Manchester Metropolitan University

e-space

Manchester Metropolitan University's Research Repository

Please cite the Published Version

Han, D, Tom Dieck, M and Jung, TH (2018) User Experience Model for Augmented Reality Applications in Urban Heritage Tourism. Journal of Heritage Tourism, 13 (1). pp. 46-61. ISSN 1747-6631

DOI: https://doi.org/10.1080/1743873X.2016.1251931

Publisher: Taylor & Francis

Version: Accepted Version

Downloaded from: https://e-space.mmu.ac.uk/617925/

Additional Information: This is an Author Accepted Manuscript of a paper accepted for publication in Journal of Heritage Tourism, published by and copyright Taylor & Francis.

Enquiries:
If you have questions about this document, contact openresearch@mmu.ac.uk. Please include the URL of the record in e-space. If you believe that your, or a third party's rights have been compromised through this document please see our Take Down policy (available from https://www.mmu.ac.uk/library/using-the-library/policies-and-guidelines)

This is the authors' final version of an article published in:

Journal of Heritage Tourism

The original publication is available at: DOI: 10.1108/JHTT-09-2015-0036

User Experience Model for Augmented Reality Applications in Urban Heritage Tourism

D. Han[a] M.C. tom Dieck[a], T. Jung[a]
[a]*School of Tourism, Events and Hospitality Management, Faculty of Business & Law, Manchester Metropolitan University, Manchester, M15 6BG, UK*

Abstract

While Augmented Reality (AR) is increasingly being implemented across a number of industry sectors, an open issue remains over the emotional as well as experiential impacts of this new technology within urban cultural heritage tourism. Therefore, the purpose of this study is to create a tourist experience model for AR tourism applications in the context of urban heritage tourism. The data were collected through five focus groups with a total of 49 participants. A theoretical tourist experience model was generated using Hassenzahl's (2003) model of user experience. Hassenzahl's (2003) model relies on the basic idea that product characteristics and features have an effect on the actual consequences. The data were analysed using thematic analysis in order to examine the alignment of themes according to previously identified themes from the literature as well as investigate new emergent themes from the focus groups. This study extends the theoretical aspect of the user experience model by Hassenzahl (2003) through empirical confirmation. The findings reveal that the user experience is formed by the correlation of product features and the perceptions and experiences of tourists. Due to the fact that successful implementation use cases of mobile AR applications is still limited, particularly within the tourism industry, the establishment of a comprehensive set of factors has been considered to be crucial for successful implementation.

Keywords: augmented reality; urban heritage tourism; tourist experience model; thematic analysis; Dublin AR

1. Introduction

The cultural heritage tourism sector is increasingly looking for new ways of visitor engagement through latest technological innovations (Tscheu and Buhalis, 2016). While Augmented Reality (AR) is increasingly being implemented across many industry sectors, an open issue remains over the emotional as well as experiential impacts of this new technology within the urban cultural heritage context. As more tourists are using mobile devices, the potential benefits of using AR for the enhancement of the tourist experience are increasing (tom Dieck and Jung, 2015). Nevertheless, cultural heritage tourism organisations need to carefully explore the potential of investing in new technologies, as visitor satisfaction and intention to return and spread positive word-of-mouth is closely linked to the destination's overall success (tom Dieck and Jung, 2016). User experience developed as an important area within Human Computer Interaction and involves aspects such as usability, usefulness and emotional impacts (Hassenzahl 2005, Zahidi et al. 2014). However, the topic of user experience lacks theory and empirical research, particularly in the context of urban heritage tourism. The importance to understand the user experience has been acknowledged in early studies, investigating its determinants and situational/personal mediation (Hassenzahl, 2003). While Mahlke (2005b) argued that the investigation of the user's emotional stage within a given experience is still limited and requires further examination in regards to its interrelationships, limited studies of user experience have been conducted in the context of urban heritage tourism.

The study was conducted in Dublin after careful consideration of a number of potential urban heritage tourism destinations, due to its marketing strategy to be recognized as a 'test bed of innovation' across Europe (Curtis, 2012). While international tourism to Dublin has recently experienced a drastic decline (Failte Ireland, 2014a), Dublin formulated the aim to rebrand itself as a vibrant and modern city (Failte Ireland, 2014b) in order to increase tourist numbers once again. AR was previously found to influence behavioral intentions (Jung et al., 2015). Consequently, AR was recognized as a potentially important driver to enhance the tourist experience in the destination. However, qualitative research on the AR tourist experience is still limited. The aim of this study is therefore to create a tourist experience model for AR tourism applications in the context of urban heritage tourism in Dublin.

2. Literature Review

2.1 User Experience

As companies have highly valued good user experiences due to the result in continuous use and increasing customer loyalty, it was found imperative to design products that create good delightful experiences (Garrett, 2006). Chitturi et al. (2008) supported this view by noting that products that can delight customers would result in positive word of mouth and increased spending intentions. Previous studies have since highlighted how poor product attributes resulted in dissatisfied customers due to the misalignment of features to the usability (Harrison et al., 2013). On the contrary, the identification of features that increase customer satisfaction was found to result in many award-winning successful products (Saunders et al., 2011). However, solely relying on product features such as ease of use has been acknowledged to be insufficient (Law, 2011). Therefore, it is crucial to understand how and which features affect the overall user experience.

While user experience has received a lot of attention from researchers in the field

of human computer interaction, it was argued to generally reflect any interaction between a user and a product (Arhippainen and Tähti, 2003; Kuniavsky, 2007). A common definition of user experience was later formulated by the ISO 9241-11, as "a consequence of the presentation, functionality, system performance, interactive behaviour, and assistive capabilities of an interactive system, both hardware and software. It is also a consequence of the user's prior experiences, attitudes, skills, habits and personality. With respect to the ISO 9241-11, the concept of usability is thus broadened by means of its re-interpretation from the perspective of the users' personal goals, which can include perceptual and emotional aspects" (ISO 2010:7). Similarly, Law et al. (2009:719) defined user experience as "a person's perceptions and responses that result from the use or anticipated use of a product, system or service". The human computer interaction discipline has since experienced an increased interest in the area of user experience (Hassenzahl 2005). However, Blythe and Wright (2005) stated in an early study that traditional usability models from the information systems background were primarily task-oriented and focused on the usability (functionality, usefulness, ease of use) of technologies such as the original technology acceptance model by Davis in 1989. This idea stems back to times when technologies were studied within the workplace environment. While usability and quality have been assessed in previous studies of human computer interaction (Law, 2011; Harrison et al., 2013), few studies have focused on the effect on the overall user experience. Consequently, more research is required on user experience within the leisure tourism context.

Blythe and Wright (2005) and Hassenzahl and Tractinsky (2006) suggested in their respectful studies that future research focusing on user experience, needed to incorporate enjoyment and overall hedonic attributes as antecedents of users' satisfaction of technologies. Jordan (2000:3) even argued "people are no longer pleasantly surprised when a product is usable, but are unpleasantly surprised by difficulty in use". Similarly, developers had already started engaging in a 'pleasure-based' approach, whereby they designed their product and software in order to create an enjoyable and pleasant experience for the user (Jordan, 2000). Mahlke (2005a) acknowledged this trend and integrated perceived hedonic quality, next to perceived usefulness and perceived ease of use, into his model of web user experience. Furthermore, Hassenzahl and Tractinsky (2006) identified the importance of overall product aesthetics for the user experience similar to Mahlke (2005b), concluding that attractiveness played an important role for the users' intention to use technology. Hassenzahl and Tractinsky (2006) furthermore divided the user experience into three perspectives, the user's internal state, the system's characteristics, and the context of use. Blythe et al. (2007) on the other hand proposed a distinction between holistic and reductive approaches. The holistic approach reflects a phenomenological view of the experience and is based on the assumption that psychological phenomena are closely linked to the physical appearance. Reductive approaches on the other hand simplify experiences by basing them on cognitive psychology. Therefore, it is possible to evaluate them as usability, aesthetics, emotions and pleasure (McCarthy and Wright, 2004). Karapanos et al. (2009) identified three areas of user experience including emotional attachment (personal and social); functional dependency (long term usability and usefulness); as well as familiarity (stimulation and learnability). Similarly, O'Sullivan and Grigoras (2013) later argued that the mobile user experience is a result of functions striving to optimize the user's overall experience. As mobile applications are increasingly related to the user's immediate environment, O'Sullivan et al. (2013) suggested minimising the latency and use of bandwidth that

would otherwise result in increased waiting times. Charland and Leroux (2011) on the other hand proposed that a mobile user experience is dependent on two variables, the context and the implementation. In this regard, context described elements that were fixed, and could not be adjusted, such as hardware capabilities, the environment of use, or the mobile platform. In the implementation however, the designer was able to modify the experience through user interface design, performance, and alignment of the application with hardware features (Charland and Leroux, 2011). However, the present paper is based on the position put forward by Hassenzahl (2010) that has been validated and supported by a number of studies. In this regard, user experience is generally described as all aspects of interaction between a user and a product (Arhippainen and Tähti, 2003; Marcus, 2006; McNamara and Kirakowski, 2006; Kuniavsky, 2007). In alignment to later studies, the concept was argued to be dependent on the context, as it incorporates a variety of scope, objects and elements that need to be considered (Law and Van Schaik, 2010). However, studies including factors that contribute to a positive user experience, particularly for the field of urban heritage tourism are limited.

Hassenzahl (2005) indicated a discrepancy in the primarily work-related applicability of the existing user experience model and therefore, he proposed a user experience model as presented in Figure 1. While a number of models have since been proposed to illustrate the user experience (Jordan, 2000; Forlizzi and Battarbee, 2004; Hassenzahl, 2004; Hassenzahl and Tractinsky, 2006), Hassenzahl's original model of the user experience was selected to provide the theoretical background of the study due to its initial investigation of product features that result in apparent product perceptions. As this study is based on an initial investigation of product requirements, Hassenzahl's (2003) model was considered to be the most suitable for the purpose of this study. While Vermeeren et al. (2010) suggested exploring early design features in the early development stage in order to get feedback on new products, it was argued that studying the change of user experience over time was becoming increasingly important (Courage et al., 2009). Particularly for creating customer loyalty, it was not considered sufficient to rely on early study results, but long-term studies were necessary.

Hassenzahl's (2003) model relies on the basic idea that product characteristics and features have an effect on the consequences. Mahlke (2005b) supported Hassenzahl (2003) and concluded that the process of information and events is influenced by the quality of the technology. Overall, Hassenzahl (2003) proposed that user experience is influenced by a combination of product features and individual user differences. Hassenzahl (2003) furthermore assessed that the product character is influences by each user's particular situation. Therefore, Hassenzahl (2003) concluded that the apparent product character could potentially be changed for the same user with an increase of experience. This would result in an increasingly familiar product to lose its novelty factor and its capability to stimulate the user. Furthermore, pragmatic attributes (manipulation), such as ease of use or usefulness were also argued to potentially change with the increased experience and diminishing novelty factor. This was supported by Liu et al. (2009) who confirmed a decline in perceived usefulness and concentration due to the decrease in novelty. Finally, Hassenzahl (2003) proposed that users would have emotional consequences when using a product such as satisfaction, pleasure or appeal. A well-designed product that triggers positive emotions was therefore likely to result in satisfaction and joyfulness. Deng et al. (2010) on the other hand distinguished between two categories namely satisfaction and pleasure and revealed that satisfaction is the result

of meeting the user's expectations while pleasure is not established on prior perceptions and knowledge. However, Hassenzahl (2003) stressed the importance of individual situations and concluded that the entire process of user experiences is based on the goals of the individual for using the product. In this regard, Deng et al. (2010) argued that the user's situation could either be a goal-mode or action-mode. Within goal-mode situations, users would focus on the fulfillment of the goal, which equals to the most efficient way to reach the end target. In action-mode on the other hand, the user emphasizes the excitement in the interaction with the product. Therefore, situations might change over time when products lose their novelty factor or are used repetitively due to the shifting mode of the user.

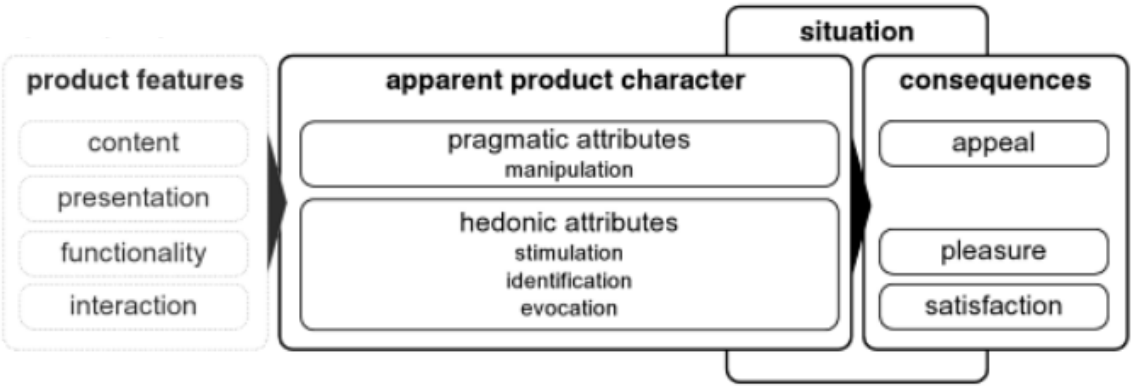

Fig. 1. User Experience Model ©[Hassenzahl]

2.2 Augmented Reality in Tourism

AR is defined as the overlay of computerised information in the real environment (tom Dieck and Jung, 2015). Although AR has existed for many years in the industry, it has just recently become a highly discussed and debated topic in mainstream Information Technology. While industries, such as manufacturing and production as well as retail and gaming are already embracing the potential of AR, Olsson et al. (2013) argued that AR is still regarded in the infancy in the tourism sector. Only recently, Yovcheva et al. (2014) and Lee et al. (2015) started to investigate the opportunities of mobile-based AR to enhance the tourist experience. To date, the main driver to mainstream AR has been the rapid development of smartphone capabilities. Thus, an increase in mobile applications is evident and is growing rapidly. The implementation of AR in tourism were generally categorised into two functionalities, location-based and marker-based AR. Location-based, also commonly referred to as GPS-based AR pinpoints the user's location using the GPS tracker on the mobile device and provides information in the tourist's immediate surroundings. Kounavis et al. (2012) argued the tourism industry to be the coherent sector for using GPS-based AR, supported by early mobile application developments, such as Junaio and Geo Travel. However, according to Carmigniani et al. (2011) the hardware capacities of the GPS sensor in smartphones have been limited, which conflicts with accurate and meaningful AR overlays in the outdoor environment. As alternative, marker-based AR has been widely implemented in various forms and cross-sectors, through a Quick-Response (QR) Code system, providing additional information such as links to websites upon scanning a two-dimensional code (Emaldi et al., 2012). However,

marker-based applications in tourism are still limited to but a few, which use a combination of marker-based as well as GPS-based AR enhancements (Kounavis et al. 2012). Studies in this area have mostly focused on combining the tourism product with AR functions (Noh et al. 2009; Choubassi et al. 2010; Marimon et al. 2010). Recently, tom Dieck and Jung (2015) proposed an AR acceptance model in the urban heritage tourism context and identified that information and system quality, cost of use, recommendations, innovativeness, risk and facilitating conditions influence young tourists' AR acceptance. Chung et al. (2015), focusing on the same context, found that technology readiness, visual appeal and facilitating conditions influence tourists' adoption of new technology. Furthermore, Jung et al. (2015) tested a quality model to investigate tourists' satisfaction and their intention to recommend tourism AR applications. In addition, Jung et al. (2016: 621) explored "how long- and short-term orientation moderates the relationship between experience economy". This review showed that there has been increasing research in the area of AR in the cultural heritage tourism context with a strong focus on tourists' adoption. However, research in regards to user experience of tourists is still limited. Hassenzahl (2005) argued that the interaction between computer and user would increasingly lead to providing experiences rather than simply isolated product functions. While user experience is a debated topic particularly within human-computer interaction, a gap was identified in defining user experience characteristics in the context of AR applications for cultural heritage tourism. Therefore, this study aims to create a user experience model for AR tourism applications in the context of urban heritage tourism.

3. Methods

3.1 Data Collection

The study was conducted in O'Connell Street, in one of the historical cultural heritage trails in Dublin. The data collection was conducted between 4th to 6th November 2013 and intended to measure the reaction as well as user experience indicators and requirements for the development of concept demonstrators of a mobile AR tourism application in the context of Dublin's Independence trail. The participants for the focus groups were undergraduate students from England visiting Dublin as part of a field trip representing the young British travellers' market. A non-probability sampling method was used by choosing all field trip participants. Tayie (2005) revealed that the non-probability sampling is appropriate when data is collected from a voluntary and readily accessible group of participants such as students. As part of the research, groups of four to five students experienced a GPS-based AR application in O'Connell Street in Dublin's city center, and a marker-based application in the museum of the General Post Office in Dublin. After participants tested the applications, the focus groups were conducted in order to evaluate participants' perceptions of the applications. Five focus groups were conducted including 49 participants in total from the young British market in the age group of 19 – 29, each lasting an average of 25 minutes. The focus group comprised three main sections, reaction and perception of the tested Dublin AR application demonstrators, general mobile AR tourism application requirements and experience indicators and user resistance towards the use of mobile AR tourism applications.

3.2 Data Analysis

The collected qualitative data were transcribed and analyzed using thematic analysis in order to examine the alignment of themes according to previously identified themes from

the literature as well as investigate whether new themes emerged from the focus groups. Flick (2014) argued that thematic analysis develops a framework of themes based on previous literature in order to serve as guideline for further theme identification and model development. Additionally, Denzin and Lincoln (2005) argued that thematic analysis was often used among researchers as unified method for communicating results in order to implement into other analysis methods. Thus, a codebook was generated structuring the findings from all focus groups with regards to the tourists' experience. This process supported the organization and identification of relationships among the data and provided a framework to uncover newly approached ideas in addition to the literature.

4. Results

4.1 Demographic Analysis

Table 1 presents the demographic characteristics of focus group participants. Although an equal distribution of demographic profiles were considered, the British young market segment was found to be suitable for an initial qualitative study as that market segment was believed to have accepted technology and mobile devices as part of their life (Caruso, 2004). Lenhart et al. (2010) defined the market segment as 'Millenial' generation between the ages of 18 to 29, arguing that 93% of the market segment was going online on a regular basis just within the U.S.

Table 1. Demographic characteristics of respondents (n=49)

Categories	Items	N	%
Gender	Male	6	12
	Female	43	88
Age	<20	38	78
	21-29	10	20
	No indication	1	2
Prior AR experience	Yes	3	6
	No	46	94

From 49 participants in the focus groups, 12% were male and 88% female. 78% of participants were 20 and younger, while 20% were between 21 and 29 years old, and 2% not providing any age indication. All participants were taken from a pool of students, as the study was specifically investigating the young market segment. While the majority were first-time users of AR applications, 6% of participants had prior experience with AR. Within the analysis participants were coded using the Focus Group number (F(x)) and Participant number (P(x)), for instance F1P1 would refer to the first participant of Focus Group 1.

4.2 AR Tourist Experience Model

Referring to Hassenzahl's (2003) model of user experience, an AR tourist experience model was generated according to the outcomes of the focus groups, which were conducted in order to test the eminent product features and to provide an indication of expected consequences for AR mobile applications in tourism based on pragmatic and hedonic product attributes as well as a simulated situation context.

4.2.1 Product features

Product features were analysed according to Hassenzahl's (2003) division into content, presentation, functionality and interaction.

Content. The present study revealed that the content factor encompasses personalised information, information on local venues, tourist reviews and ratings as well options and routes of transportation within the Dublin AR context. F1P4 mentioned, that particularly for tourists AR applications had a high potential as they are generally interested in their surroundings and are trying to find their way around a new destination (F1P4: 'I think if a tourist is new to an area, like it's the first time they've been here, with the app they can find places they are good to go and visit and help them find where it is, the location and stuff, it would work really well.'). F1P6 supported this argument by stating, '[…] when you're out in the street, I think it's very good to know where attractions and other things are'. F1P10 on the other hand mentioned tailoring the information to personal interests as well as rating functions to share in order to get an overview of viewable tourist attractions (F1P10: 'For example restaurants, and other things that might interest me. As in, I could vote the things that I like and I don't like.'). F1P10 added in this regard that not only the presentation of personalised information was required, but furthermore the option to opt-out from irrelevant information for the user (F1P10: 'I would like to block some things. If you keep seeing something you don't like you could block it.'). Additionally, F1P4 mentioned that key information relevant for tourists, such as public transportation options and general information of tourist attractions would be highly useful and should be incorporated in a mobile AR tourism application (F1P4: 'Maybe if it told you the different types of transport that you can get in the city to get around the things that you want to see. Or that you could get information and times and stuff on attraction that you're trying to visit and when they're open and how much it would cost, so like give you some additional information as well as like educational information.'; F1P3: 'In the application, if you chose a certain attraction there also might be an entry price, or admission. […] So admission fee would be a good idea, so the target audience knows how much they will be expected to pay.'). This argument was supported by F1P1, F1P2, F1P3, F1P5, F1P6, F1P7, F1P8, F1P9 and F1P10. Findings in the literature suggested that tourist applications should be beneficial not only for tourism purposes, but for everyday life in order to increase its usage and overall value (Huang et al., 2010). However, in order to guarantee the valid projection of content in the application, van Krevelen and Poelman (2010) suggested a stable Wi-Fi infrastructure that was accessible throughout the trip in order to provide relevant information to tourists during their trip. While it seemed if focus group participants were intrigued to access additional information during their trip, it would imply a stable and speedy Internet connection or alternative functionalities within the AR tourism application in order to keep the content up to date (Gafni, 2008). Papagiannakis et al. (2008) agreed stating that connection to the Internet was crucial for meaningful tourism applications.

Presentation. Within the factor of presentation, users' AR experience is dependent on a simple user interface, accurate GPS as well as authentic design. F1P3 stated that it would provide significant value for tourists, particularly if designed with an easy to use interface (F1P3: 'I think it's pretty simple to use and especially the new technology involvement in tourism, that's a good thing.'). This statement was supported

by F1P1, F1P2, F1P4, F1P5, F1P6, F1P7, F1P8, F1P9 and F1P10. F1P4 argued that the accurate GPS positioning was important in order to present relevant information in the tourist's immediate surrounding (F1P4: 'Maybe if it was also able to tell whereabouts you were. So it could give you different places around, like nearby where you are. So it doesn't actually give you an attraction on the other side of the city, so it could actually tell where you are.'). The accuracy of the GPS sensor in mobile devices has been one of the main challenges to overcome particularly in dense areas (Morrison et al., 2011; Carmigniani et al., 2011). Nonetheless, it was added in regards to the GPS based AR function that Google Maps would already provide the basic necessities in order to find and navigate their way around an unknown area and tourists would most likely do research beforehand (F1P3: '[…] And some people would prefer to go to Google Maps, which they're used to using.'; F1P2: 'I think most of the people do like research before they come to the destination so they're like, 'I want to go here.' And they just go there, so initially you don't need the application.'). However, F1P3 argued that in the near future mobile AR tourism applications had the potential to be incorporated into daily life just as smartphones have become a normality among people in developed countries and therefore, such applications would be highly valuable (F1P3: 'Like five years ago, not many people had smartphones and they didn't use applications. But now it's so common and so popular among young people than the older ones. So in the next five years it's going to be that popular that the application is going to have a big target audience and it's going to be wider. More people are going to be interested in accessing it.'). Schinke et al. (2010) and Carmigniani et al. (2011) suggested designing an easily understandable user interface in order to increase its use by a potentially larger audience and accelerate user adoption of new technologies. Schinke et al. (2010) particularly argued that future applications should include natural gestures in order to speed up the learning process.

Functionality. Another factor proposed by Hassenzahl (2003) is functionality and within the specific AR context, functionality encompasses the options to navigate, save or filter information as well as use multiple languages. F1P10 argued that being able to communicate various languages, it would not only support the implementation in multiple destinations, but also the access to necessary information on the push of a button without having to struggle with foreign language barriers (F1P10: 'It's more specific. It breaks the language barrier as well. If a foreigner doesn't speak English in the city if everything is in Irish, and I can't pronounce or looking in a map.'; F1P3: 'If you're going to make the application international, then there would have to be different choices of languages in the application. So if the target audience in Dublin, might be…if it was China, then there would have to be Chinese language available, so in the current or particular place, making sure that the language is available.'). In order to support the navigation tool of the application, F1P4 recommended, 'a map of the area they are in' as a basic function (F1P4: '[…] especially if they're first time visitors. If you have to know the places to see or are of interest and you'd have a map to help you getting around. That would be quite useful.'). This argument was supported by F1P3 who added to include an interactive function within the map in order to select points of interest (POI) in the area. 1P1 added in this regard that AR should be used to help navigating to certain POIs such as tourist attractions (F1P1: 'I thought instead of just seeing a destination, I would like to navigate where the attractions are rather than looking where you are when you're already there.'). F1P10 on the other hand mentioned that it should include a basic search function which was able to filter the required information in order to avoid information overload (F1P10: 'It would be nice to choose something, like if you're looking for a pub, just

search for pubs near here, and if you're looking for souvenirs, just search for that, so they're not popping out at the same time. […] I want to know where James Joyce's house is. It would be nice to have a device where you just search for it, and it gives you directions how to get there. On the way I want to have a cup of coffee, just insert that and get a cup of coffee. Just take the most direct turn.'). F1P1, F1P2, F1P3, F1P4, F1P5, F1P6, F1P7, F1P8 and F1P9 agreed to this statement. Being able to personalise the application according to tourist interests was suggested to enhance the tourist experience (Marimon et al., 2010). Previous studies suggested in this regard that sorting available information into categories would facilitate not only the interaction process with the application, but also enhance the overall user experience (Gafni, 2008; Huang and Bian, 2009; Herskovic et al., 2011). Morrison et al. (2011) added further that information should be presented reasonably providing only relevant information for the tourist avoiding the overload of accessible information.

Interaction. Finally, within the product features category users' experience of AR within the factor of interaction is formed by the accessibility, efficiency. F1P3 mentioned AR tourism applications would be of high interest if accessible anywhere at anytime (F1P3: 'I think it's accessible to use anywhere, at anytime, anyone.'). Additionally, F1P4 highlighted the importance of quick response of the application in order to access information on demand (F1P4: 'It was quite quick as well. So it was working quite fast. So you got the information quite quickly, so that's a good point.'; F1P7: 'It's quick.'). This was supported by the argument of being able to use the personal mobile device without having to rely on new hardware (F1P6: 'Everyone has smartphones nowadays as well. Everyone uses apps and knows how to use it, so I think it's quite handy.'; F4P6: 'I think that you can use it on the phone, because the phone you have always with you I think.'; F1P2: 'If you don't have a device that could have the device, then you're not going to be able to use it.'). F5P5 further compared using the AR application with prior used devices, such as Laptops as well as other alternative applications used for accessing information (F5P5, F5P4: 'It's like usually for things like that people need laptops and stuff like that. Like how I used it, it just freezed. It just goes to fast and then freezes and just goes off. But with that, it's just easier. It just comes and you click it and it just works instantly. It doesn't have to load on the street, like the camera is just there.'). F5P4 supported that statement adding that using the AR application would make it more convenient and faster to access information on the go. Easy interaction was highlighted multiple times within the Focus Groups stating that the application should be designed in a way that would not require the user to learn additional functions (F4P7: 'I think just something not too complicated.'). However, F4P4 mentioned that being able to 'ask questions' would be a valuable addition in the case of any further information was required. The focus group findings revealed that ease of use of interaction still seemed to be of importance to participants (Carmigniani et al., 2011). The concern was outlined not only by the simplicity of navigating through the application menu, but furthermore for practicality issues using the application during a trip. This statement confirmed previous findings, noting practicality issues while interacting with AR applications on current mobile devices (Morrison et al. (2009).

4.2.2 Product characteristics

Product characteristics were identified and categorised into pragmatic and hedonic attributes. Thus, the correlation of pragmatic and hedonic product attributes as a result of

the interaction with the application are building the consequences as an emotional reaction.

Pragmatic Attributes. Pragmatic attributes considered by Dublin AR users included ease of use, efficiency and audio and video support. F1P3 argued that it would be particularly helpful for users with visual impairments to have the opportunity to access the information through other senses. Furthermore, AR tourism applications were regarded as helpful tool for elderly people. However, it was added that technological usability issues might arise with this market segment and therefore, the application would require to be designed for anyone to understand (F1P3: 'I think it's helpful for some people perhaps with visual impairments if there is audio, so you can actually listen to it, rather than to read all the information on the board. That includes the elderly people, which is also a target market for museums. But it's more difficult for elderly people because they don't use much technology […].'; F2P2: 'And it speaks to you, so that's good for children or people who maybe suffer from like dyslexia or something. Or blind people yeah. It's really like, or if you're deaf and you need to read. So they can experience it, too. I think that's a good idea for people that struggle with that.'). Furthermore, it was highlighted multiple times that simplicity is a key value for users next to accessibility and convenience (F1P10: 'It's easy. Easy to access even though you have no idea what it is. You just click on it and it works. 'F3P5: 'I think it was easy to use, which is good as well.'). While Kaufmann and Dünser (2007) were critical for the adoption of new technology and claimed it would take time for users to utilise, Sumadio and Rambli (2010) claimed that AR would be quickly adopted once technological challenges were overcome. However, Olsson and Salo (2011) argued that it was vital for applications to provide a user benefit not only in specific scenarios, but to achieve daily tasks.

Hedonic Attributes. Sub-factors for hedonic attributes were identified as cleverness, stimulation, more interesting than offline options, and evocation through information in first person perspective, convenience as well as playfulness in particularly for children. When investigating user reactions of the provided AR experiences, the majority agreed that AR application would have high potential for the tourism industry (F1P2: 'I think it's a really good idea, because in the future, you will be able to, tourists will be able to like know any attraction, with possibly pointing the camera, is it the camera…at something and know anything about it. So I think it's a really good idea.'; F1P9: 'I think it's very good to know where attractions are and other things are.'; F3P5: 'I think it's really clever. It's better than spending lots of money on all the tourism stuff, you just get the app and go by yourself.'; F1P3: 'Impressive.'; F5P3: 'Wow!'). The option of various methods of augmentation was highlighted as a valuable alternative to access information (F2P2: 'I think it's a really good idea. And it's good to learn by listening, not just reading. It's more interactive and then it let's you connect more with what you're seeing.'; F3P5: 'And that it read it out to you. It catches your attention more if someone reads it out. It's more interesting listening to something instead of reading something.'; F4P6: 'But I think it was good that when you were inside, one of them was a video, wasn't it? One of them was a picture, and the other one was just text. That was kind of good that it was different. That it was kind of visual, wasn't it.'; 5P10: 'I like the fact that it shows different information ports actually, different information in the museum. It gives you more depth about what you're seeing.'). Furthermore, it was mentioned that offline options should be included for tourists in order to avoid data

roaming charges and encourage tourists to use the application (F1P1: 'But if your phone is not connected to the network. Because we've come here and cannot connect to the network. What if you get charged and stuff and you have to go to the Internet you wouldn't be able to use it.'; F1P4: 'And they have to take into consideration that maybe international tourists that are coming here they need the app, because it's their first time or something. They've got their phone from abroad and it's obviously going to charge it to use it. If that's not working, then they're obviously not going to use it. And that's the people the app is trying to target the most, like those tourists and stuff.'). This statement was supported by F1P3 who mentioned, 'if it requires Wi-Fi then it's going to be very restricted, because there isn't Wi-Fi in many places apart from the city centre here'. Many participants saw the potential of AR applications for entertaining purposes for the younger audience. While alternative information access was highlighted, it was often put in relation to keeping children entertained and interested by modifying content to a particular market accordingly (F2P3,F2P5, F2P9: 'It's good if you have a photo and don't know what it's all about, or if you have a big text and children are afraid to read it, and if someone is telling you, not just telling you that you hear a voice, but if you have a small video or showing something it's easier for children and maybe more attractive and useful for them instead of reading like a big text.'). Gordillo et al. (2013) therefore suggested implementing learning games in order to facilitate the learning process of children while travelling. F5P4 and F5P5 additionally commented on the convenience of using AR applications on the go (F5P5: 'But with that, it's just easier. It just comes and you click it and it just works instantly. It doesn't have to load on the street, like the camera is just there.'). The argument was supported by F5P8 who admitted to use the application stating, 'I'd use that if it works. Especially if you don't know the street name you can just use the app and you just know'.

The GPS-based AR application was compared to the widely known and utilised Google Maps system, which was beneficial for users as it did not require the additional knowledge of a new system (F1P6: 'I think it's similar to Google Maps, but I think it provides just a bit more information for more tourists, especially.'; F1P3: 'So it's like Google Maps really with information about attractions.'). However, it was argued that participants would still use the GPS AR function in order to get instant information access and knowledge transmission for orientation purposes in the immediate surrounding (F5P1: 'But then it's good if you didn't know where something was, like I wouldn't know that was the Spire, but if you hold it up and it gives you information on it. That's probably what I would use it the most, when I didn't know what something was and I wanted more information on it.'; F5P7: 'Like you could see what was right there. It was like a map, but you could actually see what was there. Like in a map you wouldn't naturally see where it is, but here you could actually see it where everything is.'; F4P6: 'And it's also great when you can see in 150 metres or something, where is the restaurant, where is this. You don't have to go exactly to this place, but you can see.'; F5P4: 'In the Dubline Trail some of the things, like maps or something weren't in the right place, so you wouldn't know which trail was which, so in the app that would be really helpful.').

The usability of AR on mobile devices was discussed, as it seemed impractical to hold the phone at designated angles particularly in the outdoor environment. F1P9 was suggesting that users might get tired of holding their phone cameras pointing at various objects around them in order to receive additional information (F1P9: 'I think you'll get

tired of holding your phone when you're reading the walls in the museum. I think you'll get tired of holding your phone when you're reading the walls in the museum.'). In addition, F1P4 stated that it might be easier to save the provided information on the phone in order to access without having to point the camera at the object (F1P4: 'Yeah, the information doesn't stay on the screen, if you like move away your phone from the thing you're reading. It would probably be better if it could save the information so you could read it, I don't know.'). In regards to content, opinions were divided. While some participants enjoyed the alternative possibility to access information through audio instead of having to read it, others argued that content should be designed in addition to the already existing information and not repeat itself (F1P6: 'I think it's good, but I think as we used it in the museum, I think it's not very helpful because the information is already provided, so it's probably a waste of time and when you're like out in the street, I think it's very good to know where attractions are and other things are.'; F2P7: 'It was good to have additional information to what was actually in the museum.'; F2P3: 'The good thing is apart from…it would actually give you a bit more information than what was given to you in reality, so that was a plus.'). The issue of practicality was discussed by Morrisson et al. (2009) suggesting alternative interaction methods in order to avoid security and privacy issues in public environments. While solutions, such as saving previously accessed information and downloading content through taking a picture of points of interest are still on trial, it implies a minimum hardware and Internet capacity and therefore are continuously being improved in order to provide a rich user experience.

This study does not provide indications on specific consequences based on the tourist experience and does not investigate further in user situations, however, it is recommended to further examine the issues in future research to provide a more context-oriented approach to user experience. Therefore, the following model was generated to determine expected consequences based on product features and tourists' reaction.

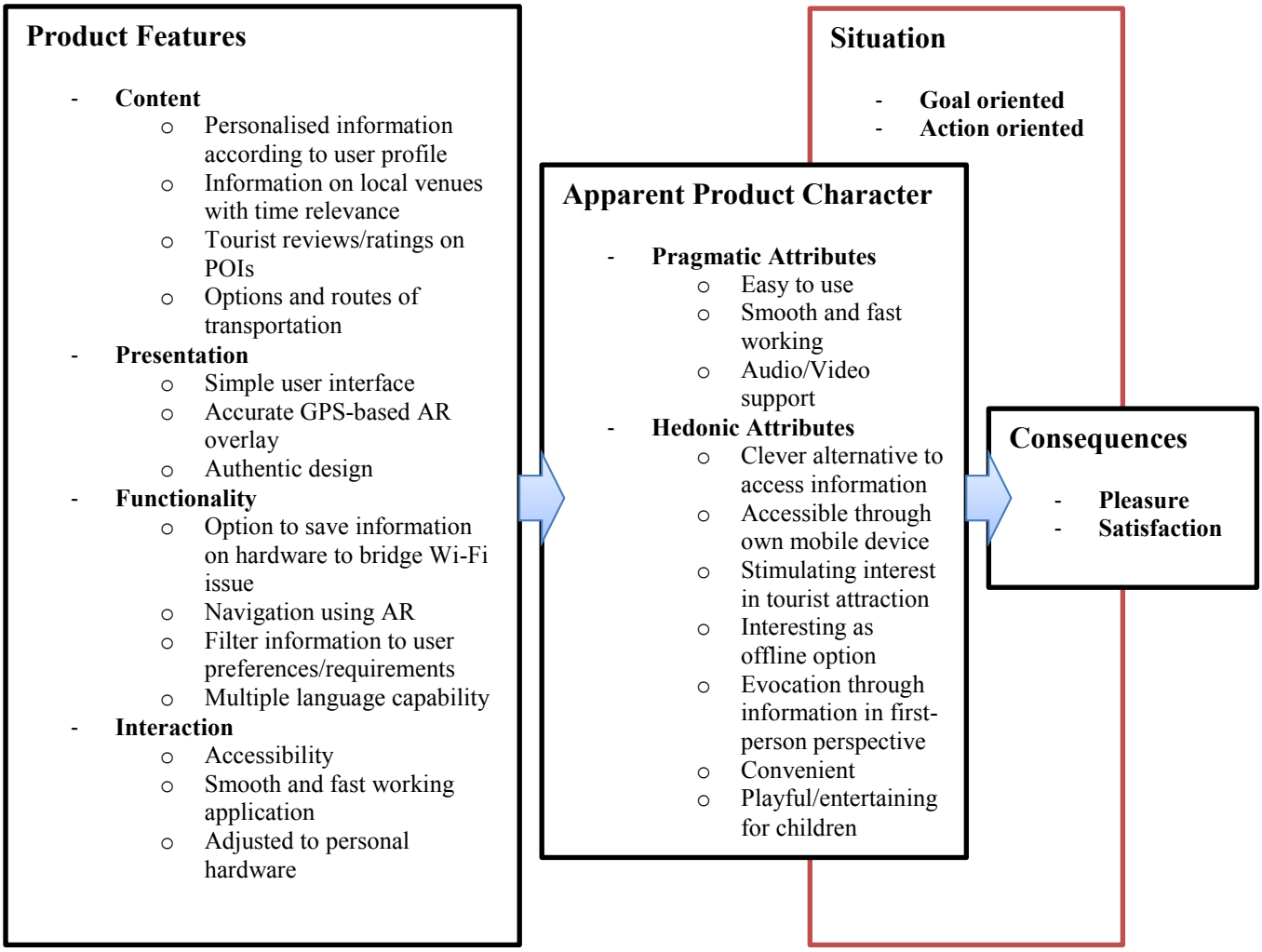

Fig. 2. User Experience Model for Augmented Reality Applications in Urban Heritage Tourism

5. Discussion and Conclusion

Hassenzahl (2003) and Mahlke (2005) proposed a validation of the user experience model for future research in order to continuously expand the understanding of user experience, its determinants, as well as situational and personal factors. Thus, the aim of this study was the identification of user experience factors within the Dublin AR context to fill the gap in the AR user experience literature. Based on the findings from the focus groups, which identified a number of sub-factors for each category within Hassenzahl's (2003) user experience model, we were able to extend the model to fit the context of AR in tourism.

The outcomes of the focus groups demonstrated that some of the product features noted in the literature were still significant for the development of mobile AR applications. The results showed that tourists were still considering map-based applications for urban heritage tourism settings as one of the most crucial features of a mobile AR application. As tourism is largely linked to the immediate environment, this feature is expected to remain relevant for future applications and hardware respectively.

Shi et al. (2010) therefore suggested to link tourism applications with map-based applications such as Google maps that users were familiar with. The findings further revealed that it was crucial to be able to personalize information presented in mobile AR tourism applications, as tourists were looking for quick access to relevant information particularly in destinations such as urban heritage sites. This was previously noted in earlier studies within mobile computing (Gafni, 2008; Herskovic et al., 2011). While overall information quality was argued to be a determinant for choosing and reusing mobile AR applications in urban destinations, public transportation was mentioned to be fundamental for tourists. It was therefore acknowledged and included in the provided user experience model. On the other hand, limited options to access information was seen as a determinant of users, arguing that an offline functionality would be suitable for mobile AR tourism applications. Although many urban destinations have initiated a citywide free Wi-Fi service for tourists, focus group outcomes showed that tourists were not widely aware, or constantly moving, making a stable Internet connection challenging. However, this issue requires further investigation, as offline options would ultimately result in larger application sizes, and could potentially lead to longer loading times deterring the user experience.

To conclude, this study provided a user experience model for AR applications through the identification of AR-related factors that influence users' satisfaction. This study extends the theoretical aspect of the user experience model by Hassenzahl (2003) through empirical confirmation as scholars such as Mahlke (2003) have suggested. Previous research in the area of AR in the cultural heritage tourism context focused primarily on user acceptance investigating which factors influence the visitor's decision to accept or reject the technology as part of a museum or art gallery visit (Chung et al., 2015; Jung et al., 2015; tom Dieck and Jung, 2015; Jung et al., 2016). The present study added to this recent pool of knowledge by focusing on the user experience as well as application features and apparent application characters in particular. As user adoption and acceptance are important areas of research for cultural heritage institutions to examine whether certain technologies are accepted or rejected, future adoption research could integrate the proposed factors into a structural model.

The study holds a number of implications for mobile AR application developers as well as for practitioners and DMOs in urban heritage tourism. For mobile AR application developers, the outcomes of this study provide a model with product features for a user-centered interface design in the context of urban heritage tourism. Considering the user experience model provided in the study, application developers are presented with a set of characteristics to influence tourists' experiences by designing product features purposefully into mobile AR applications in the urban heritage context. Furthermore, they are able to reduce the gap in the alignment of product features to consumer expectations in order to prevent dissatisfaction of users resulting in negative user experiences.

For industry practitioners in urban heritage destinations, the outcomes of this study provide a comprehensive set of factors that affect the tourist experience when implementing mobile AR tourism applications in the destination. Therefore, the tourist experience can be enhanced when implementing mobile AR applications in the tourism product with consideration of the provided product features. Due to the fact that AR applications are still new for smartphone devices and particularly within the tourism

industry, the establishment of a comprehensive set of factors is crucial for future successful implementation. Furthermore, DMOs and industry practitioners in urban heritage tourism can refer to the provided model for guidance in their decision-making process for future investment in mobile AR technology.

There are a number of limitations within the present study. The first limitation concerns the qualitative data collection technique, making the results and findings difficult to generalize. Furthermore, the present study used the British young market visiting Dublin as a sample. Thus, the sample is considered a limitation, as a test of the application within a wider population could have resulted in a deeper understanding of the user experience. Not only the relatively young age of participants, but also the distribution of male and female participants is considered a limitation. Future research is recommended to explore gender-specific user experience constructs. In addition, the model was solely extended qualitatively and the results were not tested through a quantitative study making it again harder to generalize. It is therefore recommended for future research to conduct quantitative research to validate the proposed factors. Finally, it is suggested to conduct a similar study in different research settings including tourists from a wide array of age groups and nationalities to enhance the quality of the findings.

6. References

Alben, L. (1996). Quality of experience: Defining the criteria for effective interaction design. *Interactions, 3(3),* 11-15.

Anderson, N.H. (1981). *Foundation of Information Integration Theory.* Academic Press, New York.

Arhippainen, L., & Tähti, M. (2003). Empirical evaluation of user experience in two adaptive mobile application prototypes. *Proceedings of the 2nd International Conference on Mobile and Ubiquitous Multimedia,* 27-34.

Blythe, M., Hassenzahl, M., Law, E., & Vermeeren, A. (2007). An analysis framework for user experience (UX) studies: a green paper. *In E. Law, A. Vermeeren, M. Hassenzahl, & M. Blythe (Eds.), Towards a UX Manifesto-proceedings of a cost 294-affiliated workshop on BHCI,* 1-5.

Blythe, M., & Wright P (2005). From Usability to Enjoyment. In Blythe, M. et al. (Eds), *Funology – From Usability to Enjoyment*, Kluwer Academic Publishers, Dordrecht, 8-15.

Carmigniani, J., Borko, F., Anisetti, M., Ceravol, P, Damiani, E., & Ivkovic, M. (2011). Augmented reality technologies, systems and applications. *Multimedia Tools and Applications, 51(1),* 341-377.

Charland, A., & Leroux, B. (2011). Mobile application development: web vs. native. *Communications of the ACM*, *54*(5), 49-53.

Chitturi, R., Raghunathan, R., & Mahajan, V. (2008). Delight by design: the role of hedonic versus utilitarian benefits. *Journal of Marketing 72*, 48-63.

Chung, N., Han, H., & Joun, Y. (2015). Tourists' intention to visit a destination: The role of augmented reality (AR) application for a heritage site. *Computers in Human Behavior, 50*, 588-599.

Courage, C., Jain, J., & Rosenbaum, S. (2009). Best practices in longitudinal research. *Proceedings of the International Conference Extended Abstract on Human Factors in Computing Systems,* 4791-4794.

Curtis, B. (2012) *The Dublin Experience – Fostering a SMART City where Creativity & Innovation Thrive.* Dublin City [Online] [Retrieved on 20 January, 2016]

http://www.theinnovationgroup.it/wp- content/uploads/2012/05/Curtis_Dublin-City.pdf

David, F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*, 319-340.

Den Ouden, E., Yuan, L., Sonnemans, P. J. M., & Brombacher, A. C. (2006). Quality and reliability problems from a consumer's perspective: an increasing problem overlooked by businesses? *Quality and Reliability Engineering International, 22(7)*, 821-838.

Deng, L., Turner, D.E., Gehling, R., & Prince, B. (2010). User experience, satisfaction, and continual usage intention of IT. *European Journal of Information Systems, 19 (1),* 60-75.

Denzin, N.K., & Lincoln, Y.S. (2005). *The handbook of qualitative research*, 3rd ed., Sage, London.

Emaldi, M., Lázaro, J., Laiseca, X., & López-de-Ipiña, D. (2012). LinkedQR: Improving tourism experience through linked data and QR codes. In Bravo, J.. et al. (Eds), *Ubiquitous Computing and Ambient Intelligence*, Springer, Heidelberg, 371-378.

Failte Ireland (2014a). Destination Dublin: A Collective Strategy for Tourism Growth to 2020. Retrieved from media/WebsiteStructure/Documents/4_Corporate_Documents/Strategy_Operations_Plans/Dublin-a-Collective-Strategy-for-Tourism-Growth.pdf

Failte Ireland (2014b). New blueprint to grow tourism in Dublin launched. Retrieved from http://www.failteireland.ie/Utility/Media-Centre/New-blueprint-to-grow-tourism-in-Dublin-launched.aspx

Flick, U. (2014). *An Introduction to Qualitative Research,* 5th ed., Sage.

Forlizzi, J., & Battarbee, K. (2004). Understanding experience in interactive systems. *Proceedings of the DIS 04 Conference on Designing Interactive Systems: Processes, Practices, Methods and Techniques,* 261-268.

Forlizzi, J., & Ford, S. (2000). The building blocks of experience: an early framework for interaction designers. *Proceedings of Designing Interactive Systems,* 419-423.

Gafni, R. (2008). Framework for quality metrics in mobile-wireless information systems. *Interdisciplinary Journal of Information, Knowledge, and Management*, *3,* 23-38.

Garrett, J. (2006). Customer loyalty and the elements of user experience. *Design management review. 17(1),* 35-39.

Gordillo, A., Gallego, D., Barra, E., & Quemada, J. (2013). The city as a learning gamified platform. *Frontiers in Education Conference, 2013 IEEE*, 372-378.

Harrison, R., Flood, D., & Duce, D. (2013). Usability of mobile applications: literature review and rationale for a new usability model. *Journal of Interaction Science*, *1*(1), 1-16.

Hassenzahl, M. (2003). From usability to enjoyment. In Blythe, M. et al.(Eds), *Funology – From Usability to Enjoyment*, Kluwer Academic Publishers, Dordrecht, 32-42.

Hassenzahl, M. (2004). The interplay of beauty, goodness, and usability in interactive products. *Human-Computer Interaction, 19(4),* 319-349.

Hassenzahl, M. (2005). The thing and I: Understanding the relationship between user and product. In Blythe, M. et al.(Eds), *Funology – From Usability to Enjoyment*, Kluwer Academic Publishers, Dordrecht, 31-42.

Hassenzahl, M. (2010). Experience design: technology for all the right reasons. *In John M. Carroll (Ed.), Synthesis lectures on human-centered informatics.* Morgan & Claypool Publishers, San Rafael, CA, USA.

Hassenzahl, M., Kekez, R., & Burmester, M. (2002). The importance of a software's pragmatic quality depends on usage modes. Paper presented at 6th international conference on Work With Display Units.

Hassenzahl, M., & Tractinsky, N. (2006). User experience – a research agenda. *Behaviour & Information Technology 25(2),* 91-97.

Herskovic, V., Ochoa, S. F., Pino, J. A., & Neyem, H. A. (2011). The iceberg effect: Behind the user interface of mobile collaborative systems. *J. UCS*, *17*(2), 183-201.

Huang, Y., & Bian, L. (2009). A bayesian network and analytic hierarchy process based personalized recommendations for tourist attractions over the internet. *Expert Systems with Applications, 36(1),* 933-943.

Huang, H. M., Rauch, U., & Liaw, S. S. (2010). Investigating learners' attitudes toward virtual reality learning environments: based on a constructivist approach. *Computers & Education, 55(3),* 1171-1182.

ISO. (2010). ISO 9241-210. *Ergonomics of human system interaction-Part 210: Human-centred design for interactive systems (formerly known as 13407).* Switzerland: International Organization for Standardization (ISO).

Jordan, P.W. (2000). *Designing Pleasurable Products: An Introduction to New Human Factors.* Taylor & Francis, London.

Jung, T., Chung, N., & Leue, M. C. (2015). The determinants of recommendations to use augmented reality technologies: The case of a Korean theme park. *Tourism Management*, *49*, 75-86.

Jung, T., tom Dieck, M.C., Lee, H., & Chung, N. (2016). Effects of Virtual Reality and Augmented Reality on Visitor Experience on Museum. In Inversini, A. and Schegg, R. (Eds.). *Information and Communication Technologies in Tourism 2015*, Springer International Publishing, Heidelberg, 621-636.

Kaufmann, H., & Dünser, A. (2007). Summary of usability evaluations of an educational augmented reality application. *Virtual Reality*, 660-669.

Kim, J., & Han, S.H. (2008). A methodology for developing a usability index of consumer electronic products. *International Journal of Industrial Ergonomics 38(3-4),* 333-345.

Kounavis, C., Anna, D., Kasimati, E., Zamani, E., & Giaglis G.M. (2012). Enhancing the tourism experience through mobile augmented reality: Challenges and prospects. *International Journal of Engineering Business Management, 4(10),* 1-6.

Kuniavsky, M. (2007). User experience and HCI. *In A. Sears & J. A. Jacko (Eds.), The human-computer interaction handbook: Fundamentals, evolving technologies, and emerging applications* 2nd ed., Lawrence Erlbaum Associates, New York.

Law, E.L.-C. (2011). The measurability and predictability of user experience. *Proceedings of the EICS 2011,* 1-10.

Law, E., Chong, L., Roto, V., Hassenzahl, M., Vermeeren, A., & Kort, J. (2009). Understanding, scoping and defining user experience: a survey approach. Paper presented at the SIGCHI Conference on Human Factors in Computing Systems.

Law, E.L-C., & van Schaik, P. (2010). Modelling user experience – an agenda for research and practice. *Interacting with Computers 22(5),* 313-322.

Lee, H., Chung, N., & Jung, T. (2015). Examining the cultural differences in acceptance of mobile augmented reality: Comparison of South Korea and Ireland. In Tussyadiah, I. and Inversini, L. (Eds.), *Information and Communication Technologies in Tourism 2015*, Springer International Publishing, Heidelberg, 477-491.

Mahlke, S. (2005). An integrative model on web user experience. Paper presented at the IADIS International Conference WWW/Internet, 91-95.

Marcus, A. (2006). Cross-cultural user-experience design. *The International Symposium on Collaborative Technologies and Systems,* Las Vegas, NV.

Marimon, D., Sarasua, C., Carrasco, P., Álvarez, R., Montesa, J., Adamek, T., Romero, I., Ortega, M., & Gascó, P. (2010). MobiAR: tourist experiences through mobile augmented reality. *Telefonica Research and Development, Barcelona, Spain*.

McCarthy, J., & Wright, P. (2004). *Technology as Experience.* MIT Press.

McNamara, N., & Kirakowski, J. (2006). Functionality, usability, and user experience: Three areas of concern. *Interactions, 13(6),* 26-28.

Morrison, A., Mulloni, A., Lemmelä, S., Oulasvirta, A., Jacucci, G., Peltonen, P., Schmalstieg, D., & Regenbrecht, H. (2011). Collaborative use of mobile augmented reality with paper maps. *Computers & Graphics, 35(4),* 789-799.

Noh, Z., Shahrizal Sunar, M., & Pan, Z. (2009). A review on augmented reality for virtual heritage system. In Chang, M. et al. (eds), *Learning by Playing. Game-based Education System Design and Development*, Springer, Heidelberg, 50-61.

O'Sullivan, M. J., & Grigoras, D. (2013). User experience of mobile cloud applications-current state and future directions*.), 2013 IEEE 12th International Symposium on Parallel and Distributed Computing (ISPDC*), 85-92.

Olsson, T., Lagerstam, E., Kärkkäinen, T., & Väänänen-Vainio-Mattila, K. (2013). Expected user experience of mobile augmented reality services: a user study in the context of shopping centres. *Personal and ubiquitous computing, 17(2),* 287-304.

Olsson, T., & Salo, M. (2011). Online user survey on current mobile augmented reality applications. *Mixed and Augmented Reality (ISMAR), 2011,* 75-84.

Saunders, M. N., Seepersad, C. C., & Hölttä-Otto, K. (2011). The characteristics of innovative, mechanical products. *Journal of Mechanical Design, 133(2)*, 21009-1-21009-9.

Schinke, T., Henze, N., & Boll, S. (2010). Visualization of off-screen objects in mobile augmented reality. *Proceedings of the 12th international conference on Human computer interaction with mobile devices and services*, 313-316.

Sumadio, D. D., & Rambli, D. R. A. (2010). Preliminary evaluation on user acceptance of the augmented reality use for education. *Computer Engineering and Applications (ICCEA), 2010 Second International Conference* 2, 461-465.

Tayie, S. (2005). *Research Methods and Writing Research Proposals*, CAPSCU, Cairo.

Tom Dieck, M. C., & Jung, T. (2015). A theoretical model of mobile augmented reality acceptance in urban heritage tourism. *Current Issues in Tourism*, 1-21.

Tom Dieck, M. C., & Jung, T. (2016). Value of Augmented Reality to enhance the Visitor Experience: A Case study of Manchester Jewish Museum. *eReview of Tourism Research, 7*, 1-5.

Tscheu, F., & Buhalis, D. (2016). Augmented Reality at Cultural Heritage Sites. In Inversini, A. and Schegg, R. (Eds.). *Information and Communication Technologies in Tourism 2015*, Springer International Publishing, Heidelberg, 607- 619.

Van Krevelen, D.W.F., & Poelman, R. (2010). A survey of augmented reality technologies, applications and limitations. *International Journal of Virtual Reality, 9(2),* 1-20.

Vermeeren, A., Lai-Chong Law, E., Roto, V., Obrist, M., Hoonhaut, J., & Väänänen-Vainio-Mattila, K. (2010). User experience evaluation methods: current state and development needs. *Proceedings of the NordiCHI Conference.*

Yovcheva, Z., Buhalis, D., Gatzidis, C., & Corne, P. (2014). Empirical evaluation of smartphone augmented reality browsers in an urban tourism destination context. *International Journal of Mobile Human Computer Interaction,* 6(2), 10-31.

Zahidi, Z., Lim. Y., & Woods, P.C. (2014). Understanding the user experience (UX) factors that influence user satisfaction in digital culture heritage online collections for non-expert users. Paper presented at Science and Information Conference, London.