TV/Radio	12	3,5
	Travel Agency	3	0,9

The other output that was realized the face to face interviewing is about the profile of the visitor, indicated that the visitors of the Göbeklitepe are usually choosing to travel independently without travel agency.

The values are sorted in Table 2, showed that the visitors of Gobeklitepe have a very strong perception about usefulness of the interactive applications. The item, ¨The interactive applications are generally useful¨ has the highest value in the first dimension.

Table 2: Perceived Usefulness (Cronbach's Alpha,773)

	Items	Mean	Std. Deviation
1	The interactive applications provide effectiveness for my visit in the archeological site.	4,7267	,61638
2	The interactive applications are efficient tools for visit in the archeological site.	4,5291	,60056
3	The interactive applications contributed to access easily to information for me.	4,6831	,58270
4	The interactive applications are generally useful.	4,7587	,47984
5	The interactive applications provided utility to perceive information that is presented on the site.	4,7471	,46760

The Table 3 express that the ease of using the interactive applications mentioned that the visitors perceived positively. The item, ¨I accessed easily to the information thanks to the interactive applications¨ has the highest value in the second scale dimension.

Table 3: Percieved Easy of Use (Cronbach's Alpha ,695)

	Items	Mean	Std. Deviation
1	The using of the interactive applications are clear and understandable.	4,6715	,54500
2	The interaction with interactive applications was not complicated.	4,6657	,53603
3	I accessed easily to the information thanks to the interactive applications.	4,7674	,45623

The findings are regarding to dimension three in Table 4. These values have pointed out that the revisit intention of the visitors is very strong. The highest item is "After my interactive experience, I think to visit Gobeklitepe" also the highest phrase of the visitors.

Table 4: Destination visit intention (Cronbach's Alpha ,640)

	Items	Mean	Std. Deviation
1	After my interactive experience, I think to revisit Gobeklitepe.	4,7413	,48287
2	After my interactive experience, I think to recommend to others to visit Gobeklitepe.	4,7151	,48319

The last dimension is about the attractiveness of the interactive applications in which are located in Gobeklitepe and contribution to the tourism. According to Table 5, the visitors believe that the interactive applications make more attractive the archeological sites, its visitor center and museums. It is seen that the visitor opinions confirmed that the applications provide an important contribution to the tourism. In addition, considering all dimensions in the scale this dimension has also the highest values.

Table 5: Attractiveness and contribution to tourism (Cronbach's Alpha ,718)

	Items	Mean	Std. Deviation
1	I believe that the interactive applications made more attractive to the Gobeklitepe	4,8488	,36677
2	I believe that the interactive applications provide an important contribution for archeological sites and museums.	4,8459	,42114

The research design that was separated two models as Model 1 and Model 2, was checked via AMOS 22 Statistical program and have been used the path analysis.
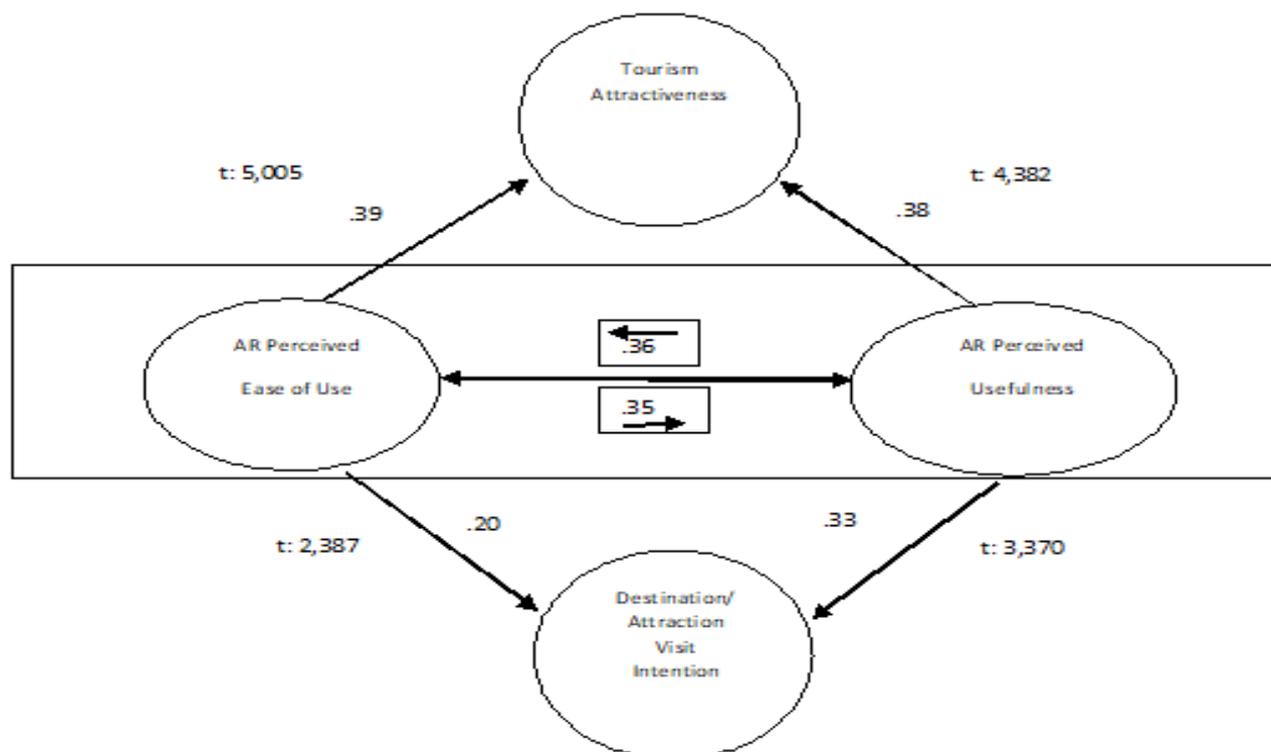

Figure 2. Research Model

H1. AR perceived ease of use has a positive effect on AR perceived usefulness.

H2. *AR perceived usefulness has a positive effect on destination/attraction visit intention.*

H3. *AR perceived ease of use has a positive effect on destination/attraction visit intention.*

H4. *AR application perception has a positive effect on tourism attractiveness.*

According to the path analysis results via AMOS 22, all hypotheses that generate elements of the model design, employed and confirmed as statistical. The "Augmented Reality" applications, perceived ease of use and perceived usefulness have positive effects on the visit intention of the visitors to the destination.

The "Augmented Reality" applications, perceived ease of use and perceived usefulness, cause to increase of the tourism attractiveness. The fit values are below in Table 6:

Table. 6 Model Fit Index

Values	Model 1	Model 2
X^2	110,270	109,257
df	31	32
p	0.000	0.000
X^2/ df	3,557	3,414
GFI	.941	.940
IFI	.918	.908
CFI	.917	.907
RMSEA	.085	.084

After the path analysis in AMOS 22 statistical program, it is seen that all hypotheses in research model were confirmed. The fit values where is sorted in Table 6, are coherent with accepted standard value (Hooper et al. 2008) in the literature.

6. DISCUSSION AND IMPLICATIONS

The using of the AR within the tourism sector is a new application for Turkey. Göbeklitepe is the first practice that is aiming to improve the tourist experience generally in an archeological site. The AR information systems can help tourists in accessing information and improving their knowledge regarding an attraction or a whole destination while enhancing the tourist experience but the study can be seen as a feedback about to the user of the AR technologies and is a data to discuss the efficiency and usefulness of the applications for the visitors.

The findings explain why and how the tourist use AR application and its influence on the experience of the visitors in the archeological site Gobeklitepe and intention to visit destination. Some important results of the findings can be summarized as;

- ✓ The findings show that the Augmented Reality has an important practical implication for the historic sites and museums particularly enriching of the visitor experience and satisfaction.

- ✓ The "Augmented Reality" applications have also positive impact on the visit intention of the visitors. Because of that, the applications can be applied and extended to increase of the, attractiveness of the different sites, as Gökbeklitepe, museums and historical destinations.

- ✓ The "Augmented Reality" applications are perceived a tourism attraction by the visitors. That is why, the using of the applications should extend and improve to rise of the destination's attractiveness.

The study indicated as Kalawsky et al. (2000) underlines that is important the using of the new technologies such as mobile, virtual or augmented applications for the tourism industry to enhance the tourist experience. The literature on AR acceptance context including enjoyment (Haugstvedt & Krogstie, 2012), perceived benefits (Olsson et al., 2012), as well as information quality (Jung et al., 2015; Olsson et al., 2012), was supported. With the findings of the research, opinions on the perceived benefits (Lopez-Nicolas, Molina-Castillo, & Bouwman, 2008) were confirmed to influence the behavioral intention to use.

The study has shown that the majority of the visitors tend to use AR and this can be also functional and supportive to obtain a valuable experience without a tour guide in an archeological site. The utilization examples of AR were explored and discussed in many researches (Fritz, Susperregui, & Linaza, 2005; Yovcheva et al., 2013; Hunter, Chung, Gretzel, & Koo, 2015; Jung et al., 2015) regarding to tourism and AR. Some of them (Yovcheva et al. 2013) have accessed similar results as this study and confirmed that AR will help to maximize tourist satisfaction. Although the study did not include data on the quantitative results of the using AR applications by visitors, the findings evident that the interactive applications have been used actively and effectively them. For this reason, it can be thought that the findings have supported that the adaptation of visitors to the new technologies can realize in a short time contrary to Chung, Han & Joun (2015)'s results. However, it is clear that new field researches are needed in order to discuss the adaptation process and timing.

7. CONCLUSIONS AND LIMITATIONS

This field research has examined the importance and effectiveness of the AR technologies through visitor experiences in the tourism industry. It is tried to develop the literature which is related to AR in a tourism context, why people use AR or how its use affected visits to tourist destinations or attractions through the Göbeklitepe archeological site and visitor center. The research specifically focused on the impacts of interactive applications (AR) on visitors' experience case of Göbeklitepe and is surveyed only domestic tourist' perceptions.

The study was built on AR users emphasized that a positive attitude toward AR at a heritage destination and attractions or try to visit the destination or attractions again. In this context, this study conceptualizes crucial dimensions which are "perceived usefulness", "perceived ease of use)", "destination/attraction visit intention" and "attractiveness & contribution to tourism" and how these dimensions' influence visitors' AR usage intention and destination visit intention through AR technology perception (perceived usefulness and ease of use). In summary, to that, it is revealed that the AR applications contribute to tourism as an attractiveness and to enhance the visitor experiences. As a part and dimension of the new technologies AR can increased the efficiency of the visits particularly in historical places such as archeological sites, visitor centers and museums.

The field research is limited to Gobeklitepe case and the AR applications utilized in the visitor center of Gobeklitepe. It is clear that the results of the study should be compared and discussed with the new studies and implementations in the future. Yet, the findings of the study can assist the new researchers who intend to discover different dimensions of the AR.

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