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**DESIGNING A GAMIFIED AUGMENTED
REALITY APPLICATION FOR TOURISTS
TO ENCOURAGE THEIR LOCAL FOOD
CONSUMPTION**

Faculty of Information Technology and
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ABSTRACT

Jeongeun Lee: Designing a Gamified Augmented Reality Application for Tourists to Encourage Their Local Food Consumption
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Local food has become a significant attraction of travel, and consuming local food involves sustainability by reducing the distance the food comes from the production. In other words, travelers provide benefits for destination and environment in addition to their pleasures and memories from local food consumption. However, local food is unfamiliar to travelers in the new place, and it is a challenge that requires much time and effort to choose and find the information.

In this sense, Augmented Reality (AR) and gamification can derive a possibility to support travelers to consume local food. AR can provide travelers with an easy way to acquire information by over-layering the virtual items on top of the real environment in one screen. Mobile Augmented Reality (MAR) operating on mobile devices has further advantages of mobility. Moreover, gamification can motivate travelers and increase their pleasure using game elements.

In this thesis, the benefits of MAR and gamification were explored through design and evaluation of a gamified MAR application prototype to encourage travelers' local food consumption. From the user study with observations, interviews and initial concept evaluation, tourists' needs were identified, and UX goals were defined as adventure, autonomy, and competence as to what experiences the application provides. The goals guided the design and evaluation of a gamified MAR application. The application recognizes the real food through an AR mobile screen and displays basic food information with name/ingredient and 'food miles' which refers to how far the main ingredients come from the distance. Besides, gamification was applied for the users' actions as collecting the food/ingredients and assigning levels according to how much local food a user consumed.

After two rounds of paper prototyping design and evaluation, the final interactive prototype was created in the prototyping tool, Torch, working on iOS-based iPhone (In this study, iPhone 7). A total of 10 participants tested the interactive prototype. The final evaluation of the interactive prototype indicated that users were highly motivated to consume local food using the application, although the long-term effect of the motivation is uncertain. The test users enjoyed the prototype due to the use of new AR technologies and gamified capabilities. Notably, users reacted positively from the experience of competence based on game elements and the experience of autonomy based on exploring various information in the user's context with easy interaction.

In this study, a variety of factors such as MAR, gamification, the specific context of food consumption in travel, and motivational purpose were brought together and showed the possibility of a gamified MAR application. In order to develop further after this research, considering the findings obtained from user studies, design and evaluation, it is expected that more advanced designs will boost more potential by adding feedback and interaction with personalization, social aspects, and multi-sensory feedback or interaction in the future. In addition, as AR technology is further developed, and more people are accustomed to the use of technology, the gamified MAR application could provide more useful and fruitful experience in the future.

Keywords: mobile augmented reality, gamification, food consumption, tourist, user experience design

The originality of this thesis has been checked using the Turnitin OriginalityCheck service.

PREFACE

While studying User Experience and Human Technology Interaction, I used to imagine how I might apply the technology or the way of interaction I learned to my daily life on my way home. It was a pleasure. Local food was one of the thoughts that I face every day. As a stranger and a traveler in Finland, I was curious about new foods in this place, and it was a day of joy when I get to know them. Fortunately, I was delighted to be able to pick and study this thesis topic from my curiosity and motivation.

I wanted to reflect the knowledge and methods I have learned as much as possible, even if it could be broad or challenging by putting many elements into my thesis. Nonetheless, my two supervisors, Dr. Kirsikka Kaipainen and Professor Kaisa Väänänen, supported me with this. They gave me new perspectives, allowed me to realize my missing pieces, and encouraged me to cope with difficulties with patience. I want to great thanks to both of them.

I am grateful to my friends and colleagues in school, Chathura Kotugodelle Yapa Mudi-yanselage and Aparajita Chowdhury, for helping me with the user testing and many words of encouragement for the last six months.

Finally, I deeply thank my husband, Youngho Chun, and my parents, for their unstinting support and love.

Tampere, 20 May 2018

Jeongeun Lee

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LIST OF SYMBOLS AND ABBREVIATIONS

3D	Three Dimensional
AR	Augmented Reality
IMI	Intrinsic Motivation Inventory
iOS	iPhone Operating System
IT	Information Technology
MAR	Mobile Augmented Reality
SD	Standard Deviation
UX	User Experience
XR	Mixed Reality

1. INTRODUCTION

This thesis aims to explore how tourists can be supported and motivated to consume local food while traveling with a Mobile Augmented Reality (MAR) technology and gamification. The study is conducted in the iterative design process with three phases, which are a user study, paper prototyping, and interactive prototyping.

1.1 Background and Motivation

Food is one of the crucial parts in travel experience beyond merely providing energy to the body. Even though it varies depending on the background of the traveler and the destination, a study shows that food consumption is spent up to 35% of travel expenses (Hall & Sharples, 2003). In Finland, food and beverage accounted for 21% of tourism consumption of money (Statistics Service Rudolf, 2018). Local food, especially, has become an attraction to many tourists due to unique, fresh ingredients and eating cultures (Björk & Kauppinen-Räsänen, 2014), and it also affects the environment. Consuming local food can reduce food miles for which food is transported from the provider to the consumer and, consequently, yields fewer carbon emissions. It also gives economic benefits and cultural opportunities to make reviving the crops, livestock, or unique food products that have existed historically in a culture. (Andersson, Mossberg, & Therkelsen, 2017)

As tourists become more interested in food in their travel destinations, a variety of digital products and services have also been developed to meet. Travelers are able to acquire food information and restaurants in the destination by searching the internet or using several applications on web or mobile. For example, Tripadvisor (<https://www.tripadvisor.com/>) provides a rate and reviews of restaurants in addition to basic information such as opening hours or menu. However, tourists still have limitations to get access to the food information in an unfamiliar. Even though they visit a good local restaurant while traveling, they know little about what the foods or ingredients are and where the food is coming from. They may ask the server about the food in the restaurant or search the food with several keywords by themselves, but it takes time and efforts. In this sense, advanced technologies could be beneficial. One such technology is Augmented Reality (AR).

AR refers to a type of mixed reality in which the real elements and the virtual ones are combined (Milgram and Kishino, 1994). In other words, AR shows certain digital information by overlaying on top of the real objects in the physical environment, which enhances the user experience by reducing the cost of user's action to get information and shortening the cognitive load without switching attentions (Angie & Therese, 2016). This aspect of AR seems to fit well into the specific context in this study that travelers consume their food at the place of travel. Furthermore, AR on a mobile device, called Mobile Augmented Reality (MAR), can be easily used by many people with their smartphones that are the most widespread devices nowadays. In particular, travelers need mobility for various travel activities, and MAR can fulfill them.

In addition to providing the necessary information to travelers with the technological assistance of MAR, another way is needed to encourage local food consumption, one of which is gamification. Gamification refers to a concept that improves the user experience and increases engagement by utilizing game design elements in other fields than the game. (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011). Although there has been controversy over the long-term and innovation

effects, gamification provide motivational benefits, and thus affects positively on a system or service. To utilize the benefits and lead a successful system, the context should be considered most critically. (Hamari, Koivisto, & Sarsa, 2014) In this respect, the study is in need of understanding of the users and its specific context in priority when designing the application to promote local food consumption.

Building on this background, the motivation of this study is to derive a possibility of a gamified MAR application, which is beneficial for users as to acquiring information and being motivated positively in their right context.

1.2 Research Objectives

The main objective of the thesis is to explore and design a Mobile Augmented Reality (MAR) application to have travelers obtain information easily and to encourage them to consume local food which has a positive effect on the environment and their experience. Towards this goal, gamification is applied for the application in terms of motivation.

The main questions that this study explores are:

Research question 1: What kind of gamified MAR application can support travelers to find information about local food?

Research question 2: Do travelers get motivated to consume local food when they use the gamified AR application?

1.3 Thesis Outline

This thesis consists of six chapters. Chapter 2 provides an overview of previous works regarding design considerations from three aspects. The contents of food consumption for tourists and related applications are discussed. Another aspect, gamification and motivation, is also reviewed with the design considerations. Lastly, Mobile Augmented Reality (MAR) is argued from the concept to applications and the user experience of MAR.

Chapter 3 illustrates the overall design process and methods for the design and evaluation in each phase of user studies, paper prototyping, and interactive prototyping. The initial concept development is also presented.

Chapter 4 presents user studies from observation to interview and initial concept evaluation. The analysis and results of the user studies are reported based on the data, and design implications are presented lastly in this section.

Chapter 5 describes user experience (UX) goals for designing the application based on the insights found in the previous user study. The design and evaluation of paper prototyping and interactive prototyping are described accordingly. The paper prototyping is explained through two iterations and design implications from them. The interactive prototyping is highlighted as the final prototype and the evaluation of the prototype in the quantitative and qualitative method.

In chapter 6, the main findings of the thesis are summarized. The research questions raised at the beginning of the thesis are answered, and discussions and limitations of this study, and future work are illustrated.

2. RELATED WORK

This chapter briefly examines previous work in three relevant fields; the domain of food consumption for tourists (2.1), gamification and motivation (2.2), and Mobile Augmented Reality (MAR) (2.3). In the end, the reviews are summarized, and the potential of a gamified AR is described. These reviews enhance understanding of the topic covered in this study and contributes to identifying primary design considerations for an application in each field.

2.1 Food Consumption for Tourists

Food consumption involves the process of exploring, choosing, and eating food. Defining local food and exploring relevant notions and type of travelers provide a deeper understanding of the theme and possible user groups Exploring related applications explains what experiences and needs exist and satisfy them and inspires further ideas.

2.1.1 Local Food and Types of Tourists

Local food is a valuable source of attractions in travel, which is valid for those who have a neutral attitude towards food as well as for the ones who have strong interests in food (Henderson, 2009). However, the term 'local food' has no universal or official definition but it could be defined in general as three different meanings: (1) geographical distances between production and consumption (miles or driving hours or political boundaries), (2) specialty or brand in relation to the region, (3) emotional or social characteristics (homegrown food by itself, friends, relatives, or neighbors) (Martinez et al., 2010; Dunne et al., 2011; Feldmann & Hamm, 2015).

In the field of tourism, local food may be differently conceived. Björk & Kauppinen-Räsänen (2016) used the word 'local food' as the food that is served at a certain destination or food that is prepared from local ingredients, while 'local food market' refers to a broader concept of food, including culture, specialties, and local food that is served and consumed in the place (Björk & Kauppinen-Räsänen, 2016). Considering the purpose of this thesis and all the definitions above, the meaning of *local food* in this study can be specified as the *local geological ingredients or the cooked food from them or processed food products from them in the destination*. The rest of wider food notions will be covered as 'local food market'.

In this sense, local food implies a short distance of 'food miles' which is a length of transportation from producer to consumer. Paxton (1994) raised the question of the increasing food miles for the first time using several examples of foods that have long food miles in the UK, such as apples or oranges. The author also illustrated subsequent issues such as environment, health, and animal welfare. (Paxton, 1994) Thereafter, to calculate food miles related to carbon dioxide emissions, more sophisticated methods (e.g., transportation costs, energy efficiency, economic/social externalities, etc.) have been devised (Passel, 2013; Schnell, 2013), rather than simple distances from production to consumption. Despite the detailed calculation of the food miles, local food consumption in tourism cuts food miles and provides environmental benefits (Andersson et al., 2017).

On the other hand, several types of travelers were identified in two studies. First, Hjalager & Johansen (2013) identified the four ways as tourists perceive local food: *existential, experimental, diversionary, and recreational*. The existential tourists would like to improve their knowledge of food, so they tend to eat local food that local people consume. The experimental food tourists go for popular food or restaurant at the time of travel, whereas the recreational tourists do not value

for the trendy or local food and the diversionary tourists prefer familiar food and the abundance such as the food of widely famous franchise. (Hjalager & Johansen, 2013)

Another study of Björk & Kauppinen-Räsänen (2016) surveyed 158 respondents in MATKA fair in Finland about their thoughts and behavior towards food/local food in their tour. Based on the survey, they classified travelers into three types depending on their food attitude: (Björk & Kauppinen-Räsänen, 2016)

1. *Experiencers* who travel to gain food experiences,
2. *Enjoyers* who have a positive attitude for food, and
3. *Survivors* who are not or little interested in food.

For these three types of travelers, they analyzed further answers as to information sourcing and elements that influence the local food experience. It turns out that all kinds of travelers use internet channel rather than others like radio, TV commercial, newspaper, although there is a difference in how much they use that. Besides, the groups are all interested in the restaurant and local food, but experiencers pay more attention to originality, newness. (Björk & Kauppinen-Räsänen, 2016) Tourists were distinguished similarly, but the 'Experiencer' group of this study can include the groups of 'existential' and 'experimental' in the former study. The group 'Enjoyer' may correspond to 'diversionary', and the group 'Survivor' can be matched to 'recreational' in former study.

As these two studies implicate, diverse groups of travelers can be identified according to their attitude and motivation for food, which determines whether they are willing to find local food information and also affects the quality and quantity of finding information. Conversely, the way of providing information for food could be differentiated as groups or personalized as individuals.

2.1.2 Factors that Affect Tourist Food Consumption

A variety of factors affect travelers' food consumption. Randall & Sanjur (1981) present three main categories that arouse food consuming behavior to people based on previous researches: *the individual*, *the food*, and *the environment*. *The individual* relates to personal history or background, for example, socio-cultural, psychological, and physiological factors, while *the food* refers the food content itself that people sense such as flavor and scent, and *the environment* includes external contexts like social, economic, and physical things. (Randall & Sanjur, 1981)

Kim, Eves, & Scarles (2009) proposed a model of food consumption in a travel destination. The authors inductively found the factors that influence local food and beverage consumption in travel, using both literature reviews and empirical interview approach. As shown in Figure 1 below, three major categories are suggested as *demographic factors*, *psychological factors*, and *motivational factors*. To be specific, demographic factors contain gender, age, background, whereas psychological factors consist of food neophilia and neophobia from a personality concerning trial to new foods. The motivational factors include several elements in detail: exciting experience, escape from routine, health concern, learning knowledge, authentic experience, togetherness, prestige, sensory appeal, and physical environment.

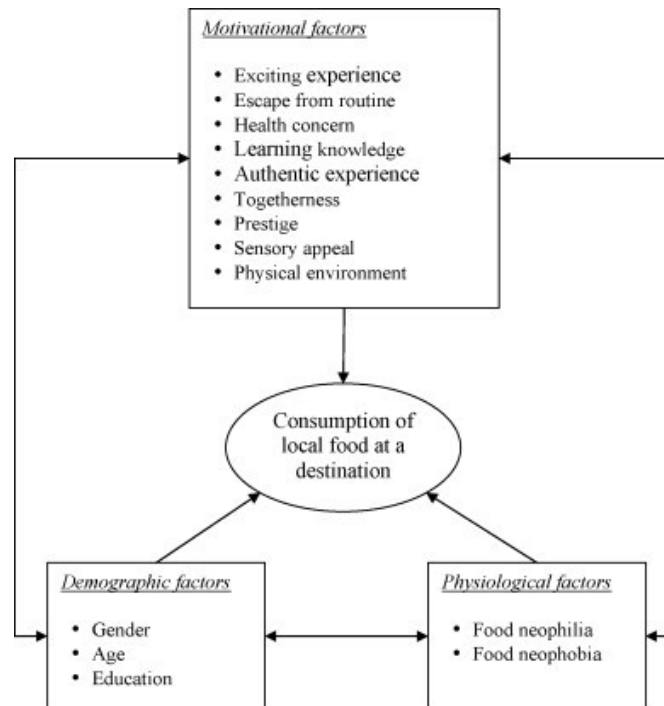


Figure 1. The built model of local food consumption (Kim et al., 2009, p.429)

On the other hand, Mak et al. (2011) identified the five influential factors more specifically under the ‘the individual’ category as shown in Figure 1 which is based on a theoretical framework of the previous study (Randall & Sanjur, 1981) by reviewing 33 tourism studies of food consumption and sociological research. The elements are *cultural/religious influences, socio-demographic aspects, motivational factors, food-related personality traits, and exposure effect/past experience*. Culture and religion determine what tourists choose and consume depending on whether they can accept certain foods at a general level. Socio-demographic elements refer to the social, economic, and demographic state of a person such as age, gender, and education. Motivational aspects are variables that motivate tourists to choose and consume specific food in a destination, and if this motivation is strong, they even travel for food. Food-related personality traits are personal tendencies toward food consumption, for example, to be reluctant to eat a new food or to seek a variety of food. The exposure effect and past experience are causal elements that make differences in food selection and consumption from familiarity with food. For instance, higher exposure to particular foods by revisiting has an effect on favoring them. (Mak et al., 2011)

Since motivational aspects play a significant role in food consumption of tourists, the authors of the study also specified the tourists’ motivation into five traits: symbolic, obligatory, contrast, extension, and pleasure. Symbolic dimension indicates the desire to seek traditional status, authentic experience, and exploring the local food. Obligatory element relates to physical needs to keep their body healthy. The contrast element is another motivation to look for something new and breathtaking. The extension means an inclination to continue their daily lives with familiar tastes or behavior of food consumption. Lastly, the pleasure aspect refers to pursuing amusement through the food experience. (Mak et al., 2011)

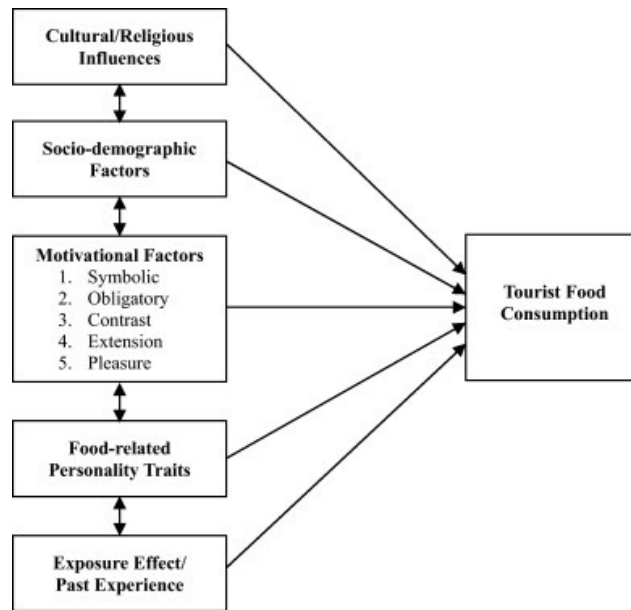


Figure 2. Factors influencing tourist food consumption. (Mak et al., 2011, p.934)

Overall, we can see that the motivational aspect was addressed as a critical factor that affects travelers' consumption. The concrete factors can be summarized in the reasonings as *personal*, *novel/diverse*, *familiar*, *locality-aware*, and *enjoyable* experience elements from the tourist's perspective which may provide clues that encourage tourists to consume local food. The personal element is attributed to any kinds of individual characteristics such as social/cultural background or preference such as healthy dietary. The novel/diverse element illustrates seeking new and diverse foods away from routine. The familiar element involves past experience and the degree of exposure to certain foods. The locality-aware element embodies trying authentic food, learning local food with cultures, or experiencing the physical environment in a meaningful way. The enjoyable element includes sensual or emotional pleasure from a unique food itself or relationship with others regarding food.

Both the novel/diverse and the familiar elements seem to be very incompatible with each other, but in reality, we seem to think and balance any choice or consumption of food between them to some extent during the trip. Besides, the types of travelers mentioned in the previous section may be distinguished by how much they are influenced by these two elements differently.

2.1.3 Applications for Food Consumption

As digital technologies are transforming the whole of our lives, many digital devices and applications are becoming necessities in tourism. Travelers may utilize these to search for food information before they choose food, to record their experience during consuming, and to enjoy memorable events or share with others after consumption. A wide variety of digital applications for tourists' food consumption have been studied and released in the market as the following examples shows.

An empirical study of Chamberlain & Griffiths (2013) presents a multimedia platform called Tastebook, a system where local people and travelers co-create food-related content and share it in digital forms such as pictures, videos, and maps. For instance, Figure 3 shows a page of such a digital book, representing local food information in text, photographs, videos, and map. Notably, in the live map, markers can be pinned for local restaurants, markets where the local ingredient can be found, etc., and the other users can find out more detailed information by clicking each marker. In this way, travelers are able to understand and experience the local food in the destination. In addition, the user groups include local food producer and farmers in this system to combine their fruitful knowledge of local food, culture, places. (Chamberlain & Griffiths, 2013)

In this regard, this study focused on satisfying the users who want to know and use the genuine local food information, which could be linked to the experience 'locality-aware' outlined in the previous section 2.1.2.

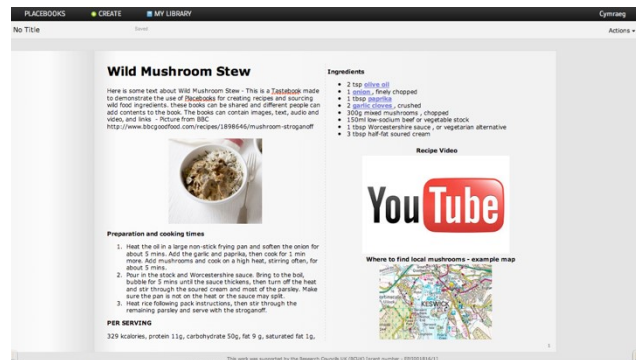


Figure 3. Example screen from a food book in Tastebook application (Chamberlain & Griffiths, 2013, p.58)

Another study, a mobile application prototype, FlavourCrusader, was introduced by Young & Hagen (2014) to encourage people to consume fresh local food towards final goals to curtail carbon emissions, boost local community, and facilitate health. At the beginning of the study, six motivations were drawn from five in-depth interviews: connecting with food producers, supporting the local economy, improved taste and quality, health benefits, sustainability, and distrust of mainstream retailers and certification schemes. Based on the findings, the prototype of a mobile app was created to provide information about locally produced seasonal food. A list of seasonal food items was displayed in the main screen, and related story or recipes using the ingredients were added to another tab of the screen reflecting the result of a user testing in the iterative process of the prototype development. The test revealed that the food information itself is inadequate to motivate the users and bring them into action. (Young & Hagen, 2014) The result of this study suggests that the user's context needs to be considered, and the food information should be integrated with other relevant information in the context. Moreover, we can see that this study also has 'locality-aware' experience elements by focusing on seasonal information, although the users were general people rather than travelers alone.

As an example from the sustainable aspect, Bonanni (2011) developed an open source system, SourceMap, (now commercial web service) that shows the supply chain of a product on a map for sustainable decision-making. In the early stage of the development, the author opened the system for free, allowing users to register it freely, in which a third of the maps were created for various food-related ideas. According to the author, this suggests that many people are interested in the sources of food from different aspects such as culture, environment, or health. For example, the supply chains were displayed on a map, which enables users to figure out the shipping distances and to make a better decision in terms of sustainability and business. As we can see from left to right in Figure 4, the transporting distance was reduced by checking the supply chain using the system and determining to change the plant close to the breweries.

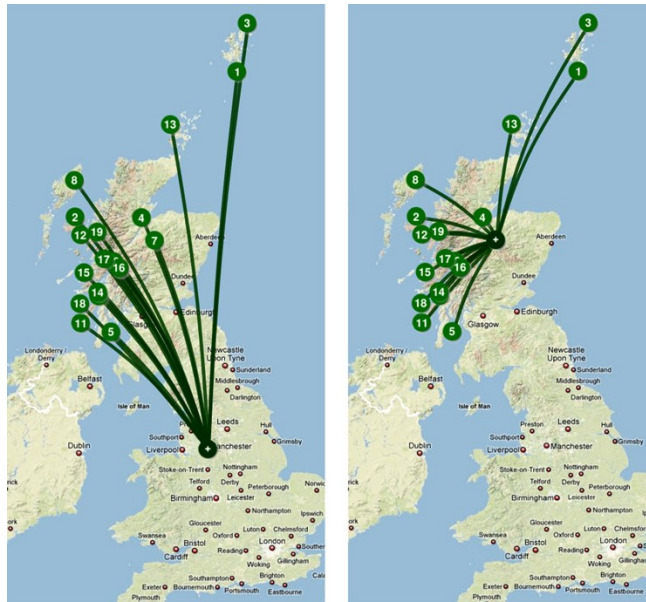


Figure 4. Sharing supply chains on map for sustainable decision: breweries shipment with old plant (left); a new plant (right) (Bonanni, 2011, p.24)

In addition to the applications in the research area, various applications on the market are already involved in local food consumption while traveling. Airbnb (<https://www.airbnb.com/>) provides a local food trip or cooking class in 'Experience' feature from a humanistic approach. The application connects travelers with the specific program by local people, which is to meet the tourists' desire for the authentic local food experience such as food history and cultures as well as the food tastes itself. This point covers 'locality-aware', 'novel/diverse', and 'enjoyable' experience elements identified in the previous section. Recently, AR application Kabaq (<http://www.kabaq.io/>) offers a virtual 3D food menu or advertisement on the table in a restaurant using smartphones and tablet devices, as shown in Figure 5. Users can browse the menu list in 3D and 360 degrees, and menus such as catering can be ordered in advance after checking actual height and size simulated by the application (Kabaq, n.d.). This application may arouse a joyful experience in addition to supporting information, which is related to 'enjoyable' and 'novel/diverse' experience elements found in the previous section.

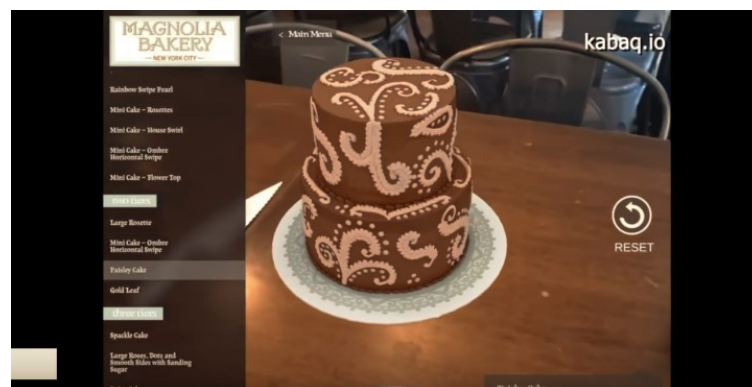


Figure 5. Example screen of Kabaq Application (<http://www.kabaq.io/>)

In sum, many applications are combining with several motivations, or new technologies, not merely providing static information of the destination. In particular, if we apply the motivational-centric experience elements summarized in the previous section to those applications from studies and markets, we can find the elements 'locality-aware', 'enjoyable' and 'novel/diverse' noticeable. In contrast, 'personal' or 'familiar' parts are less illuminated.

2.2 Gamification for Motivation

Gamification is a method to promote motivation positively with a certain intention, and motivation is moving to do something according to Ryan & Deci (2000a). This section outlines what gamification and motivation are, how gamification works to promote motivation, how to design gamification for motivation, and what kind of gamified applications exist.

2.2.1 Gamification and Motivation

Gamification is a way of using game-like elements in any areas other than game to boost user experience and user participation (Deterding et al., 2011). The general concept of gamification has evolved over recent years since game elements induce people to get attention and keep motivated and provide a possible solution regarding engagement and motivation (Walz & Deterding, 2015).

Motivating a person refers to his or her moving to do something. People have a different amount of (that is referred to as 'level') and different kinds of (that is referred to as 'orientation') motivation. Especially, orientation is critical since it gives a direct reason behind a goal or attitude to trigger one's action. In this sense, motivation is classified into two broad categories according to Self-Determination Theory (SDT): intrinsic and extrinsic motivation. Intrinsic motivation is doing something or acting in a certain way by being satisfied or enjoyed inherently, while extrinsic motivation refers to behaving by separated outcome(s). (Ryan & Deci, 2000a)

Since intrinsic motivation is much more powerful than extrinsic motivation and sustains the performance of the behavior, Ryan & Deci (2000b) studied intrinsic motivation and how extrinsic motivation can be internalized through a certain process. In terms of intrinsic motivation, it turns out that three psychological needs are involved: competence, autonomy, and relatedness. Besides, as Figure 6 presents, the specific steps towards intrinsic motivation are external regulation, introjection, identification, and integration. External regulation works by offering explicit external rewards that people desire, and introjection makes people behave partially autonomous in more individual level of reinforcement such as self-pride or shame. The next step of regulation is to identify the importance of their behavior towards their value, which means more internalized. Integration refers to a state that the behaviors are aligned with other characteristics of self. (Ryan & Deci, 2000b)

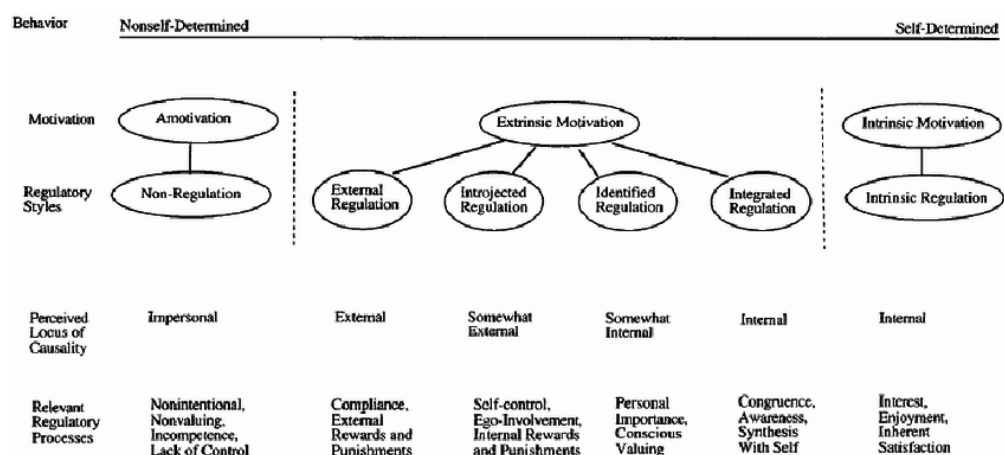


Figure 6. The self-determination continuum (Ryan & Deci, 2000b, p72)

Gamification can promote the internalization process of motivation by providing users with their intrinsic values with game elements. Hamari et al. (2014) elaborated further on the gamification concept through the three main parts, as Figure 7 illustrates: Motivational affordances, Psychological outcomes, and Behavioral outcomes.

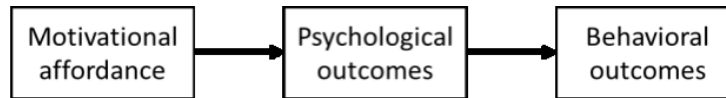


Figure 7. Conceptualization of gamification (Hamari et al., 2014, p.3026)

Motivational affordances are actionable attributes that actuate the way of holding up motivational needs, which means that if people perceive the attributes, they move towards the action to satisfy the needs (Zhang, 2008). The motivational affordances lead to the result of a particular psychological state and behavioral consequences at the end. In this sense, the following section explains how the gamification can be designed on motivational affordances.

2.2.2 Gamification Design for Motivation

Based on the theoretical background of gamification and motivation, how do we design gamification for motivation in a digital product or service? Zhang (2008) suggests design principles on motivational affordances. He argues that Information Communication and Technology (ICT) should have motivational affordances since users feel pleasure and want to use more often when ICT meets their motivational needs. Thus, ten principles were proposed, based on five sources and needs, as shown in Table 1. The contents of the principles are the same as that of the original one, but the examples were partially adapted in Table 1. The needs, cognitions, and emotions as internal motives are considered. Specifically, the source 'needs' has three aspects; physiological, psychological, and social among which physiological needs are excluded.

Table 1. Summary of design principles for motivational affordance. Adapted from Zhang (2008), p. 146.

Motivational Sources and Needs	Design Principles
Psychological Needs: <i>Autonomy and the Self</i>	Principle 1. Support autonomy. Principle 2. Promote creation and representation of self-identity. E.g. desktop skins, cell phone ring tones
Cognitions: <i>Competence and Achievement</i>	Principle 3. Design for optimal challenge. Principle 4. Provide timely and positive feedback. E.g. games and learning systems with various challenge levels and feedback
Social & Psychological Needs: <i>Relatedness</i>	Principle 5. Facilitate human-human interaction. Principle 6. Represent human social bond. E.g. group-based games (e.g. online bridge) with a chat section
Social & Psychological Needs: <i>Leadership and Followership</i>	Principle 7. Facilitate one's desire to influence others. Principle 8. Facilitate one's desire to be influenced by others. E.g. blogs (satisfy one's desire to influence by authoring, and to be influenced by reading)
Emotional: <i>Affect and emotion</i>	Principle 9. Induce intended emotions via initial exposure to ICT. Principle 10. Induce intended emotions via intensive interaction with ICT.

	E.g. slick/attractive look of iPod or cell phones, engaging games, ICT that induce optimal flow experience.
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Walz & Deterding (2015) discussed three psychological needs on gamification based on motivation theory of Ryan & Deci (2000b) described in the previous section 2.2.1. First of all, *competence* or mastery refers to the feeling of achievement or growth, and optimal challenging or accomplishment in gamification could work successfully. Second, *autonomy* is the feeling of free will, and free choices in gamification would affect positively whereas being controlled by other people, object, or environment in gamification would have a negative effect. In this point, some autonomous elements could be counterproductive, irrespective of the design intention, since the sense of autonomy is susceptible to the possible situations disturbed or controlled by any element. Third, *relatedness* is the psychological needs of feeling connected or supported by others. During game-like play, the non-human system may have the characteristics of relatedness to meet the needs of feelings similar to the user as a human. (Walz & Deterding, 2015)

On the other hand, Sailer, Hense, Mandl, & Klevers (2014) investigated how game elements contribute to motivation. Nine classical game elements were listed up based on the previous studies: Points, Badges, Leaderboards, Progress, Performance graphs, Quests, Meaningful stories, Avatars, Profile development. On the other side, the authors identified six primary perspectives about gamification: trait, behavioral learning, cognitive, self-determination, interest, and emotion. Finally, they linked each game element to the perspectives as it covered. The perspective, description and the connected game elements can be summarized, as shown in Table 2. (Sailer et al., 2014) Table 2 was drawn by the original texts of the paper.

Table 2. Summary of psychological perspectives on motivation through gamification. Adapted from Sailer et al. (2014), p.31-35.

Perspective	Description (sources that evoke motivation)	Game elements
Trait	Personal needs and motives such as achievement, power, affiliation	Badges, Leaderboards
Behavioral learning	Reinforcement from the previous experience; positive or negative	Points,
Cognitive	Results from logically analyzed purposes and means such as specific goals, expectancies, values	Badges, Progress and performance graphs, Quests
Self-determination	Social contextual condition of the psychological needs based on Self-Determination Theory (SDT); competence, autonomy, relatedness	Badges, Leaderboards, Meaningful stories, Avatar and profile development
Interest	The relationship between a person and content-oriented matters such as flow experience through a task	Points, Badges, Progress and performance graphs, Quests, Meaningful stories, Avatar and profile development
Emotion	Emotions influenced by strategies in cognitive and motivational process. For example, motivating by reducing negative feelings such as fear or by increasing positive feelings such as pleasure.	Meaningful stories

The game elements used in the study by Sailer et al. (2014) seem to somewhat specific, compared with the elements extracted as motivational affordances in the study of Hamari et al. (2014). They listed motivational affordances to embrace the other elements in the previous studies, which

leads a generalized concept and words such as 'clear goal' 'feedback', 'reward', 'challenge'. However, the study of Sailer et al. (2014) used 'Avatar', 'Quests', 'Performance graph' which sounds more specific but still sufficient to take account of the basic game elements.

To summarize the gamification design considerations of the three studies above (Zhang, 2008; Sailer et al., 2014; Walz & Deterding, 2015), all three studies presented the aspect of psychological needs (autonomy, competence, and relatedness) and gameful characteristics to meet them such as free options, challenging tasks, or social interactions. This point is also closely associated with this thesis that aims to motivate users' local food consumption. Moreover, two studies (Zhang, 2008; Sailer et al., 2014) described cognitive and emotional perspectives, suggesting that a user needs to take advantage of the game elements, for example, logical goals and feedback (cognitive) and positive emotional stories (emotional). Since the aspect of emotion greatly influences on the first feeling about a system, it is necessary to consider a design for raising the positive emotion of "pleasure" using gamification as mentioned above. The last research presented the other aspects of personal, behavioral learning, and interest. Personal traits, particularly, could be taken into account when designing gamification, as individual characteristics were found one of the elements that influence the food consumption in travel in previous section 2.1.2.

Regarding limitations or side-effects that hinders motivation, two of studies (Hamari et al., 2014; Walz & Deterding, 2015) mentioned that excessive external rewards might chip away internal motivation. To illustrate, in an experiment that used fMRI to track activities in the brain, using external rewards as money for a task increased the subject's motivation for a short time but later then revealed that their motivation decreased which is lower than the other subjects who did not get any external reward (Walz & Deterding, 2015). If we apply this adverse effect to the context of their local food consumption for travelers, for example, when users consume local food and receive rewards as attraction/food coupons, they may get motivated the first few times due to the explicit benefits, but the ongoing provision may rather dampen their interests, and the intrinsic motivation may be reduced. Specifically, if the content of the coupon reward is useless for travelers on their contextual situation, their motivations would be easily diminished. In this regard, external rewards should be weighed up carefully with the user's context, the content of the reward, and necessity.

2.2.3 Applications of Gamification

Gamification has been applied and tested in different fields such as education, healthcare, training, marketing, tourism, and sustainable systems to improve motivation and engagement. In the field of tourism and food consumption that is relevant to the content of this study, the following three examples are reviewed.

In tourism, travelers are increasingly looking for personal, exceptional memories through new technology development and gamification. TripAdvisor (<https://www.tripadvisor.com/>) has applied gamification to their website to expand users' immersive experience and engagement. They offer a personalized page and a social graph associated with Facebook, as illustrated in Figure 8. To be specific, reading and filtering travel contents provide users with autonomy, and interactions with friends on the website through Facebook allows them the feeling of relatedness. Besides, the scorecard feature enables users to compare activities and its outcomes with friends, which promote competence. Overall, the users are encouraged to learn new information, experience immersion, and so keep using the application by 'playing' activities and personalizing them, which is an integration process of internal and external motivation. (Sigala, 2015)

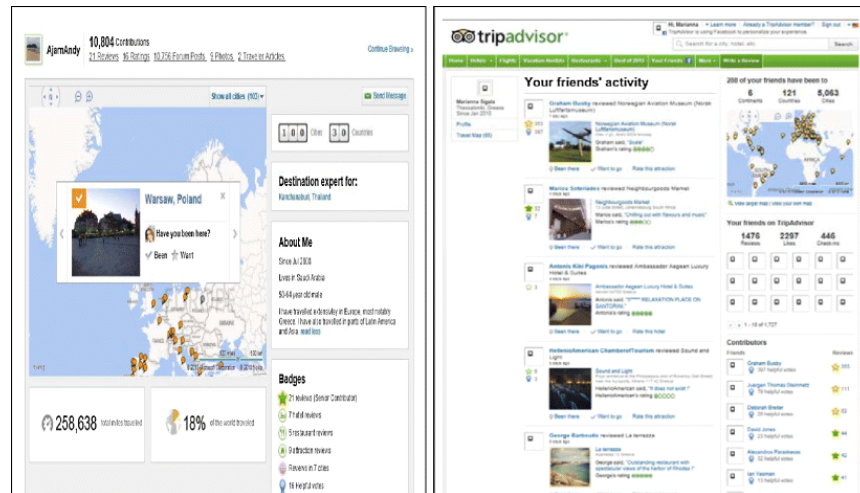


Figure 8. TripAdvisor's gamified application along with Facebook (Sigala, 2015, p.196)

Xu, Buhalis, & Weber (2017) mentioned Geocaching (<https://www.geocaching.com/play>) (Figure 9) as an example of gamification in tourism, which is a gaming application of hunting treasure in travel destinations. Using the location information of users in their mobile device, they can find the treasure containers on the map and discover it in the physical environment. Travelers can learn the destination by reading local information surrounding the treasure location such as architecture, history using the application. Besides, travelers can contact the owner of the treasure who has hidden it. This way users become engaged actively in the destination and maximize their adventure experience in the context of travel

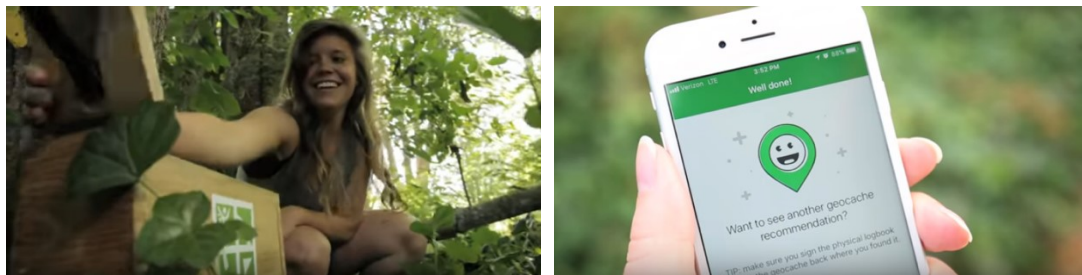


Figure 9. Geocaching application for travel experience (<https://www.geocaching.com/play>)

The final example is a study about 'FIT' game with a gamification approach to motivate students to consume fruits and vegetables at school and its evaluation. FITs are virtual heroes, and students had a primary goal to help the FITs to catch another virtual character called the villain. Three different ways of gamification were performed in three steps for six weeks in elementary school. In the first step, 'competition' element was applied in the way of competing with other schools and a medal was awarded as a reward if they consumed more fruits and vegetables than other schools and above the criteria. The next step used 'story' game element. Teachers read 3 minutes of stories, and after they achieved the goal of the particular food consumption, they were rewarded by reading the next story. Third, the students received one game currency unit by the gram when they exceeded the amounts of criteria, and the acquired currencies were shown on display in public place. They could use the virtual currencies to purchase necessary items as a reward in this step. The game element that applied for this would be 'external reward' and 'feedback'. The evaluation through survey showed that the consumption of fruit and vegetables increased by more than 30% each, and students enjoyed. (Jones, Madden, & Wengreen, 2014) This experimental study shows that the use of game elements such as reward, competition, story, and feedback could have a positive impact on the consumption of certain foods as expected. Moreover, the game elements cover the psychological aspects as autonomy, competence, and

relatedness, which are emphasized in the previous section 2.2.2 about the gamification design. However, there is a limit to accepting the positive effect over a longer time than six weeks with special regard to external rewards such as the medals and game currencies.

2.3 Mobile Augmented Reality

Augmented Reality (AR) and Mobile Augmented Reality (MAR) are becoming currently popular, and many of their applications have been developed to penetrate the lives of ordinary people as well as experts or researchers. This section reviews the concept of AR and MAR and illustrates the user experience of MAR, and explores different kinds of applications of MAR.

2.3.1 The Concept of AR and MAR

Briefly how AR and MAR have developed and why it is becoming important and popular is explained with the order in which the concepts appeared.

A brief history from MR to AR and MAR

The concept of Mixed Reality (MR) was firstly introduced by Milgram & Kishino (1994). The term MR refers to all realities in the form of a mixture of virtual and real elements between both extremes: the virtual reality that is surrounded by virtual elements and the real world that refers to the real objects and environments. Augmented Reality (AR) is known as a type of MR that refers to a middle form of environment between real objects and virtual elements on “virtuality continuum” as shown in Figure 10. (Milgram & Kishino, 1994)

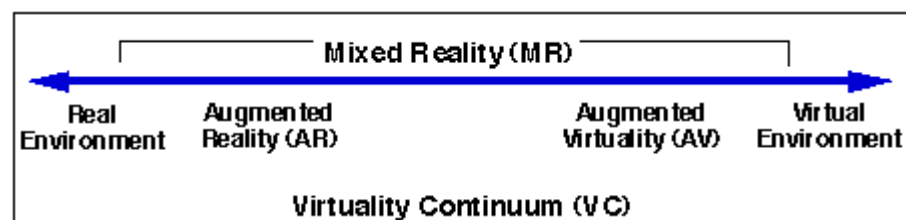


Figure 10. Representation of a virtuality continuum (Milgram & Kishino, 1994, p1323)

The first actual system of AR was invented by Ivan Sutherland as a head-mounted three-dimensional display with mechanical moving fixtures of the ceiling, as seen in Figure 11. The wearable display was to see virtual information created from the computer on top of the real environment (Sutherland, 1968).

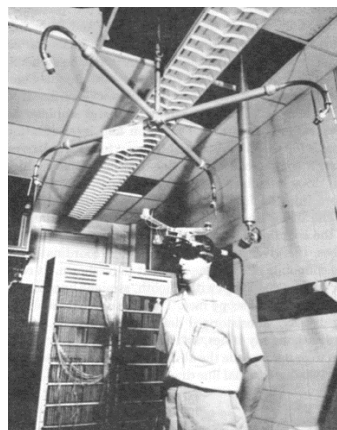


Figure 11. An original head mounted display by Sutherland (Ivan E. Sutherland, 1968, p.760)

Augmented Reality (MAR) has advanced for last decades, built on the general AR. The first mobile form of AR was introduced by Feiner, MacIntyre, Höllerer & Webster (1997), which was wearable touring machine prototype designed to guide campus visitors in Columbia University. The set of prototype devices has mobility and provides layered virtual information on the real images as shown in Figure 12. (Feiner et al., 1997)



Figure 12. Prototype campus information system. (a)(left) Wearable backpack, head-worn display, and a handheld display and its stylus. (b)(right) See-through view with the display that shows campus buildings names. (Feiner et al., 1997, p209-210)

As our real world has gone through a rapid transition with the technologies of computer graphics, tracking images, and networks, AR has also transformed, especially with new devices, that are called “mobile devices” nowadays such as smartphones or tablets. AR information can be placed on the real environment through a mobile screen. For example, Morrison et al. (2009) introduced a magic lens, called MapLens, which shows virtual information on the real paper map in an augmented way as presented Figure 13. (Morrison et al., 2009)



Figure 13. MapLens on a paper map (Morrison et al., 2009, p.1889)

Mobile Augmented Reality (MAR)

Unlike the general AR that is usually accompanied by bulky wearable devices on the physical body such as the head or the back, Mobile Augmented Reality (MAR) allows people to carry easily and displays the augmented information directly on the physical environment in the mobile devices. Olsson, Lagerstam, Kärkkäinen, & Väänänen -Vainio-Mattila (2013) framed the concept of Mobile Augmented Reality (MAR) as AR used on mobile devices within a mobile condition. Chatzopoulos et al. (2017) concluded four characteristics of MAR after reviewing the previous definitions; “MAR (1) combines real and virtual objects in a real environment, (2) is interactive in real time, (3) registers and aligns real and virtual objects with each other, and (4) runs and/or displays the augmented view on a mobile device”. (Chatzopoulos et al., 2017, p.6917)

Of the various types of mobile devices, mobile phones are currently the most capable of using AR functions. However, due to limited screen size and inconvenience of holding a mobile phone by hand while interacting with MAR applications on it, other types of devices are under development continuously, and a few of them are even coming into the market such as Google Glass, Microsoft Hololens. (Chatzopoulos et al., 2017) MAR market is even expected to reach 70 billion by 2023, according to Globe Newswire (2018). Many companies selling mobile devices keep also updating their AR platforms such as Google's ARCore or Apple's ARKit, to promote the design and development of MAR applications.

In this thesis, the scope limits to MAR, which presents augmented information specifically on mobile phones, since a majority of people use mobile phones on their daily basis, and the mobile phones are easy to carry in the context of traveling.

2.3.2 Applications of MAR

In the early development of AR, many studies had focused only on special fields such as education or medicine in which the users are professionals, and the content is very domain-specific. However, as AR technology has recently advanced, general consumers in public can get more access to commercial products and development tools (Kim, Billingham, Bruder, Duh, & Welch, 2018) Several MAR applications are reviewed in the domain of tourism and food consumption as follows.

Many applications have been proposed in the travel industry because the characteristics of tracking location and mobility fit well with contexts of unfamiliar places that require a lot of information, for instance, directions, restaurants, history, culture, etc. Miyashita et al. (2008) created an AR museum guide application in which an augmented character gives animated guidance in the purpose of specific experiences as "familiarity", "surprise", "wonder" towards visitors. The AR device plays the guide information automatically when the user is positioned in front of a piece of work. The evaluation of this application indicated that the users successfully enjoyed, as they aimed experience elements beforehand and designed along with the experience, considering the context of users' movement, which is beyond the usability-level evaluation. (Miyashita *et al.*, 2008)

Haugstvedt & Krogstie (2012) developed a MAR application that presents historically visualized information by timeline on a historical place, as shown in Figure 14. They found that two technological acceptance factors influence positively on users' intention whether they use the AR application; (1) perceived usefulness and (2) perceived enjoyment. It implicates that the two elements need to be improved as for the design and development of MAR application. (Haugstvedt & Krogstie, 2012)



Figure 14. AR view in the application of 'The Historical Tour Guide' (Haugstvedt & Krogstie, 2012, p250)

As an example of food consumption, ServAR (Figure 15) was introduced to assist users to gauge an accurate amount of food by using AR virtual information when they serve or consume a certain food. This way, the users can regulate their food consumption, which would positively affect their health. The study used comparison assessment between the groups who used the AR tool and the non-used group. The result indicated that the tool support users to achieve higher accuracy and consistency for their standard size. (Rollo, Bucher, Smith, & Collins, 2017)

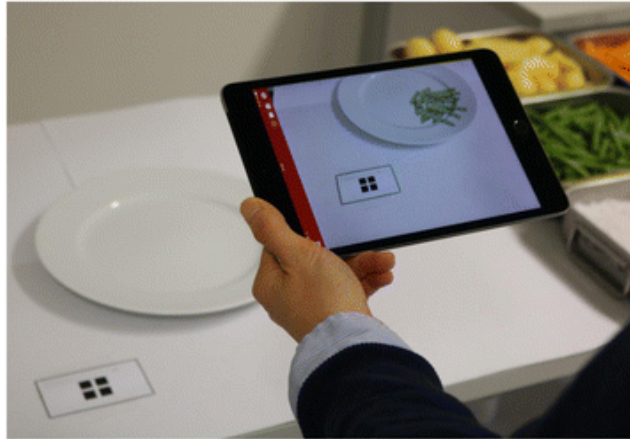


Figure 15. *The ServAR application (Rollo et al., 2017, p.3)*

From the commercial side, Google Translate (<https://translate.google.com/>) is a good example of a successful, informative application that allows people to read different language with the AR option without typing. The application displays signs or menus in immediately translated results through the AR camera view (Google, n.d.), which is highly beneficial for travelers to obtain information in travel destinations. Figure 16 shows the context of using Google Translate (<https://translate.google.com/>) for food by translating the food name and flavor Finnish to English.

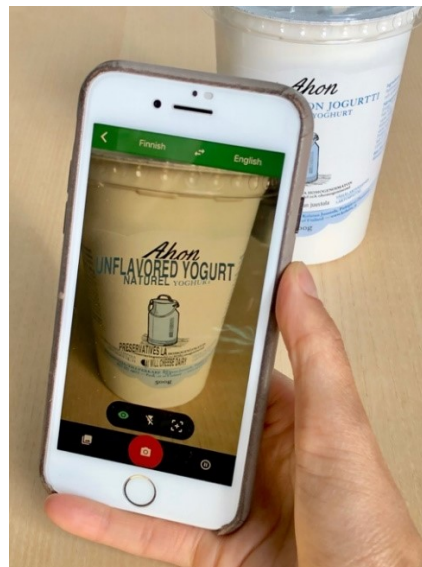


Figure 16. *The example context of use for food using Google Translate*

Overall, these applications have in common that they all focused on users and their context information, which is in line with the user experience of MAR. In addition, not only utilizing the internal information on the mobile such as GPS, tracking sensor, but also as the last example shows, when combined with other external sensors such as beacon, infrastructures' data in real-time, the potentials of MAR are promising in a positive way.

2.3.3 User Experience of MAR

User experience (UX) encompasses a variety of aspects related to the users and the context of a product or service in Information Technology (IT). Designing UX became crucial in the success of the product since it allows people to use the product easily and even positively enjoy that. However, the concept of UX has been less considered in the recent advanced technologies, but rather the functionality has only been focused. Notably, one of the technologies, mobile augmented reality (MAR), has a good market prospect for the near future, and it needs to be reckoned with the UX concept.

User Experience (UX) has emerged and evolved in line with the development of digital products. UX is defined as “user’s perceptions and responses that result from the use and/or anticipated use of a system, product or service” (ISO 9241 210:2010, 2.15, modified, 2018). In another way, Norman and Nielsen refer UX as the entire conditions where users interact with a product, service, or even company. The concept is broader than that of ISO. They also state two main goals of the UX; meeting the needs of the user without confusion and fulfilling a joy to own/use. (Norman & Nielsen, n.d.) Even though the two definitions of UX have a little different range, both resources emphasize the users’ point of view, not the provider side of view.

On the other hand, Hassenzahl & Tractinsky (2006) delineated UX more specifically as an outcome of the characteristics of a system created for a specific function or purpose, a user’s conditions such as needs, motivations, and their interactions in a context. (Hassenzahl & Tractinsky, 2006). As for the shared definition on UX field in practice and academics, Law, Roto, Vermeeren, Kort, and Hassenzahl (2008) conducted surveys in which most respondents in the survey agreed that UX has dynamic, subjective, and context-dependent factors (Law et al., 2008). This finding seems still valid, since the replication of the survey conducted after 17 years by Lallemand, Gronier, and Koenig (2015) and the result shows that user-related factors (e.g., needs, motivation, value) and context factors are significant as their respondents answered in the survey (Lallemand et al., 2015).

All in all, user experience highlights the characteristics of the users and their contexts with a system, product or service, and aims to satisfy their needs and joyfulness. Based on this notion, the following discusses how user experience can support MAR.

Angie & Therese (2016) argued that AR is helpful for user experience in three ways. First of all, AR reduces the cost of the user’s action to access information by showing the relevant data or figure in the real right place. Second, AR also decreases cognitive load without any effort to remember how to use or to find out the information. Lastly, users can access multi-combined information easily without switching attention. (Angie & Therese, 2016). Despite the many studies and practices regarding AR or MAR applications across different kinds of domains such as health, tourism, and games, there have been less in-depth studies of their user experience.

Dünser, Grasset, & Billinghamurst (2008) analyzed 161 previous AR studies since the first experiment on AR in 1995, and found three topics in general (Dünser et al., 2008):

1. *Performance and Interaction* refer to how users interact with both the reality and virtual contents, and especially how they control the digital elements. (62.5% of the studies)
2. *Perception* refers to how users understand the digital information on real objects differently and how to distinguish between real and virtual information. (29% of the investigated studies)
3. *Collaboration* refers to how users work together with an AR application, both online and offline. (8.5% of the studies)

As a result, ‘Collaboration’ was less considered as to the cases of using the AR system from multiple users. Nonetheless, to take into account the few findings of ‘collaboration’, the designers should define clearly their user group which could be a single person or several people, and how

they will use the application with each other. In particular, this can be done at an early stage in the design process to effectively develop the concept of the application and improve the user experience.

In addition, Olsson et al. (2013) focused on MAR closely. The authors studied what users expect from MAR and provided design requirements. They not only pointed out the importance of understanding users' expectations to establish a basic level for the overall service but also suggested design considerations about users' perceptions and behaviors in accordance with the expectations. The authors acknowledge that user experience in MAR could have a wide range of dimensions from the result of interview and survey they carried out. Furthermore, they found three design aspects as requirements; functionality, information content, and interaction, based on Hassenzahl's framework of user experience. For example, the sub-elements of the functionality are privacy and control, and reactivity, which means that MAR applications should perform safely without sharing any private data under the control of users and the information in AR view should be appropriately reactive with the physical environment. (Olsson et al., 2013)

On the other hand, Kourouthanassis, Boletsis, Bardaki, & Chasanidou (2015) also proposed five design implications to develop MAR applications, based on theoretical research and an empirical study about a travel application:

1. Utilize the context information for providing content
2. Give connectivity with the content
3. Take care of the privacy issues related to the content
4. Provide feedback about the objects and their moving in the real world
5. Help the process and memory of use.

They also applied these principles to examine several existing MAR applications. Among eight applications, 6 MAR of them did not satisfy the third and fourth principles. (Kourouthanassis et al., 2015) It means that the two aspects, especially, can be easily overlooked and the designer should take into consideration those. The privacy should be kept, and appropriate feedback should support users in using the application safely even when the mobile moves abruptly or unexpectedly.

To summarize all the UX fundamental concepts and the studies that deal with the UX of the MAR, the perspectives could be classified as *users, context, information content, interaction, performance*.

2.4 Summary and Potentials of a Gamified MAR

Local food is noteworthy in terms of sustainability of short food transport distances in addition to touristic attractions. The studies reviewed in Chapter 2.1 illustrate that not all travelers have the same motivation and attitude towards food consumption by which the travelers can be grouped differently, such as experiencer, enjoyer, and survivor. The experience elements for the reasoning of travelers' food consumption are identified as personal, novel/diverse, familiar, locality-aware, enjoyable. Apart from the personal element, the other elements are based on motivational aspects. Besides, the food information should be linked to the other information coherently on the user's context to have an actual impact on one's action.

Gamification promotes intrinsic motivation or internalization process from external to internal motivation, and it affects movement towards psychological and behavioral outcomes consequently. In this regard, psychological needs are the most critical factor for designing gamification, and the aspects of cognitive, emotional, and personal characteristics should also be considered. The reviewed example applications indicated that most of them were designed to meet the psychological needs, and cognitive aspects were also addressed, especially from the cases of travel

applications which seems to be associated with the satisfaction for the 'locality-aware' experience element mentioned above.

AR is a mixed reality in which physical environment/objects and virtual information are combined. MAR is a type of AR that is presented in mobile devices in a mobile condition. The scope of this study is confined to mobile phones specifically. MAR displays the superimposed virtual images directly on the real world, which results in relieving cognitive burdens, retaining their attention, and easier accessing to the information with less interaction. That is, user experience can be enhanced using MAR. Notably, MAR in the context of food consumption could add more value due to the highly mobile context in the travel destination. When designing a MAR application, the essential perspective – users, the context of use, information content, interaction, performance – should be taken into account. The connectivity to the content, the multi-user context, and the privacy are the detailed design implications.

Furthermore, the combination of AR and gamification might provide a more powerful experience and motivate travelers. Both AR and gamification have similarity in that they involve in the process of motivation and engagement for people to do a certain behavior in a positive way (Noor et al., 2015). Moreover, they tend to fit or extend to multiple aspects easily, such as other devices, sensors, and particular context. However, it is still at the beginning of the combined application with AR and gamification, particularly in design aspects.

The following summarizes **possible design implications of a gamified MAR from the perspectives of user experience in MAR** found from the literature review above.

Users:

1. *Personalization*: Personal traits and past experience can be reflected and adjusted to information content and/or game elements.
2. *Multiple users*: In the case of multiple users, the exact user groups need to be defined in the early stage of design.

Context:

3. *Context-awareness*: utilizing mobile sensors (e.g., GPS, camera, accelerometers) could provide meaningful contexts of use
4. *Emotional arousal*: emotional arousal may have a positive/negative effect depending on the users' situation. (e.g., game element of 'Stories')

Information content:

5. *Trust*: the source of information content should be assured (accurate and reliable)
6. *Cognition*: the logical goal or value can be planned along with the information content and gamified such as progress.

Interaction:

7. *Affordances*: clear affordances can make it easier to start interacting with familiar or universal metaphors.
8. *Physical safety*: the safety of users while interacting should be taken into consideration by the mobility of users and mobile devices.

Performance:

9. *Autonomy*: several free choices may grant users a feeling of autonomy, but it needs to care about AR context in which it may cause high cognitive load.
10. *Privacy*: the activity information should be announcing appropriately whether the information is stored or shared.

3. DESIGN PROCESS AND INITIAL CONCEPT

This chapter describes the design process on the whole and how the initial idea was developed.

3.1 Design Process

Figure 17 presents overall design process and methods of the design and evaluation. After initial concept was quickly developed based on the review of related work in food consumption and MAR, user studies were carried out using the methods of observation, interview and initial concept evaluation. Second, the paper prototyping was proceeded, reflecting on the results and UX goals derived from the user studies. Lastly, interactive prototyping was performed with more details based on the result of the paper prototyping. As a result, there were a total of three phases regarding the activities of design and evaluation. Each phase involves user evaluation.

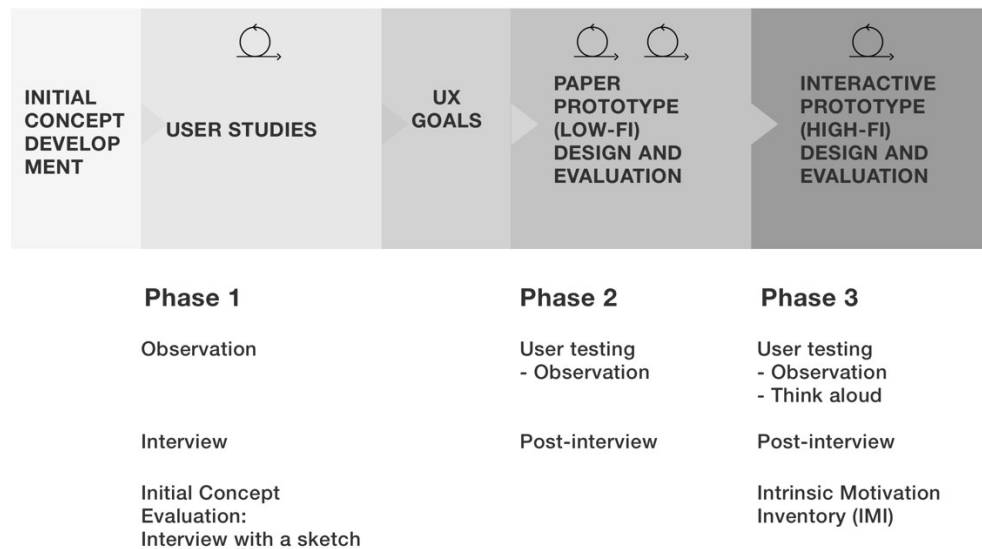


Figure 17. Design Process and Methods

3.2 Initial Concept Development

Before proceeding with user studies (phase 1), the initial concept was quickly ideated about a possible AR application concept to validate the possibility of MAR in a short time and gather feedback and ideas about further designs by sharing the concept of MAR exactly (how AR works in mobile). The initial concept was based on the related works in Chapter 2; sustainable food consumption theme and MAR technology.

First of all, sustainable content was applied since the purpose of the thesis is to motivate travelers to consume local food with sustainability. SourceMap was an inspiring example for that, which was an opensource web system created by Bonanni (2011) showing the supply chain of products on a map. An example was the supply chains of the local food ingredient. Users of the system can see the distances where the food ingredients are coming from. To be specific, the first user of the initial system was Robert Harris, a local food chef, who created source maps from his suppliers, as presented in Figure 17. (Bonanni, 2011)

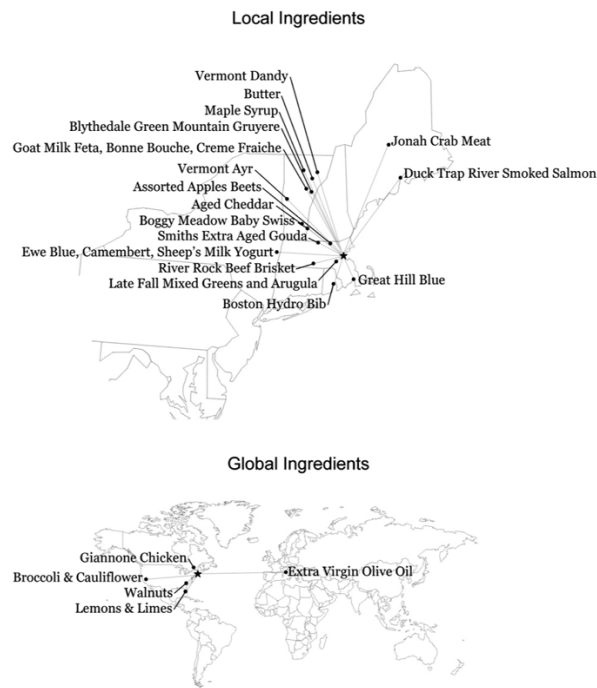


Figure 18. An example of SourceMap by local food chef Robert Harris (Bonanni, 2011, p.24)

From another aspect, to test the possibilities of MAR, the concept of the MAR needs to be communicated and understood by the users for the first phase of user studies to find out their needs. In this respect, the concept was shaped as a simple MAR application example inspired by the features of the applications investigated in the previous studies such as Kabaq (<http://www.kabaq.io/>) that shows a virtual 3D food menu application for a restaurant or catering service as Chapter 2.1.3 introduced.

Gamification is not covered in the initial concept at this point since the aim was to explain the possible MAR application at first to potential users and obtain the right feedback in the user studies.

Overall, the initial concept was floated as a possible idea to provide food information for tourists under consideration of sustainability with MAR, as illustrated in Figure 18.

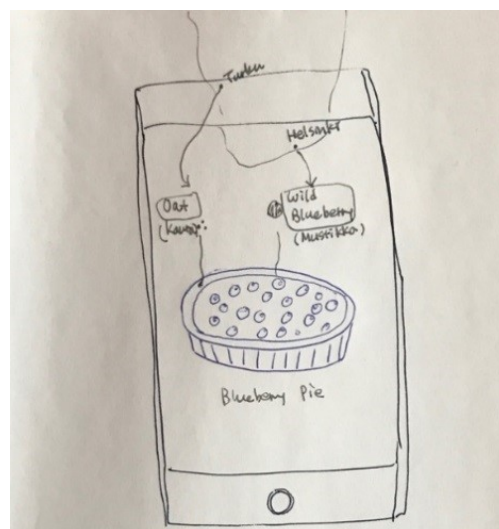


Figure 19. Initial Concept Sketch

In the sketch, the blue colored drawing presents the real image (that is the food, blueberry pie), and the black colored drawing refers to the virtual image (that is the information of the food). It depicts a scene that appears as an AR view on the mobile, and its major elements and interactions can be described in detail as follows.

1. *Information content*: The name of the food and the main ingredients are displayed on top of the actual food.
2. *Affordance*: The main ingredients are visualized by popping up from real food.
3. *Interaction*: When a user moves the mobile phone upwards stayed in AR state, it shows where the main ingredients come from on the map.

4. PHASE 1: USER STUDIES

This chapter illustrates the methods and results of the two user studies conducted in the first phase of the design process. The first study was observation, and the second study was interview, including the initial concept evaluation.

4.1 Objectives and Procedure

The objective of the user studies was to understand how travelers consume food in a travel destination and find out their needs with MAR application before designing. Under this objective, two user studies were conducted: (1) Observation, (2) Interview and Initial concept evaluation. First of all, the observation was carried out in natural food-related settings to understand how users consume their food naturally in travel destinations. Secondly, interview sessions were conducted separately from the observation, including in-depth interviews and initial concept evaluation at a time. Data collected through the observation and interviews were analyzed by the content analysis method. The initial concept evaluation, which was done in the interview session, was not included in the data. Instead the users' answers are separately organized for further improvement and ideation by grouping the answer notes. From the analysis and grouped notes, final themes and insights were attained. Figure 20 shows the overall procedure.

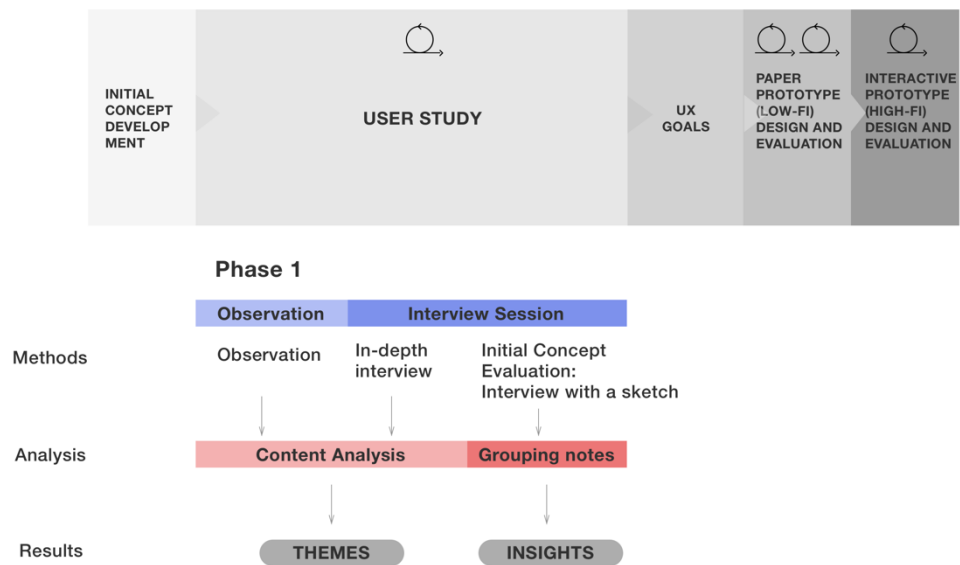


Figure 20. Procedure of user studies

4.2 Study 1: Observation

The observation was undertaken to discover the traveler's natural behavior or attitude towards their food consumption under a food-related environment. The observation was made from 17th to 29th December in the city of Tampere and Rovaniemi in Finland. In the five different sites, 17 groups were observed, and two intercept interviews were carried out.

As specific observation sites, five different places were chosen such as restaurants and markets where food can be consumed, and the rank is high in TripAdvisor and Google that is the most used web sources by travelers. One site, named 'Tampereen Joulutori', was chosen for

seasonal popularity for tourists, but the rest of four sites were all categorized by 'Local Cuisine' in TripAdvisor with top ranks and had the highest number of reviews in Google at the same time. Table 3 below shows the specified information on each of the five sites with pictures.

Table 3. Five observation sites

City	Name and picture of the site	Type	In/Out	Date
Tampere	Tampereen Kauppahall 	Market	Inside	17.Dec (Mon), 13:30-14:30
Tampere	Tampereen Joulutori 	Market	Outside	18.Dec (Tue), 15:30-16:30
Tampere	Plevna 	Restaurant	Inside	18.Dec (Tue), 17:00-19:00
Rovaniemi	Roka 	Restaurant	Inside	28.Dec (Fri), 12:00-13:30
Rovaniemi	Nili 	Restaurant	Inside	29.Dec (Sat), 19:00-21:00

The tourists were distinguished mainly by their language of use (other than Finnish) and by the appearance factors such as trunks, large backpacks. Once suitable people to observe were identified, their relevant actions or words (if they spoke English) were written down in the Notes app of the mobile phone. Besides, after the observation, a quick interceptor interview was attempted. By the times the people who had been observed were about to leave the restaurant or

market, this study topic was briefly introduced. They were asked about their thoughts and feelings of the food they just consumed. The short three questions are as below:

1. How did you choose the certain food or this restaurant?
2. How do you usually consume food while you are traveling?
3. How do you feel about local food in your travel?

Several intercept interviews were attempted but only two groups were interviewed. The answers were shortly written down as notes.

4.3 Study 2: Interview and Initial Concept Evaluation

The second user study consisted of in-depth interview and initial concept evaluation, which were conducted during one interview session. An interview session lasted for a total of 40-60 minutes during the period from 19. Jan. to 30. Jan, with the in-depth interview for 30-40 minutes and the initial concept evaluation for 10-20 minutes consecutively. The session took place in a cafe in Tampere university that had a comfortable atmosphere.

Recruitment and Participation

The participants were recruited by advertising this study to two community groups of Facebook, which are called 'Tampere foreigners (and not : D)' and 'Tampere | International Students 2019 | Erasmus and Exchange'. The posts to these two groups were intended to get participants as newcomers or travelers to Finland with a wide range of backgrounds which are beneficial to gather more realistic answers by reminding their recent experiences. They were all volunteers, not given rewards.

In total, 7 participants (3 males, 4 females) participated in the interview. Most of the participants were in their 20s, and only one participant was 50s. Their nationalities were varied with 1 Vietnam, 2 Malaysia, 1 Hong Kong, 1 China, 1 Sri Lanka, and 1 France (6 different nationalities). Table 4 presents how much the participants consume local food while traveling in this user study. The most participants were in the ones who try local food 'very high'.

Table 4. The frequency of consuming local food by participants in the second user study

How much do you try local food?	
Very little	0
Some	1
High	2
Very high	4

4.3.1 In-depth Interview

This in-depth interview aimed to gain a broad understanding of how travelers consume local food while they are traveling and eventually to identify their needs.

The interview process began with a greeting and a brief introduction of this study, purpose, and interview process to participants. The consent form (Appendix A) was given to them with the explanation of gathering background data, voice recording, anonymity, and processing of the data. After agreed on the consent form, the participants were asked to fill in the background form (Appendix B) about how often they travel, how much they try local food, and how they get food

information for travel with multiple choices, in addition to the general demographic background; age, nationality, and gender. The answers were utilized during the interview for the follow-up questions and consider user types later.

As the interview started, their voices were recorded. The participants were asked to tell their stories of a recent trip shortly as an introduction to recall the real situations of traveling and familiarize themselves with the topic. After reminded their previous travel experience, the participants were asked the questions prepared in advance and the follow-up questions based on the participants' answers. The interview questions were semi-structured, and the key questions were as follow:

1. *Overall*: What kind of activities do you do during food experience on your tour?
2. *Before travel*: How do you plan and choose foods for traveling?
3. *Before/During travel*: What do you need for your meal while traveling? How do you get information?
4. *During travel*: How do you perceive the local food and are you affected by local food when you go to travel?
5. *After travel*: What do you remember or what kind of food-related memories do you have after traveling?

During the interview, why questions were followed at times, and a few of the participants were hesitant or said 'it is obvious...' at the moment, so several examples were given. However, basically they were encouraged to answer by themselves. After completing all questions, the interviews were continued by the next part of the interview session that is initial concept evaluation.

4.3.2 Initial Concept Evaluation

After the in-depth interview above, the Initial concept was introduced to the participants with the rough sketch of the screen on paper, as shown in Figure 18 of the previous Chapter 3.2. First of all, the paper was handed over to the participants, and the context of use was explained with an example as "...*Suppose that local blueberry pie is on the table of a restaurant and you are exploring this food.*...". The participants were also guided to understand what the real images were and what the virtual images were in the sketch. At last, the scene of the screen and the meanings were explained, and the participants were asked whether they were fully understood. When they understood the concept and how it works, three questions were asked to them as below.

1. *First impression*: How do you think/feel about this idea?
2. *Usefulness*: Would it be helpful for your travel? And how would it be more helpful if you have additional or another idea?
3. *Free feedback and opinions*: Do you have any additional comments?

4.4 Analysis

Three different kinds of data were collected from the two user studies:

1. *Observation notes*: the written notes during observations in Study 1 (Chapter 4.2). (e.g., She looked at the menu texts under the restaurant signboard for about 5 minutes.)
2. *In-depth Interview notes*: the transcribed data obtained by recorded files of the in-depth interviews in Study 2 (Chapter 4.3.1). (e.g., "Sometimes, I suspect risk when you travel, and you do not know what you really do ..")

3. *Evaluation notes*: the transcribed data obtained by evaluation interviews about the initial concept in Study 2 (Chapter 4.3.2). (e.g., Maybe fun facts, trivia about food. Like how many people consume blueberry in Fin-land? ..funny stuff .. ")

Two methods were used to analyze those data. Content analysis methodology was chosen for two data (The above data 1,2,), and simple grouping notes was performed for the other data (The above data 3).

Content Analysis

The content analysis method is a bottom-up process of abstraction of the text data from low-level to high-level to explore a certain situation or human experience in a qualitative way. The analysis process is (1) dividing the raw data into a semantic unit sentence (s) (*meaning unit*), (2) shortening it to a more condensed form (*condensations*), (3) coding it into a label of a few words (*code*), (4) grouping such codes using content and contexts (*category*), and (5) finally abstracting them to derive the theme of the largest conclusion unit. (*theme*). (Erlingsson & Brysiewicz, 2017)

In total, 281 meaning units were gathered from 60 observation notes and 221 in-depth interview notes. As described above, through the five abstraction steps of content analysis, the result of 42 codes, 12 categories, and 3 themes was obtained. The final themes were identified as follows:

1. A desire to experience local food within the cultural context (Table 5)
2. Efforts to find out and to refine food information (Table 6)
3. Considerations to plan/choose the food in travel (Table 7)

Table 5-7 presents the short version of the content analysis each for Theme 1-3. The full set of the content analysis table can be seen in Appendix F.

Table 5. *The short version of the content analysis: Theme 1 (the condensations are representative examples)*

Theme 1: A desire to experience local food within the cultural context		
Condensation	Code	Categories
I try local food	Trying local food,	Trying new/local/good food
Local food is the most important		
I want to try the new food as many as possible	Trying new food	
I want to explore something new and I take a risk		
I try good restaurant	Trying good restaurant	
I want to know food-related story,	Wanting to know cultural	Extensive food experience
I go the local market to see their culture, I see culture differences from the food and how the food is served	background	
I want to know how to replicate the food at my home,	Wanting to know how to cook	
I want to know how to cook at home later		
I ask how to eat (sometimes)	Wanting to know how to eat	
I want to know ingredient information if the food is special,	Wanting to know ingredients	
I go food market to see their original, fresh ingredients nearby the local place		

I want to know where the food comes from, I am interested in how the food is produced ethically or organically.	Ethical/organic food production	
I want to try the original taste, I choose the unique, original food	Trying original taste	Focusing on taste
I am curious about the taste of the food, I talk about new and different tastes like spicy food	Curious for the taste	
I need the real information from local people. I rely more on them, I would like to the real local experience with the normal food for local people's daily lives	Need real information from local people	Genuine local condition
I take pictures of food to remember and use that for writing journal, They take pictures for the food and themselves together	Taking pictures	Memories
I try to remember the name of the food	Remember food name	

Table 6. The short version of the content analysis: Theme 2 (the condensations are representative examples)

Theme 2: Efforts to find out and to refine food information		
Condensation	Code	Categories
I ask food information to server quite often	Asking for food	Finding food information
It is easy to get food information through internet, I rely more on internet resources	Browsing for food on internet	
I gather information before eating out in travel, They use different kinds of information both online and offline	Gathering food information	
She gets detail information from the brochure and the server	Checking detail information	
I do comparison for food or restaurant	Comparing food/restaurant	
I think some application is touristic	Dislike touristic/advertising information	
I do not ask waiter but did research before.	Keeping notes before eating	
I cannot understand menu in their language when ordering food, I search the food if I don't understand the name of the food in the menu	Language barriers	
I search food by name if there is no picture, I search the name on Google if I cannot understand the menu	Searching for food	
The results from Google search is powerful to get food information I do not know	Searching information is useful	
They discuss each other to choose their food	Talking about food	
I don't like too many information on the web service	Too much information	
I use different application depending on context of use. (location: Google maps, reviews: TripAdvisor)	Utilize different applications	

I like the extensive reviews, I follow a majority of opinion for the food, I see other's reviews which is important to me	Need others' opinion	Others' opinion is of use
I ask recommendation to a server, I see the recommendation in the menu, I like recommendation and reviews	Need recommendation	
I observe what other people eat/order to know the main food there, She observed other people inside restaurant	Observing other people	

Table 7. The short version of the content analysis: Theme 3 (the condensations are representative examples)

Theme 3: Considerations to plan/choose the food in travel		
Condensation	Code	Categories
I see location of restaurants on map App, I choose the food by location (if hungry) I cannot take too expensive food	Finding location of restaurant on map Not taking high price	Choice Restrictions
Sometimes, it's difficult to find the preferred food I have some food preference and go for that, I try to avoid some types of food	Difficult to find my preferred food Particular food preference	Food preference
I think what I will eat on the day without planning in advance I am attracted by food smell, The weather affects my choice for food	Not planning for food Affected by instant senses	Instant choice
Simple or normal food is enough for me	Normal meal in travel	Normal food consumption
Picture is important to know and order what I will eat, I do not understand new food by reading I enjoy the food visually at first	Picture is important Enjoying food visually	Picture/Image merits
I share food with my friends and try different taste I share pictures through social platforms	Sharing food Sharing pictures	Social interaction
I get food information from the other travelers in the same hostel I get points and compete with friends with the points in the application	Social connection (offline) Social motivation	

Grouping Notes

Separately from the data of observation and in-depth interview, the evaluation notes were loosely grouped into rough semantic units, since the aim of the initial concept evaluation was to glean feedback and further ideas helpful for the next step to evaluate the early concept. For example, as an answer to seeking ideas, P2 participant mentioned, "Maybe fun facts, trivia about food. Like how many people consume blueberry in Finland? ..funny stuff" and P7 participant also commented as "if the food has special ingredient or rare ingredients and the application shows, then It would make me wow! 'wow, this ingredient is so rare and now I am eating it". These two data could be grouped with each other using the name of 'attractive food content'.

4.5 Results

Through the above analysis activities, two results were derived: three themes resulted from content analysis, and several insights gained through evaluation note grouping.

Themes

Three major themes were identified regarding tourists' food consumption as follows:

1. A desire to experience local food within the cultural context:
Consuming food in a travel destination tend to be regarded as part of food culture and understanding of the local area. Most participants seem to accept foods related to local history or culture meaningfully. However, not all participants outweighed the food while they were traveling, but other attractions influenced them as a priority.
2. Efforts to find out and refine food information:
The participants often find food information before food consumption or even plan specific restaurants or markets before choosing food. They obtain information from online such as Google, Trip Advisor, or friend suggestions. Especially, the information gained from the tourists' friends and local people they met seems to be considered as more reliable sources. Besides, the language was one of the most difficult parts of food consumption in the destination. They have asked the server of the restaurant to find information or have searched that through the internet on their mobile.
3. Individual considerations to plan/choose the food in travel:
The choice of final food or place often depends on their context, including weather, their current location, the smell on the street, or visual attraction. In addition, two participants mentioned the individual factors such as vegetarian and preference for a certain food ingredient have a significant impact on food consumption in their travel destinations.

Insights from Evaluation

Four meaningful insights were found for the initial concept and further ideas as follows:

1. Favorable attitude for the initial concept:
"I think this is great idea. I would use this app." (P4)
"I like it. I think that's actually very good idea. It's gonna bit hard but it's good. The trend right now is 'eat local and eat good food' so organic food and local food. And people are getting more and more conscious about it. And I think Your concept is really aware of the people are going for. it's trendy. it's good trend." (P5)
2. Personalization:
"Provide Suggestions to the restaurant that if you like other berries, then you can tell the restaurant that the user may prefer more this berries.." (P6)
"Maybe if you have historical data of the user, then you would know preference of the user and then you can recommend similar or taste for example? Sweet, Sour.." (P4)
3. Attractive food content - Stories, Specialty, Tracking:
"Maybe fun facts, trivia about food. Like how many people consume blueberry in Finland? ..funny stuff.." (P2)

“if the food has special ingredient or rare ingredients and the application shows, then It would make me wow! ‘wow, this ingredient is so rare and now I am eating it’ ” (P7)
“from origin country of the food... to the shipment, packaging. it takes so much energy. And as I know at least in Europe, every food is trackable” (P5)

4. Acquiring information in advance:

“Usually, as a tourist, I look at the menu before arrive. If I have app and put the camera on the menu and touch, highlight it and then immediately I go to Google and search what kind of ingredients, what looks like?” (P1)

4.6 Design Implications

Towards designing the application in the next phase, eight design considerations under the three themes induced above, user types, ideas were outlined as design implications.

Design Considerations under the Three Themes

Based on the results of the user studies, design considerations were produced as follows:

1. A desire to experience local food within the cultural context
 - a. Users need to get new and special memories for their travel and feel adventurous.
 - b. The design should take into account local cultural elements to attract and motivate users. (e.g., stories of origin, how to eat, ingredients, cooking)
 - c. Different user groups should be considered with different approaches by their personal interests in food and motivation.
2. Efforts to find out and to refine food information
 - a. Users need to get access information easily with their phone
 - b. The information should be found in their own language or English from the general to the details in order.
 - c. Users should be able to use social information such as feelings and evaluations from experienced other travelers or local people.
3. Considerations to plan/choose the food in travel
 - a. Personal user attributes should be considered. (e.g., location, price, taste preference, health concerns)
 - b. The design should be reactive with specific context such as weather, visiting places, instant interaction with other people, visual and olfactory attraction.

User Types

As another result, the user groups were identified from both the previous literature and the user studies. Björk & Kauppinen-Räsänen (2016) classified into three tourist types, which are ‘Experienter’, ‘Survivor’, and ‘Enjoyer’. However, based on the user studies, one more distinct user type was recognized, and named as ‘Advanced Experienter’. This type of users is characterized by a desire for a more extensive variety of foods such as the daily food consumed by very local people in addition to the outstanding cuisine in the destination. In this study, the goal, that is to provide information and motivate tourists for local food, is basically applicable to all user type, but survivor and enjoyer may need to be encouraged and be internalized to more intrinsic motivations.

All nine participants in the user studies were able to be mapped to the four sets of user types: 7 participants were from the in-depth interview(P1-7), and the rest two were from the short intercept interview of observation (B10, B15). As a result, five of the participants could be classified as ‘Experienter’, two as ‘Enjoyer’, and two as ‘Advanced experienter’.

Although it is a small sample, this distribution gives us a rough idea of the user base that needs more local food motivation.

1. *Advanced experienter*: the users who want to get a real food experience as normal local people live with - P2, P3
2. *Experienter*: the users who are trying popular food or restaurant in the destination. - P1, P4, P5, P6, B15
3. *Enjoyer*: the users who have a positive attitude for food but more value on the other parts of travel. - P7, B10
4. *Survivors*: the users who are not or less interested in the food during travel and tend to go for a franchise that is familiar with them.

Ideas

As all participants responded positively to the goal of promoting local food in the initial concept evaluation, the basic concept can be maintained, but the following three other ideas could be applied to the further design of the application to make the application more beneficial.

First, *personalized content* would be good to be added in the application. For instance, the history of the food information selected by a user will enable users to harness more meaningful information tailored based on the data accumulated later and be encouraged to consume more local food.

Secondly, *attractive food-related information* needs to be provided in addition to the essential food information itself. This point is consistent with the previously studied results in the empirical study of 'FlavourCrusader' in Chapter 2.1.3. For example, providing cultural/regional stories that interest users would stimulate their psychological motivation element 'locality-aware' as identified in Chapter 2.1.1, and foster the users to consume more local food besides supporting information acquisition.

Third, *showing the virtual food images on the food name in the text* will increase the range of use in the application and make the context richer, which is in the opposite way of the initial concept that displayed food names and ingredient names on top of the real.

5. PROTOTYPE DESIGN AND EVALUATION

This chapter describes how the UX goals were defined and how the prototypes were designed and evaluated through paper prototyping (phase 2) and interactive prototyping (phase 3).

5.1 Objectives and Procedure

Phase 2 and 3 in the design process aimed to develop a suitable mobile AR application with gamification, which upholds travelers to acquire food information and encourage them to consume local food. To begin with, UX goals were formed, based on both findings of the user study and literature review. Next, towards the UX goals, a paper prototype was created and evaluated, and the same process was performed iteratively. Lastly, an interactive prototype was finally produced and assessed, reflecting improvements identified the paper prototypes.

5.2 UX Goals

UX goals capture requirements for the design and provide a direction that designers would design and evaluate for an interactive system (Väättäjä, Savioja, Roto, Olsson, & Varsaluoma, 2015). The experience elements can guide what kind of product should be developed, especially in the early phase of design. Kaasinen et al. (2015) studied how the UX goals could be defined and found five different approaches: brand, theory, empathy, technology, and vision. This study applied three of them, as presented in Table 8. The approaches 'brand' and 'vision' were deemed unsuitable for applying in this study since 'brand' deals with the image of a company/product and 'vision' are mainly to rebuild a system in deep and long-term purpose.

Table 8. Experience elements along with three different UX goal approaches

Approach	Sources and extracted experience elements
Theory	Literature reviews of Motivation <ul style="list-style-type: none"> • <i>Activation</i>: feeling of stimulated by a new task and rewards (extrinsic motivation) • <i>Engagement</i>: feeling of related and commitment for a task (internalization towards intrinsic motivation) • <i>Self-determination</i>: feeling of free will to choose or do something (intrinsic motivation)
Empathy	User studies (interview, observation) <ul style="list-style-type: none"> • <i>Joy of new experience</i>: users desire to explore and adventure the new food experience in the destination • <i>Control in unfamiliar places</i>: users find information by themselves to experience new food positively under their control in a new environment. • <i>Personalized</i>: users want suggestions or recommendations which are relevant to their background and preferences.
Technology	Literature reviews of Mobile AR and user study (initial concept evaluation)

	<ul style="list-style-type: none"> • <i>Inspiration</i>: feeling of excited from new objects or ideas • <i>Increased perception</i>: advantages of awareness of objects in the real world and immediate response in the environment. • <i>Accomplishment</i>: feeling of smart and achievement by completing a task or goal easily and efficiently.
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Based on the nine experience elements from the approaches, three high-level UX goals are finally established, which are ‘Adventure’, ‘Autonomy’, and ‘Competence’ as shown in Figure 21.

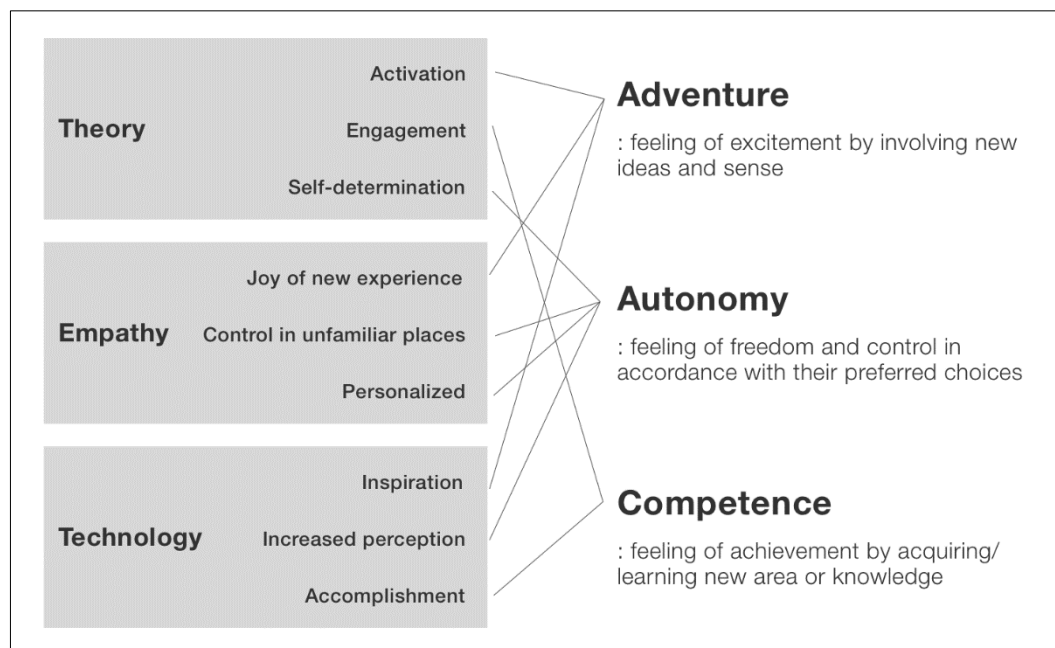


Figure 21. Final UX goals

These ultimate UX goals reflect the motivational theory, empathy from the users’ perspective, and the technological aspects of the AR, resulting in a bottom-up way, despite rather the general level of concepts. Thus, it would provide a guiding direction and basis in the following design and evaluation process of the possible application.

5.3 Phase 2: Paper Prototyping

Towards the defined UX goals, paper prototyping was quickly carried out before creating an interactive prototype working on mobile. The purpose of paper prototyping was to validate concepts and figure out major usability issues. This paper prototyping was done in four steps as Figure 22 presents: (1) First iteration: Design, (2) First iteration: Evaluation, (3) Second iteration: Design, (3) Second iteration: Evaluation.

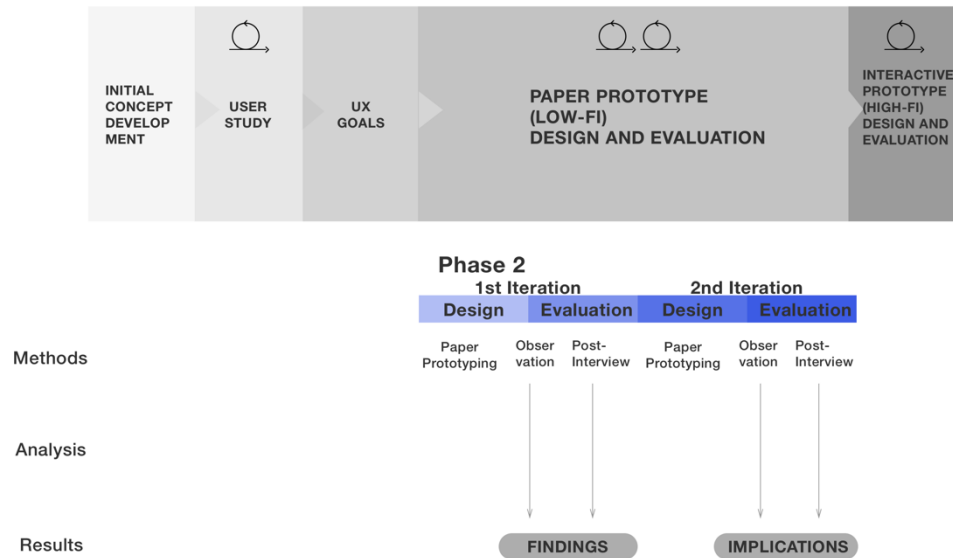


Figure 22. The procedure of paper prototyping (Phase 2)

The first paper prototype was quickly produced with rough key screens and tested. Iteratively, the second prototype was created by reflecting feedback from the first evaluation and tested by users as well. The first and second evaluations were done by observation while a user was interacting with the paper prototype and by interviewing him or her after the interaction. As a result, final implications were drawn based on the notes written during the user testing and the post-interview.

5.3.1 First Iteration: Design

Based on the UX goals and the design implications of the user studies illustrated above, the first paper prototype (Figure 23) was produced with paper and transparent plastic films. The AR view showed the real environment/objects behind the film and the pieces of papers attached to the film at the same time. When a user interacts with the virtual elements such as buttons, another paper piece(s) was attached to the film. The pieces of papers were sticky so they can be removed or attached easily.

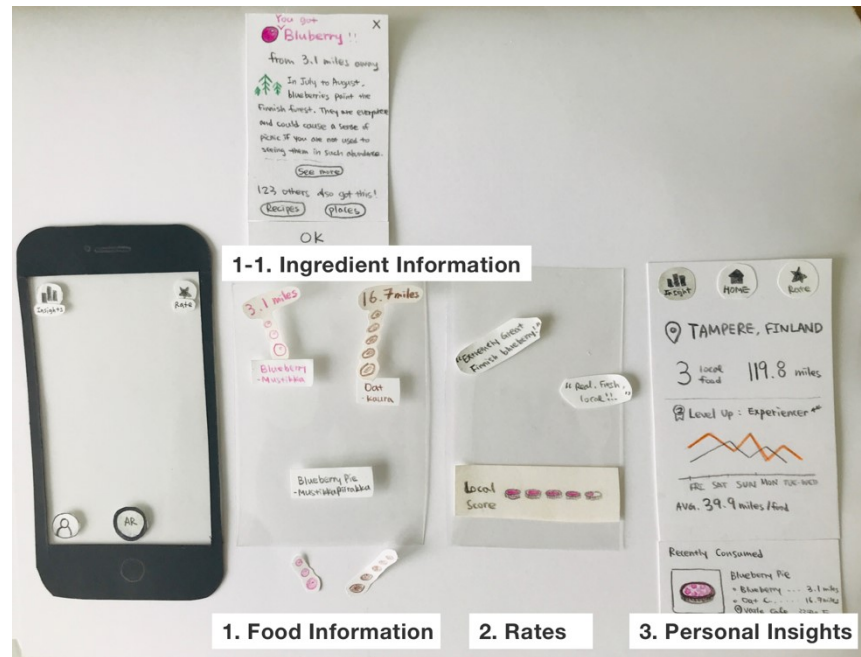


Figure 23. The first paper prototype screens

The UX goals and tasks with AR and gamification were drawn as presented in Table 9.

Table 9. UX goals and tasks with AR and gamification

UX goals	Tasks with AR	Tasks with gamification
Adventure	<ul style="list-style-type: none"> Exploring new local food information on top of the real food users want to know Exploring other traveler's opinions 	<ul style="list-style-type: none"> Collecting local food or food-relevant items Exploring new local foods with stories
Autonomy	<ul style="list-style-type: none"> Selecting one or several options of the food information Choosing extendable options related to the local food Controlling all the information under their control with easy navigation and interactions 	<ul style="list-style-type: none"> Getting positive feedback about selecting actions Controlling a user's status (e.g., profile or progress)
Competence	<ul style="list-style-type: none"> Obtaining new food information easily 	<ul style="list-style-type: none"> Competing for the amount of local food consumption with others or previous oneself (e.g. progress or personal graphs)

In order to support the tasks towards UX goals, three main features were outlined, and thus, three key screens were lightly designed. The followings are the main features and their descriptions.

1. Food information (AR view)

- Content: a user can immediately see the basic food information layered on the image of the real food on the AR view. The information includes food/ingredient name in original/English language. The number of distances where the food is coming from is also presented.

- Gamification: in addition to the names in text, the main ingredients float over the real food in a visualized form. The user can collect each ingredient by sliding the floating ingredient visuals and acquire detailed information about it.
- UX goals: the user can freely select the food he/she wants to know and get information through the AR view. (autonomy) Besides, the user can explore with new food (adventure) and feel achievement by acquiring the new local ingredient (competence).

1.1 Ingredient Information

- Content: the detailed ingredient information is presented.
- Gamification: the user gets feedback from the previous user interaction with the ingredient such as “you got the blueberry”(feedback) and interesting story(stories)
- UX goals: the user can freely choose another option here: ‘Recipes’ button or ‘Restaurant’ button or closing option. (autonomy), the user becomes aware of the new local information from the related story(adventure), the user can feel completion or stimulated by the social competition statement(“123 others also got this!” (competence)

2. Rates (AR view)

- Content: the user becomes aware of the local score of the food (how local it is) layered on the real food. The user can also explore the rates/comments of others, which is also floating on the real food on the AR view.
- UX goals: the user can explore various comments freely (autonomy) and may be excited by the new way of exploring the comments (adventure)

3. Personal Insights

- Content: the user can check personal records about their food consumption: location they are traveling; the number of local foods they consumed; accumulated distances of the main ingredients and its graph; and their food history they have consumed.
- Gamification: the user can check his/her performance graph in a cognitive way.
- UX goals: the user can feel achievement by checking his/her personal information with the outcome information he/she has done.

5.3.2 First Iteration: Evaluation

The first evaluation was to identify and improve the problems that users may experience while testing the paper prototype in terms of the test procedure and major usability issues and understanding the overall concept. The evaluation has done with the first paper prototype above during the period 11.Mar. - 15.Mar.

Participants

Three users participated in the first evaluation: two experts (colleagues in the UX field) and one general user as an international student at Tampere University. The two participants in the UX field were chosen due to the benefits of receiving more detailed and efficient feedback and ideas from their advanced knowledge and familiarity with AR and gamification.

Procedure

While a participant was interacting with the paper prototype, the author of this study took on the role of human-computer and facilitator at the same time. In the beginning, the application was introduced shortly with 2-3 sentences, and the context of use was explained to the test users. (e.g., “You are traveling in Tampere and would like to try the local blueberry pie in a café”) The participant was seated at the table where the real food was placed. Holding the mobile paper prototype, the participant started to interact with buttons and other visual elements made by paper. While the participant was testing the application, several observation notes about problems or possibilities were written, for example, “looks confused with the ingredient visuals” or “tapped

the 'recipes' button; interested?". After testing the paper prototype, post-interview was conducted about overall feeling/perception, interaction, information content, game elements, and free comments. The interview was semi-structured, and Table 10 are the questions in detail.

Table 10. Post-interview questions of the first paper prototype

Themes	Questions
Overall perception and feelings	<ul style="list-style-type: none"> • How did you feel about this application? • How easily could you understand the concept as a whole?
Interaction	<ul style="list-style-type: none"> • How did you enjoy the interaction in the first screen? • How easily could you interact? Did you have any difficulties to interact with the screens? – which part, why? • What aspects of interactions would you make better?
Information	<ul style="list-style-type: none"> • Do you think the information is useful? Or not? Why? • What kind of information did you like? /not like? Why? • What kind of information would it be more helpful?
Game elements	<ul style="list-style-type: none"> • Did you enjoy the game-like elements? Why? • How did you feel achievement? Or competence? Why? • How could you make it more exciting or attractive?

Findings

In summary, the overall concept was seen as easy to understand from the first evaluation, but some usability issues were found. The biggest issue was that the first paper prototype did not display the characteristics of the AR, which mixes reality and floating digital objects well together. The details are as follows.

Overall Understanding: As a result of the first evaluation, it turned out users were able to easily understand the overall concept and use the application as a whole through the observation and interview. For example, one participant mentioned in the interview, "*Most of the parts, I got it. Where to navigate and how to..*".

Test Procedure: Improvements have also been found in the way the user interacts with the paper prototype. Due to too small virtual floating objects and its limited moving within the mobile-size, it seemed that the user was not free to interact. It shows that there is a limitation of making a prototype in the form of sticking the paper on the film that represents the AR view.

Usability -Interaction: The main issue was 'slide' gesture to activate the food ingredients which means they can collect the local ingredient and see more detail information. All test users had difficulty in interacting with the visualized ingredient objects. Even though it might be due to the limitation of the paper prototyping, there should be a more effective way with another gesture such as 'tap'.

Usability -Perception: The position and the meaning of the menu to switch the other function screens were not clear to perceive the feature. Each menu was placed around the corner on the mobile screen, and the menus interfere with the main actions by overlapping each other in several times within the mobile screen. It also seemed to take time to recognize each menu when the menus are separately positioned easily. Another issue was that all test users were not familiar with the content of food distances with 'miles'. There were more trivial issues which are a somewhat unclear graph on insight screen, a little different perception for menu icons.

Ideas

As for new ideas or further improvements to make the application better, all the participants commented on more game elements such as progress, ladder board, or collection inventory so that they would become more attracted and motivated. One participant said, “*I would suggest rewards for user actions to keep users motivated*”. In addition, another participant gave an idea of ‘Story’. For example, the application may give descriptive feedback such as ‘It’s very Tampere-ish food’, ‘Actually, this is in any other places too’.

5.3.3 Second Iteration: Design

The second paper prototyping was accompanied by the user flow, followed by a representative context with more and specific screens. The context is a situation that the user is traveling in Tampere and would consume local Finnish blueberry pie. The user flow was planned in the process of using the application in this situation from the first screen that notifies the user’s current status before consuming a local food to the last screen that shows personal information with the current status after consuming the local food. The user flow includes seven user actions, and the screens were designed accordingly. Figure 24 presents the second paper prototype screens with the user flow.

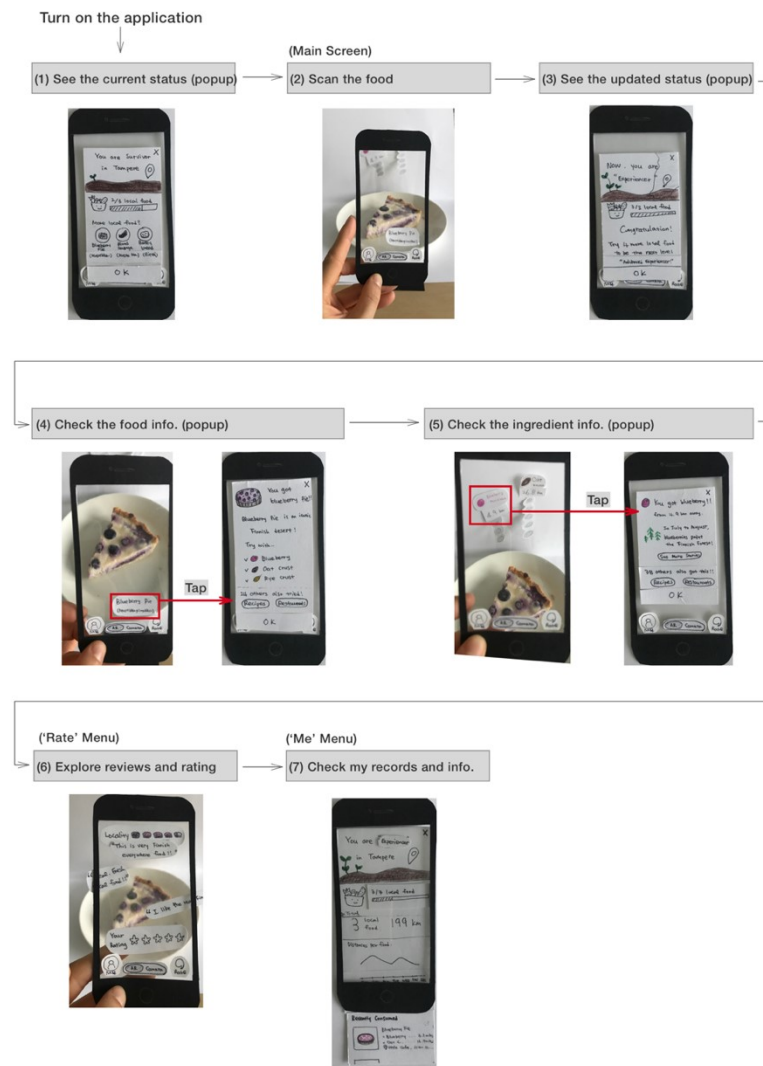


Figure 24. The second paper prototyping screens with user flow

In the second paper prototype, the key screens were evolved, and further screens between them were designed, reflecting the improvements and ideas from the results of the first evaluation:

1. *Simplified gesture*: Gesture 'slide' to activate the ingredients was changed to a simple 'tap' gesture. As the first test shows, difficult interactions can frustrate the user and not easy to do the action, and the gesture was changed to 'tap', which is easier and familiar with many of general users as travelers.
2. *Clarified buttons*: The user interface of menus are clarified. By positioning the menu buttons at the corner of each mobile screen only underneath, the buttons do not interfere AR view with other interaction or information acquisition. It also makes it easy for users to remember the same location to access to the menu.
3. *Enhanced gamification* (Figure 25)
 - 3.1 *Rewards*: Whenever users consume local food, they reap more rewards that visualize plant growth displayed in the destination area, which was with the intention to promote their intrinsic motivation.
 - 3.2 *Levels and progress*: To understand their progress and enhance their sense of accomplishment through the target level, level and progress were introduced. In addition to the number of levels, the names of the levels were designed, such as 'experimenter', which was to strengthen the competence, which is one of the UX goals.
 - 3.3 *Stories*: Instead of showing a user's location and numbers, the story-like description such as 'You are 'Experimenter' in Tampere' can enhance the experience of adventure, one of the UX goals, and arouse more positive emotions.

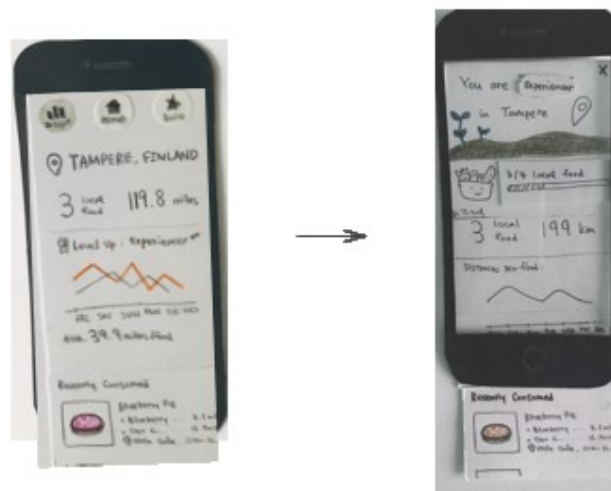


Figure 25. *Enhanced Gamification (left: the first paper prototype, right: the second paper prototype)*

5.3.4 Second Iteration: Evaluation

The second evaluation was to test how the user flow fits and how this application could motivate users along with the flow and specific design screens. The prototype was tested during the period of 16.Mar. - 23.Mar.

Participants

In total, five users participated in the evaluation sessions; two UX experts (colleagues in the UX field) who participated in the first test and three general new users who are international students in Tampere University. The two of the same participants were chosen to compare the re-designed second prototype and the first prototype to find out how well improved appropriately and

another new issues. However, in order to avoid additional distorted or biased data, the other three participants for general users were recruited as new persons who have never been tried this prototype before.

Procedure

The evaluation process was similar to the first test. While a participant was interacting with the second paper prototypes (Figure 26), the author of this study behaved as human-computer and facilitator at the same time. The role of the human-computer was to react as the application system (e.g., placing the new paper containing the next content when a user taps a button). Another role of the facilitator was to support the user test and draw the user's thought/feeling out (e.g., asking their thoughts such as *'What do you think?'* when a user asked, *'Should I try to see more stories here?'*).



Figure 26. User testing with the second paper prototype

About the user flow, the user was asked to do several tasks; getting more food/ingredient information, checking the detailed information, exploring reviews and rating, and checking your insight of food consumption. The user's behavior was observed mainly regarding how user reacts from the interaction or information content. In the meantime, some observation notes were written, and post-interview was performed after testing the prototype. The interview questions were almost the same as those of the first test (Table 8), but two questions were modified, and one question was added. The two questions were, *'Do you think the information is useful?'* (Information theme) and *'Did you enjoy the game-like elements?'* (Gamification theme). Now that the questions may induce an answer and distort the data about the user's real thought and feelings, those are modified as *'How do you think about the information provided?'* and *'What do you think about the gaming elements?'*. Besides, one motivation related question was added as *'Have you been more interested in local food after using this application?'*

Findings

Overall, all participants gained information and took actions easily by the flow, and they are interested in game elements.

Overall Understanding: In addition to the two users who already know the concept, the other new three participants were also able to understand the concept quickly and use the prototype easily. One participant mentioned, *"It was very clear. The concept is quite straight forward. The screens themselves and navigation between the screens..."* and another participant also said, *"It was a success. I think I'm good to manage this application very easy"* This seems to satisfy the autonomy of the UX goals successfully.

Gamification: Many participants mentioned game elements such as level or progress bar, and personal food consumption record information in 'insight' screen, and they feel motivated with those. A further improvement would be a level guide. The participants wanted to figure out their level position of the whole levels and actions to the next level.

Usability- interaction: The users were able to interact with the digital objects on the AR view by simply tapping those without any explanation or guide. Improvements to use as 'tap' gestures in the AR view were positive. One participant said, *"It was easy with concrete functions that are easily accessible, and all of them is intuitive. Navigate easily!"* and another participant also expressed as *"I have tried some AR applications, and I think it's very easy to interact"*

Usability- perception: Even if there seem to be no other major usability issues that hinder the concept of the application, two minor concerns are still identified. First, some of the users feel not easy to recognize what the number of distances means for the first time. It needs to improve the understanding of this information on the AR screen. The other one is the name of level 'survivor' to which the user belongs. This particular name could evoke a negative feeling, for example, 'in the sentence 'you are 'survivor' in Tampere'.

Social aspects: The users enjoyed the floating comment concepts, but two of them expected more social features that enable users to connect each other. One participant mentioned, *"I think maybe you can connect with friends somehow it would be more useful?"*. In addition, during the test of the rating screen for the others' comments, the other participant wanted to share and get recommendations from others, preferably the ones from the same country or close friends,

5.3.5 Results and Implications

The two iterations performed above shed light on the significant implications, before designing an interactive prototype of the application. To summarize, the evaluation results are described primarily in four parts: AR, gamification, personalization, and social relatedness as follows.

1. AR
 - a. The AR screen should present less information or visual elements (compared with the fully digital screen)
 - b. The flow of the AR application should be designed gradually, for example, allowing users to handle one piece of information or task at a time since the screen view is dynamic according to the movement of the hand holding the mobile.
 - c. The gestures on AR should be simple to understand and usable easily by the general user as travelers, especially when the user should interact with the virtual elements associated with the real image on the AR screen. From the first and second evaluation, 'slide' gesture was not acceptable to users, but a simple 'tap' gesture worked well.
2. Gamification
 - a. 'Story/Theme' using a specific context of use can encourage the user to become more involved in the application and its content. In the evaluation, users could get motivated by the story-like expression "You are experienter in Tampere" due to the feeling of engagement by experiencing the region and its local food gradually.
 - b. When using 'levels' for motivational affordances to the users, the designed level should be guided clearly to users. (their current level out of all levels, and actions

- to the next level) The evaluation showed all users were interested in the level concept but wanted to control the structure of the level and achieve them.
 - c. Wording for the level affects the user’s emotions. The naming should be taken into account carefully and chosen positively. (e.g. ‘survivor’)
 - d. Immediate feedback and potential rewards motivate users. In the evaluation, users are satisfied with the feedback that they got the food or ingredient as they selected after tapping the food or ingredient (e.g. "you got blueberry pie!").
3. Personalization
 - a. Personalized factors have a positive impact on user’s motivation in terms of autonomy, as the user feel control of themselves by checking their status in summary (e.g., such as their location, personal food consumption history or statistics)
 4. Social Relatedness
 - a. Social relatedness seems to be one of the vast motivations for users to do some action. In case that the other users are the ones who have the same background or context, the motivation might be stronger.

These implications were considered as further improvements for the next section.

5.4 Phase 3: Interactive Prototyping

Based on the results of paper prototyping, an interactive prototype was created. The validated user flow and design implications resulting from the previous evaluation of the two paper prototypes were mostly applied. In this study, the interactive prototype means that users can take any possible actions as designed, working within the prototyping application, called Torch (<https://www.torch.app/>), but not separate application by programming.

As Figure 27 shows, the interactive prototype was designed, and the final evaluation was done with four different methods. The evaluation includes both qualitative and quantitative methods. In qualitative manner, observation, think aloud, and post-interview were chosen, whereas quantitative method was embodied as using a set of questionnaires which is adapted from Intrinsic Motivation Inventory (IMI).

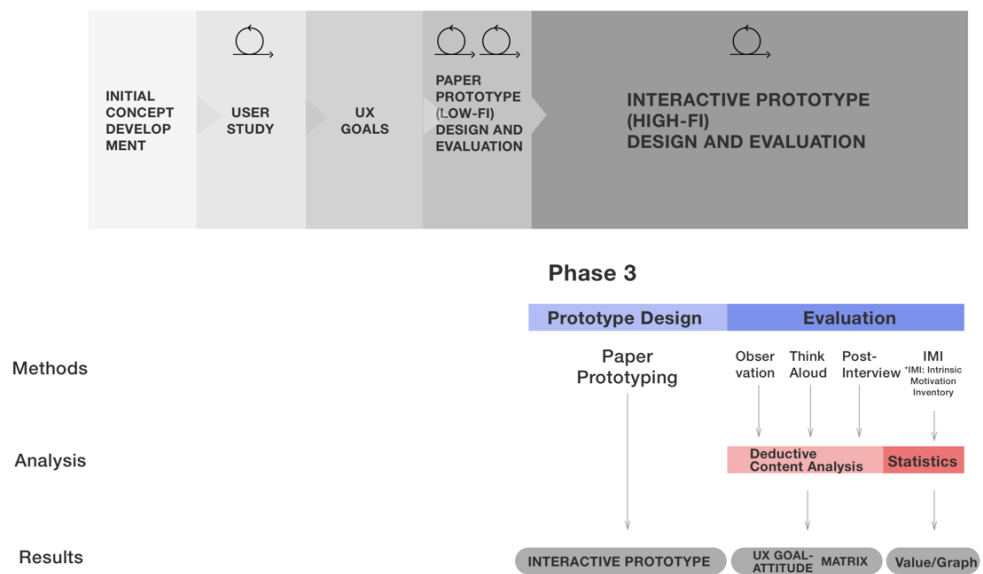


Figure 27. The Procedure of interactive prototyping (Phase 3)

5.4.1 Prototype Design and Implementation

An interactive prototype was created using a recently released prototyping application tool, Torch (<https://www.torch.app/>). The Torch was available in Appstore on iPhone Operating System (iOS) that requires specifically iOS version 11.3 or later and working on iPhone 6S or later or iPad. In this study, the interactive prototype was implemented on the tool Torch in iOS 12.2 in iPhone 7.

A set of images was produced in digital format at first, and the images were inserted into the Torch app. In the Torch application, the images were arranged, and interactions were added. To set up to add the virtual objects or interactions, the Torch app first should recognize a horizontal plane (Figure 28, left) such as table or floor and anchor a point (Figure 28, right) so that the virtual design objects can be arranged and interactable based on that plane and the point.

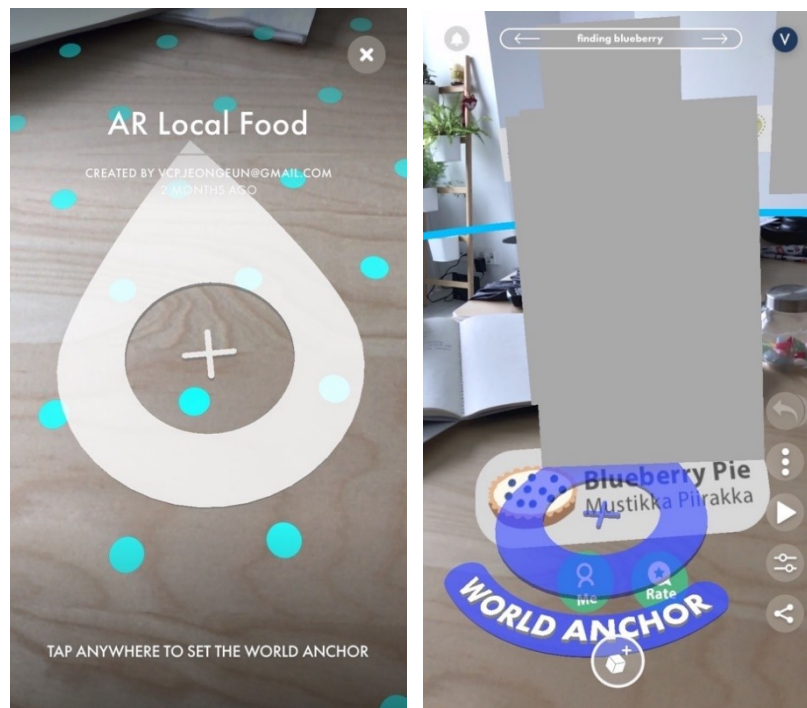


Figure 28. Set up screen (left: recognizing a horizontal plane, right: anchoring a point)

First of all, menu buttons were designed to track the camera angles by which the button object always faces users despite the tilting mobile at different angles. Image recognition was also functioned by pre-uploading the image. Moreover, image tracking was performed, for example, the ingredient images and text information of the food were arranged to move along the real food. These advantages made the prototype more powerful with details in the design.

The previously defined user flow was employed, and several elements are enhanced. As Figure 29 shows, the final design was made, working on a smartphone. To illustrate, specifically, five different details have modified. First of all, the names of levels were changed to evoke a more positive feeling for users. In the previous chapter, the user types as travelers were identified as 'survivor', 'enjoyer', 'experiencer', and 'advanced experiencer'. Now that the feedback had been negative with the name 'survivor', the new naming was ideated as 'new comer', 'enjoyer', 'explorer', 'experiencer', 'advanced experiencer', and 'adventurer'. Second, the distances from the location of production to that of the customer were visualized using the metaphor of the direction sign with the number of kilometers (km) on the road to give the user a hint that the food has moved the kilometers. Third, the local rating was removed, but the user's rating was stayed since the users had a tendency to get confused when too many elements were presented on the AR screen. Fourth, the level guide information was added in the 'Me' ('Insight') screen so that users figure out

their current level out of the whole level, and so feel more control and get encouraged to reach the next level. Lastly, fewer screens are used in a scene and enable users to follow step by step as they choose, not spreading out many pop-up screens at the same time in a scene.

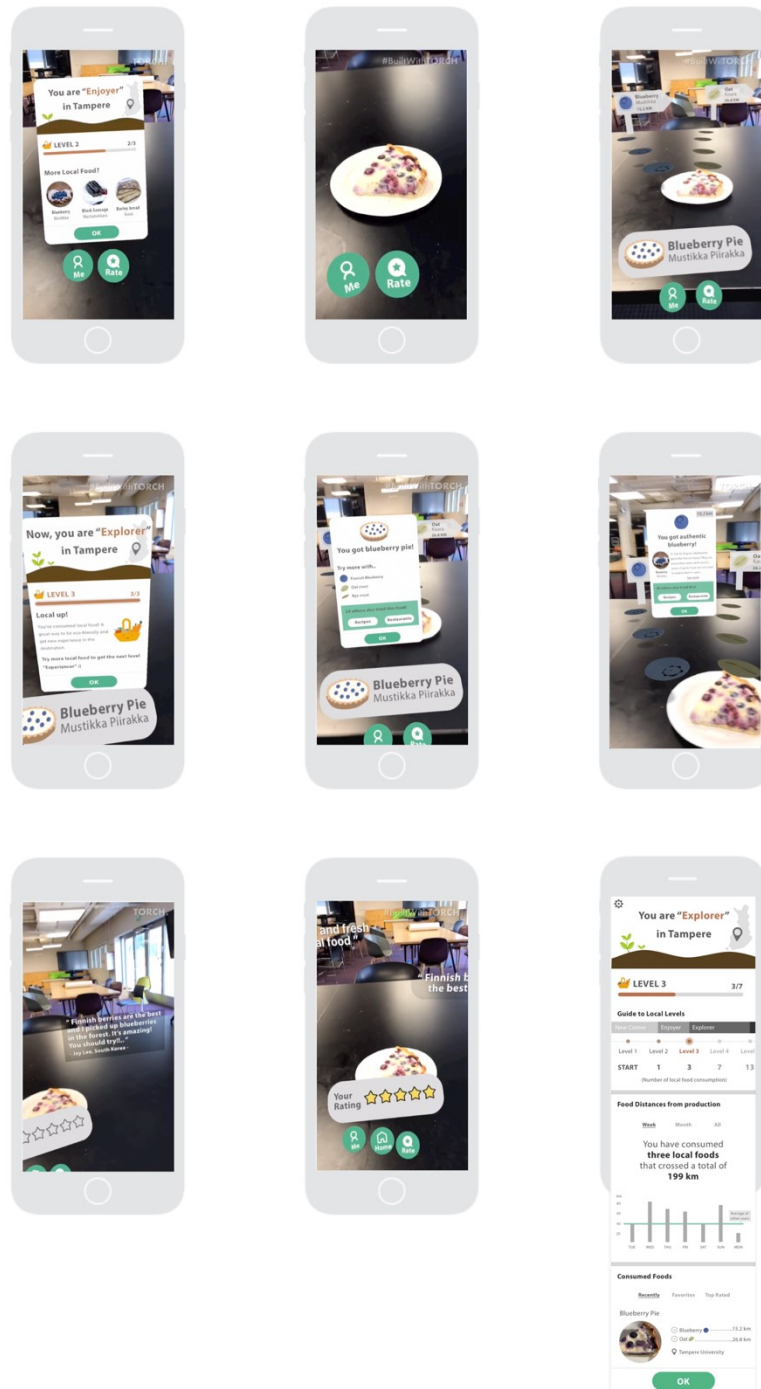


Figure 29. Interactive prototype screens

5.4.2 Evaluation

In this final evaluation, observation and Think-aloud methods were used while interacting with the prototype, and a post-questionnaire and semi-structured interview were conducted after the test. This evaluation was conducted for a period from 11. April to 19. April.

Participants

In total, 10 participants (7 males, 3 females) were recruited for the evaluation session. Their nationalities are varied with 2 Bangladesh, 1 Brazil, 2 China, 1 Germany, 1 Malaysia, 1 Nepal, 1 South Korea, and 1 Srilanka (8 different nationalities).

Three of them were the same participants from second user study, and two of them were the same ones from paper prototyping, and the rest five users were from a group of international students of Tampere University. Table 11 shows how much the participants try local food while traveling. In this evaluation session, the participants who try local food ‘Some’ was the most.

Table 11. The frequency of consuming local food by participants in the user testing for the final evaluation

How much do you try local food?	
Very little	0
Some	5
High	3
Very high	2

Test Environment

The test was conducted in the public place where has an open kitchen in the university (Tampere University, Hervanta Campus), as Figure 30 presents. This open space was chosen since it can promote a real-like atmosphere in the environment and allow the users to feel comfortable.



Figure 30. Final evaluation environment setting

Procedure

Overall, the evaluation was conducted through the process: introduction; an explanation for the purpose and procedure of the test; permission to record the test; background form; Think-aloud introduction and practice; user testing; post-test questionnaire; and interviewing. The script

for this whole process is described in Appendix D, and the main activities from user testing to interview are as follows.

User Testing: As a user agreed on this testing and video recording for the purpose of this thesis study with the consent form (Appendix C) and practiced Think-aloud, the user started to test the prototype. While the user was interacting with the prototype application by holding or moving around the table by a mobile phone, the user spoke out what he/she think and feel, which is called 'think aloud' protocol method. Several tasks in line with the user flow were given, and the user was encouraged to perform it, speaking aloud what they think and feel. During the test, the author of this study supported the procedure as a facilitator, for instance, by keeping the user 'think aloud' but not answering or interfering their actions. Their interactions running on screen and their behavior were recorded as a video (Figure 31). This way, it was possible to see how the application works by the user without any delay or distorted memory, and thus more detailed analysis can be achievable.

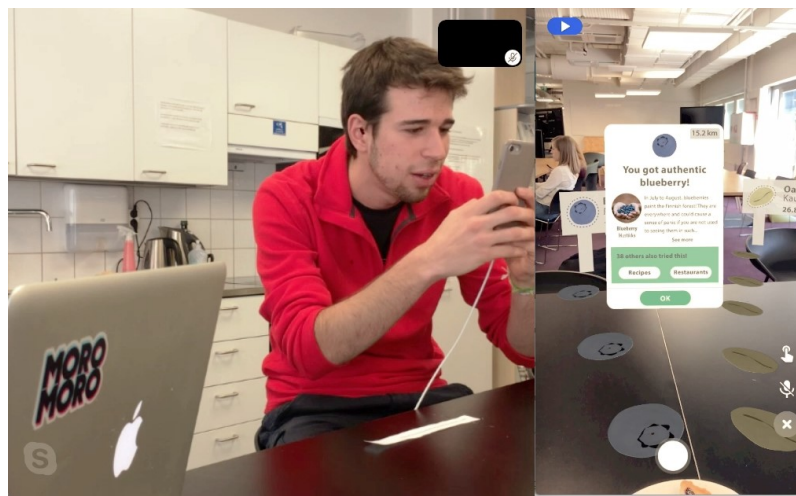


Figure 31. Recorded video for evaluation (left: the scene of user interaction, right: the mobile screen scene of the prototype)

Post-Questionnaire: After testing the prototype, the user was asked to fill in a set of questionnaires (Appendix E). The questionnaire was documented as a modified set of Intrinsic Motivation Inventory (IMI) (Center for Self-Determination Theory, n.d.). IMI is to measure human's motivation for experience and is originally invented by psychologists Ryan & Deci (2000b). IMI questionnaires are used to evaluate the subjective experiences of various aspects related to intrinsic motivation and self-regulation and have been primarily used for psychological experiments. IMI consists of six types of 'subscales', and one more subscale was added recently: (1) interest/enjoyment, (2) perceived competence, (3) effort, (4) value/usefulness, (5) felt pressure and tension, and (6) perceived choice, (7) relatedness aspect (added on recently). This study selected and adapted the questionnaires of (1) interest/enjoyment to measure intrinsic motivation itself and (4) value/usefulness to measure the possibility of internalization towards intrinsic motivation. The rest of subscales mainly deal with a specific factor of intrinsic motivation which is not necessary to find out if the designed application motivates travelers to consume local food as a second research question.

More precisely regarding this study, questionnaires of (1) can measure how much a traveler has intrinsic motivation when the traveler think and judge by oneself, and the adapted questionnaires of (4) can measure how useful or valuable a traveler consider the experience of the designed application. Table 12 shows the statements under the two selected subscales. The used questionnaires can be seen in Appendix E in which the statements randomly ordered, but the

same is used for all participants. Each statement in the questionnaire is measured with 7-point Likert scales in the range from 1 ('not at all true') to 7 ('very true').

Table 12. The content of the questionnaire in IMI (the used questionnaire sheet: Appendix E)

Interest/Enjoyment	Value/Usefulness
I enjoyed using the app very much Using the app was fun to do. I thought using the app was boring. (R) Using the app did not hold my attention at all. (R) I would describe using the app as very interesting. I thought using the app was quite enjoyable. While I was using the app, I was thinking about how much I enjoyed it.	I believe using the app could be of some value to me. I think that using the app is useful for local food consumption when I travel I think this is important to do because it can motivate me to consume local food. I would be willing to use the app again because it has some value to me. I think using the app could help me to consume local food. I believe using the app could be beneficial to me. I think using the app is important.

Post-Interview: Post interview was conducted using four different themes: overall perception and feeling, AR interaction, information, game elements, and free comments and suggestions (Appendix D). The questions are documented in advance as a semi-structured interview frame. Particularly, users were also asked about the specific game elements or features for motivation.

5.4.3 Analysis

Four different kinds of data were collected from the final evaluation (Chapter 5.4.2):

1. *Observation notes:* the written text data during user testing. (e.g., she said, "Oh I got the real oat?": a bit high pitch, and it sounds satisfied)
2. *Think-aloud quotes:* transcribed text data obtained by recorded video files for user testing. (e.g., "I would like to see more stories!")
3. *Post-interview quotes:* transcribed text data obtained by interviewing after user testing. (e.g., "Something caught my attention like pictures are following my movements.")
4. *Answers of post-questionnaires:* data of the number responded

To analyze these data, two methodologies were chosen: content analysis towards UX goals for qualitative data analysis (the above three data 1,2,3) and statistical method for quantitative data analysis (the above data 4).

Deductive Content Analysis

Deductive Content Analysis is used in the case that the category is already established by theory, model, concept, or prior study (Elo & Kyngäs, 2008). The initial data as the meaning units is the same as those of general content analysis (or inductive content analysis) described in Chapter 4.4.4. However, the process is in a different way. First, the classification frame should be built, and the initial data is coded by the classification frame (Elo & Kyngäs, 2008).

Now that UX goals were already defined in Chapter 5.2 based on literature reviews (Chapter 2) and user studies (Chapter 4), the three UX goals (adventure, autonomy, competence) can be harnessed as a classification frame in this phase. However, although the three UX goals are in the abstract level, all data may not fit into one of those three. In this sense, 'others' item can be added.

In addition, as another additional variable, user's attitude can be broadly divided into positive/negative/neutral and constitute the other axis of a matrix. In other words, the vertical axis of the matrix can be divided by UX goals, and the horizontal axis can be divided into the user's attitude to analyze the data.

The collected data in meaning unit are 13 observation notes, 60 think-aloud quotes, and 107 interview quotes from the final evaluation. The total of 156 pieces of data was classified by UX goals (adventure/autonomy/competence/others) and attitude (positive/negative/neutral) as presented in Table 13.

Table 13. The result of deductive content analysis (numbers only)

	Positive		Negative		Neutral		Total
Adventure	41	73.2%	2	3.6%	11	19.6%	56
Autonomy	41	69.5%	16	27.1%	2	3.4%	59
Competence	25	83.3%	3	10.0%	2	6.7%	30
Others	10	90.9%	1	9.1%	2	18.2%	11

Statistics of Intrinsic Motivation Inventory (IMI)

A total of 10 users responded to IMI's 14 questions in the post-questionnaires from 1 to 7 Likert points. The collected data was divided into two themes of IMI and calculated as a statistical value of the mean value and the SD. In other words, the average and SD value of 10 users for seven statements of Interest / Enjoyment theme and the other seven questions of Value/ Usefulness theme was obtained. The score of interest/enjoyment results in 6.23 on average (SD = 0.46), and the score of value/usefulness is 5.77 (SD = 0.40).

5.4.4 Results

The results of the final evaluation were drawn by the analysis above. The results have two parts. One is the outcome of the deductive content analysis as a qualitative method, and the other one is the outcome of statistics of IMI as a quantitative method.

The Result of Deductive Content Analysis

Table 14 shows the final result from the deductive content analysis with a major point in texts. Most of the data indicate as positive, with 73.2% adventure experience, 69.5% autonomy experience, 83.3%, and competence experience among the data classified by each experience. To illustrate, users feel that they are curious and excited about AR's new ways and interactions, want to explore more freely, and at the same time have control over the application to some extent. The users also felt a sense of accomplishment in getting a new knowledge or leveling up at a considerably high rate.

There are also 27.4% negative responses to autonomy experience goals. Considering the qualitative data together, the reason that the negative consequences of the autonomy experience are relatively high seems due to the difficulties to control the ingredient information which is located a little distance away from the real food on AR view.

Table 14. The result of deductive content analysis (numbers and example texts)

	Positive	Negative	Neutral	Total
	41 (73.2%)	2 (3.6%)	11 (19.6%)	54
Adventure	- Users reacted as curious, interesting, or excitement about some new information (images, texts) and interactions "It looks so awesome! The graphics and AR things! I wanted to touch"	- Users could not explore some elements and feel weird due to the limited views in a certain angle, or due to too many elements in a view. "I just got distracted a bit by those elements"	- Users explained some facts they just found at the moment or recognized later "Seems like there are a lot of levels and I am level 3." "Okay now I get the km. That"	

	<i>"Oh I can see also ingredients. Blueberry.. Oat Oh it's interesting?"</i>		<i>was the distances where the ingredients come from."</i>	
Autonomy	41 (69.5%) - Users would like to see more information or interact with those as they want freely. <i>"I would like to see the recipes!"</i> - Also, they felt the app is under their control (e.g. navigate, understanding content) work as they expected. <i>"I can keep track of what I have done before."</i> <i>"It took me actually quite easy to find how to scan it."</i>	16 (27.1%) - Users do not understand certain information or how to interact. (Mainly ingredients, distance info.) <i>"I think.. A bit hard to interact with the ingredient of this food since the food is far from here?"</i> <i>"It was easy to understand but except for...try with oat crust things. I thought 'What am I supposed to here?' "</i>	2 (3.4%) - Users expressed neutrally about what they chose an element <i>"Okay rate here! Something I am familiar with?"</i>	59
	25 (83.3%) - Users expressed their achievement when they get new items or leveled up etc. <i>"I need more higher level! I got interested in the level!"</i> <i>"I felt exciting when I move on to the next level!"</i>	3 (10.0%) - Users need more and clearer rewards. <i>"but I was not so clear about the benefits I get why I would level up."</i>	2 (6.7%) -Users explained the general statements. <i>"I think everybody is trying to do. Google. 'take on this, then you will be the next level!' it is some kind of motivation to do that."</i>	30
Others	10 (90.9%) - Users mentioned a good feeling of the first impression or overall concept of this application <i>"It is by nature to follow local food and this app will help to find local food information."</i>	1 (9.1%) - A user pointed out the current situation of the other applications with gamification and notification. <i>"But now.. trying to make it more addictive everything. So now I just want to get rid of ..from my smartphone. It helps people but maybe it's not for me. And I'd rather not using phone outside."</i>	2 (18.2%) -A user described a possible situation when the app is used much. <i>"I would not constantly turn on the (AR) camera because it consumes a lot batteries."</i>	13

The Result of Statistics of IMI

Figure 32 shows the mean values of Interest/Enjoyment subscale and Value/Usefulness subscales as a result.

The score of interest/enjoyment results in 6.23 (SD = 0.46) on the overall average and the score of value/usefulness is 5.77 (SD = 0.40) on the overall average. Those high values can demonstrate that the application works positively about motivation, especially intrinsic motivation from the user's self-assessment. However, now that the result of value/usefulness is lower than that of interest/enjoyment, users may feel this application is not very valuable, and it does not seem that the internalization possibility of the motivation is completely successful.

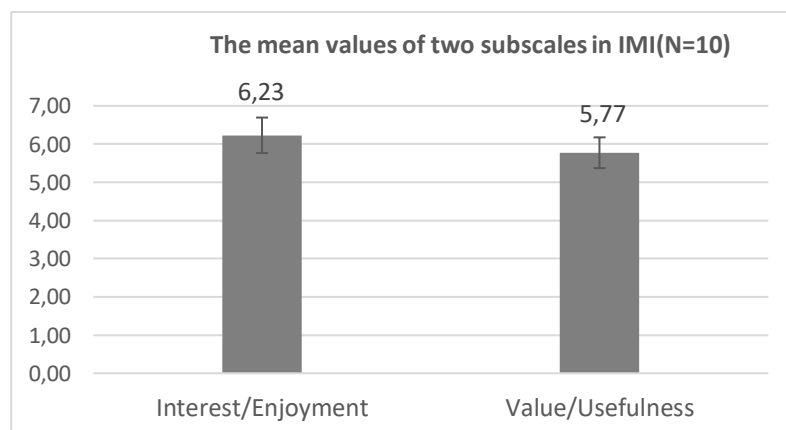


Figure 32. The mean values of two subscales in adapted IMI (N=10)

6. DISCUSSION AND CONCLUSIONS

This chapter is to summarize the results of the study and the design process; finally, answer the research questions established in the beginning. Discussions and future work are also illustrated in this section.

6.1 Summary of the Findings

The objective of this study was to discover what kind of gamified mobile AR application fosters in providing information and motivation for tourists and design and evaluate it. Based on the design outcome and evaluation results, the two main research questions are finally answered as below.

Research Question 1.

What kind of gamified MAR application can support travelers to find information about local food?

Travelers can easily access and obtain food information through the gamified MAR application by displaying the virtual food information layering on the real food in the travel destination when they consume the local food. For more concrete reasons, the three factors were found as critical in this study; minimizing the user's information acquisition process by AR technology and mobile sensors (e.g., GPS); the richness of the information associated with the user's context or personality in addition to the food information itself; Providing a small amount of information at one time. The final prototype in this study is an example type of application which provides the food information, precisely, food name, ingredients, stories in a cultural context and with game-like elements and extendable information hints.

Research Question 2.

Do travelers get motivated to consume local food when they use the gamified MAR application?

Yes, but not completely. Travelers are encouraged to consume local food by using this application, but it is doubtful that they are constantly motivated. The quantitative evaluation with IMI showed very high score of 6.23 on a scale of 7, indicating that users were intrinsically motivated using this application. Yet, the possibility that the motivation is increasingly internalized has room for improvement, since the score for that is 5.77, which is still high but less than the value above.

Of the UX goals for the gamified MAR application, autonomy and competence are psychological needs involved in the internalization of intrinsic motivation. The qualitative analysis of the final prototype evaluation suggests that design elements for competence and autonomy contribute well to the internalization of intrinsic motivation which was the game elements for competence (e.g., level, progress, collection) and information contents and interactions for autonomy (e.g., self-control by checking insightful personal information and easy navigating, seeking various information).

This study conveyed a possible example and potentials with the combination of AR, gamification, mobile device, and the context of food consumption in travel altogether.

In the overall design process of this study, four iterations were performed from initial concept evaluation, first test, to paper prototyping and final interactive prototyping. The gradual progress

showed how effectively and efficiently the iterative design can work to validate the initial ideas in the early phase and identify possible problems to be solved smoothly, which has a positive effect on the quality of the design considerably. Furthermore, the procedure seems to sustain continual communication with real users, thereby providing new idea inspirations and improvements from their own eyes and words.

6.2 Discussion

The strength of diverse resources and context specificity in a gamified MAR

In this study, while a gamified mobile AR application is explored and designed, user experience seems to be drawn from a variety of factors along with AR technology in mobile, gamification, and the context of food consumption in travel in the purpose of motivation.

According to Olsson et al. (2013), users expect that MAR could have a wide variety of aspects, including the technology itself, rich content, and the context of use. They also mentioned a possibility of illuminating information within a specific time and location, which means a very context dependent. (Olsson et al., 2013) The example of the application designed in this study may show how it has diverse aspects but with context specificity.

Notably, considering gamification as a motivational method as well as the technological aspects of AR, the variety is expanded, and accordingly, the user's interests seem to increase. Although this study did not focus on how much the value of the combination of AR and gamification is compared with the value each provides, this study suggests at least an example of the combination, and shows that user's motivation by the application is reasonably high from the result of the final evaluation described in section 5.4.4.

Regarding the context, it is obvious to some extent that the content of travel has the characteristics of mobility essentially, and travelers need information in the unfamiliar destination, which fits well for the mobile AR service. To be specific, the purpose of this application, that is to make travelers more straightforward access to the food information at the destination and encourage them to consume local food having a short distance from the production of the food, reveals a very specific context and its requirements. Conversely, it also implies that a mobile AR application may need to be defined tightly with a distinct situation and the content information at the moment.

Personalization based on traveler types

Björk & Kauppinen-Räsänen (2016) surveyed travelers' attitudes and behaviors for local food in their travel destination and classified travelers into three types: Experienter, Enjoyer, Survivor. In addition, 'Advanced Experienter' was added as a result of the user study described in section 4.6. In the design process, the four names of the user types were employed to provide the name of the user's state in accordance with the level of the game, and through the iterative feedback process, the final names were distinguished as 'new comer', 'enjoyer', 'explorer', 'experienter', 'advanced experienter' and 'adventurer'. There were several positive responses from participants in the final evaluation. However, these are only name labels relying on the game level information, and it has not been actively personalized, such as providing information in different ways or different game elements depending on this type. Perhaps the way of seeking for food information even in the beginning will vary from one type to the other, which will require additional research and a new design process.

The complexity involved in motivation

Earlier in the study, it started to describe local food and the reasons why travelers should consume local food. In particular, based on the fact that local food consumption in travel destinations can contribute to the environment by reducing the food miles (Andersson et al., 2017). In this sense, this study focused on motivation. From the previous research about the reasoning

behind the food consumption of tourists in relation to motivation (Randall & Sanjur, 1981; Kim et al., 2009; Mak et al., 2011), five experience elements were as 'personal', 'novel / diverse', 'familiar', 'locality-aware', and 'enjoyable' in section 2.1.2.

In order to support such motivational content, gamification has studied in terms of the strength of internal motivation (Ryan & Deci, 2000b), the motivational affordances of gamification to internalize people from external motivation to internal motivation (Hamari et al., 2014; Zhang, 2008).

After that, quantitative analysis was done for the final evaluation of a gamified MAR application prototype concerning intrinsic motivation and internalization of the motivation. From the statistically analyzed result of the IMI, we can doubt that the motivation may also be intertwined with novel technologies, for example, MAR in this study, since the score for intrinsic motivation itself was high, but the score for the possibility of internalization towards intrinsic motivation is lower than that. Although this study acknowledged that both AR and gamification are involved in motivation and engagement (Noor et al., 2015), but the effects of MAR on Motivation did not address in this study.

As we can see, the motivation-related factors are intricately intertwined, and designers or researchers should consider those, especially when designing gamification for motivation.

Feasibility

The food information is accompanied by great variety. It varies by regions, the originality of the chef who makes the food, or the company's strategy of supplying food to the market. In this situation, there seems to be an apparent difficulty to be able to recognize the food exactly from all regions to travel. Moreover, for this reason, if the application does not function well with a small range of food information, it could be easily discarded even before engaging in user motivation. Therefore, it is necessary to retain and upgrade as much information as possible using technologies such as image processing and artificial intelligence.

Meanwhile, a feasible concrete solution currently could be to create business apps, separate from user apps, to obtain exact input data about local foods and images, and information about the main local ingredients they use. When the user's location information is combined with that information, the user application will be able to recognize the image of the food served at the location of some restaurant or market and show that information accurately in the AR view.

6.3 Limitations

Observation in user study: At the beginning of this study, the observation was carried out as a user study to figure out how travelers experience food in the destination. This process is inadequate to extract meaningful information right away, but it has been beneficial to understand how the potential users behave/feel and their contexts in which the application would be used in natural environment setting. However, the data involves still a limitation, since the observation period was around the season of Christmas and New year, and one of the places was Rovaniemi in Finland where the group of tourists might be biased. For example, many Asian tourists from China, Korea, and Japan travel to northern place, especially during the winter season, which means their cultural aspects may affect the data as well.

User testing in the final evaluation: In the final evaluation with the interactive prototype, there was a limitation to the lack of reality since the test was not carried out in the context of use. Even though the evaluation place had a natural atmosphere in the kitchen of the open space, but the tests proceeded within a specified user flow and one food which is more like laboratory settings. In this sense, the evaluation did not well reflect realism, and this is a limiting point that reduces the validity.

Participants: In the user study, 17 groups were observed, 7 participants were recruited and interviewed. In the paper prototyping, 3 users tested in the first iteration, and 5 users tested in the second iteration. Lastly, in the interactive prototyping, 10 participants were recruited and interviewed for the final design evaluation. At this point, there are two aspects of the limit: one is the sample size, and the other is the accuracy of the sample type. Most case of tests and interviews except for observations, there are a somewhat smaller number of samples, particularly small numbers for quantitative data analysis of the final evaluation. Besides, the participants in the first user study were recruited through the Facebook page, which allowed the author of this study to conduct a variety type of people to some extent. However, in the final evaluation, the sample may slightly be distorted since the newly recruited participants were all international students in the university.

Another sample type issue was the two user experts who participated in the paper prototyping evaluation. Sampling with the experts in the UX field to test a prototype may be a good way to obtain as much feedback and ideas as possible at the beginning of prototyping, but it means that the real users were considered relatively less at the same time, which has a negative effect on the result of the prototype design even before evaluation.

On the other hand, the participants how much local food they try in their trips in the background form, but it was not used/analyzed much since this study was focusing on the research on gamification for motivation and AR for seeking information.

UX goals in design and evaluation: UX goals are ideated on three different ground – theory, empathy, and technology – using the sources of literature reviews and user study, and eventually built as three high-level UX goals. In the process, the final goals are identified intuitively to cover all the ideated experience elements. However, PLEX card (Lucero & Arrasvuori, 2010) could have been a complementary choice, since it includes well-organized 22 playful experiences which are suitable even for gamification that this study approached.

6.4 Future Work

Once this study has been designed to motivate local food consumption and evaluate whether the application is successful for that, future work could be studying longer-term motivation and redesigning the app. First of all, as mentioned in the feasibility of the above discussion section, well-functioning with sophisticated technologies would build trust and increase willingness to use and consume more local food as a first step. Secondly, it would be an appropriate game level adjustment. Too easy or difficult levels can reduce the user's positive experience, so it needs to design and test the overall level of difficulties in detail. Third, strengthening personalization could be a way to motivate in a longer time, since many participants in this study mentioned personalized information regarding their health concerns or preferences, and their memories. Finally, social aspects are a significant consideration that should be studied in the future. For example, sharing consumed local food with friends or introducing 'competition' game elements are expected to make users more motivated. According to Walz & Deterding (2015), social relatedness is one of the psychological factors for motivation, which evoke the feeling of supported by others. On top of that, several participants have commented on this social facet on additional improvements or ideas for the future to keep motivated.

On the other hand, this study has rather simplified the interaction and gestures in the design process, focused mainly on visual feedback. However, for the future, it seems needed to consider multi-sensory (e.g., haptic, auditory) feedback or multimodal interaction, since it could provide more fruitful user experience and even more motivate the users. In the final evaluation of this study, one user also expressed haptic feedback synced to the visual elements, for example, when collecting local ingredient. If these multiple sensors are also engaged in the mobile AR application,

it would have more range of possibilities. In this sense, multimodal interaction may be an important key for future development.

6.5 Conclusions

This study found that a gamified MAR application can support travelers to find local food information on their travel destination and motivate them to consume the local food for sustainability. The application can provide significant value to users since the users can acquire the food information immediately layered in the real food by reducing the step of accessing information of the users, which is a huge beneficial characteristic of AR. However, too much information displayed in the MAR cause confusing and negative emotions, so the designers should consider an appropriate amount of information at a time. In addition, the food information needed to be integrated with the other information in accordance with their context and personal characteristics to contribute more in supporting the acquisition of local food information by the gamified MAR.

This study also found that the game elements in the gamified MAR application enhance competence experience and affect a user's motivation. Information content and interaction of the application involves autonomy experience and has a positive effect on the user's motivation as well. Moreover, the game element is basically based on 'pleasure', so it is well accompanied with a positive feeling of pleasure in the context of traveling.

In the future, based on the information and motivation aspects of the application, and several design implications found in this study, other designers or researchers can further enhance the design by adding or developing other aspects such as personalization and social aspects. It is also expected that designing interactions and feedback using different sensory of human on a gamified MAR may arouse richer experience and even more motivate users.

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APPENDIX A: CONSENT FORM OF USER STUDY

We ask you to participate in a user study that is part of the research on the master's thesis of Jeongeun Lee at Tampere University. By participating in the user study, you will help us to design a new augmented reality application for tourists' food consumption.

You will be asked to fill in background form and to interview about your past experience, preferences, and opinions regarding the topic.

During the interview, we will record your voice. The audio file will be used to analyze for the later step of the study and the words may be quoted in the paper. The examiners of the study can check the material of the interview and background form. The recording will be destroyed after the study is over.

The results of the test will be reported anonymously. All recording files and participants' personal data will not be revealed.

You can stop participating in the interview session at any point.
We are happy to answer if you have any questions.

By signing this form, you will accept the above terms.

Date and place: _____

Signature: _____

Name clarification: _____

Thank you for your participation.

PARTICIPANT ID: _____

APPENDIX B: BACKGROUND FORM

Background Information

Age: _____

Country: _____

Gender: Male Female Other

How often do you travel?

- Less than 1 time a year
- 1-2 times a year
- 3-4 times a year
- More than 5 times a year

How much do you try local food?

- Very little
- Sometimes
- High
- Very high

Food information service

Check all that apply

Where do you get information for food in travel?

- People (e.g. Family or friends)
- Mass Media (e.g. TV, Radio, newspaper)
- Internet – Websites
- Internet – SNS
- Ministry of Foreign Affairs
- Travel agency
- Tourism brochure/guidebooks
- Other: _____

Participant ID: _____

APPENDIX C: CONSENT FORM OF USER TESTING

We ask you to participate in a user testing that is part of the research on master's thesis of Jeongeun Lee at Tampere University. By participating in this test, you will help us to evaluate the prototype and improve user experience of that in the future.

You will be asked to fill in background form and to interview about your past experience, preferences, and opinions regarding the topic.

During the interview, we will record video of you. The video file will be used to analyze for the later step of the study and the words may be quoted in the paper. The examiners of the study can check the material of the interview and background form. The recording will be destroyed after the study is over.

The results of the test will be reported anonymously. All recording files and participants' personal data will not be revealed.

You can stop participating in the interview session at any point.
We are happy to answer if you have any questions.

By signing this form, you will accept the above terms.

Date and place: _____

Signature: _____

Name clarification: _____

Thank you for your participation.

Participant ID: _____

APPENDIX D: EVALUATION SCRIPT IN INTERACTIVE PROTOTYPING PHASE

INTRODUCTION

Hello, my name is Jeongeun Lee and thank you for your participation in this user testing. 😊

I am studying 'User Experience' here at Tampere University, and now I am doing this evaluation for my master's thesis. So, I am going to guide you for this session.

THE PURPOSE OF THE TEST

The test aims to evaluate a mobile AR application from your experience as a user. The app is for travelers to help them consume local food in the destination. To validate the overall concept and improve user experience, I would like to observe how you experience this application and identify any problems or improvements for the future.

I will ask you to write a consent form for recording the test later, but at first, I will explain what the test is about. Your role is important since you are here to help me test the application.

TEST PROCEDURE

After you fill in the consent and short background form, you will use this mobile phone to test the application. According to a pre-defined scenario, I will give you some tasks, and you will be asked to say aloud what you think and feel during the test. We will practice this process later soon so don't worry.

You can stop participating in the test at any time and for any reason, and you don't need to explain the reasons why you quit. Also, if some task feels difficult and you no longer want to keep on doing it, please tell me, and we can move on to the next task.

Do you have some questions at this point?

PERMISSION TO RECORD THE TEST

The test is recorded on video so that we can analyze the test later.

The recorded video will be used only to analyze the service of the application. The examiner of this study can view the materials, but those will be destroyed after the study is over.

Now that you know what the test will include, I will ask a written permission from you to participate in the test that is recorded on video. Do you have some questions?

→ Hand the consent form

BACKGROUND QUESTIONNAIRE

We will also collect some background information from all participants. Could you please also fill in this form?

→ Hand the questionnaire.

THINK-ALoud

Now I'll explain how you are going to test the application. You will verbalize your thoughts and feelings while you are using the application. This way it helps me to understand how you perceive and feel and what the problems are. Therefore, I will kindly ask you to express all your thoughts and feelings during the test with the given tasks. Let me demonstrate at first as an example and let's practice!

Give an example:

(Opened 'Notes' app) add a new note with the text 'Hello!'

There are many notes here already, but I would like to add a new note. Hmm in this upper side, there is 'Edit' button and.. I think it also should be here somewhere together.. Let's see.. the other side... Oh here! I got it! Yes, here it is. Oh it's good that the keyboard is already opened here so I just type "Hello" and 'Done' ! That's what I am going to do! Great! I feel good. Well, it was easy, but I could not find the add button right away for the first time.

Practice:

(Opened 'Notes' app) edit the note with a text of your name.

Do you have any questions? If not, then let's start.

BEGIN THE TEST

I will now start recording video.

→**Start recording video**

(Explain a scenario shortly)

Now you are traveling here, Tampere. In a café, you chose blueberry pie, so you have it now on a table like this. Then you are going to explore the food information.

In the tasks, I cannot answer and help you in test time. But, if you have questions, just say it and keep going so I could recognize the questions.

Now here are some tasks printed out for you. I am going over them with you one by one, and you can start each one.

Some of the tasks may be difficult, and it does not matter if all of them are not completed. So, if you wish to give up on a task, it is ok to move to the next task. It will take about 20 minutes.

And just tell me when you are finished.

Do you have any questions before we continue?

Let's get started!

→ Hand the paper of the first task

For the tasks, could you also read aloud to get comfortable for speaking your thoughts out?

(After the participant have done, give appropriate response like 'good!')

DURING THE TEST

Tasks:

Task 1: Take a look at the first screen and close the screen.

Task 2: Scan the food and get information elements.

Task 3: Take a look at the content of the pop-up screen and close it.

Task 4: Find more information on the food and close it.

Task 5: Find more information on the ingredients of the food and close it.

Task 6: Go to "Rate" in the menu and explore the screen.

Task 7: Rate your score for the food.

Task 8: Go to "Me" in the menu and take a look at the content about your information.

In the process:

(Reminding think aloud)

- So...?

- So, you're thinking . . . ?

- Could you tell me what you are thinking?

- Please, keep on saying what you are thinking.

(Probing)

-Tell me a little more about...

- How does this make you feel?

- Is that what you expected, or not what you expected?

- Did you notice this [name of a UI object], or not?

-What would you do next?

-You just said “..(quotes)”. Help me to understand what you mean by that.

(Encouragement)

- You are so good to think-aloud!

- You are doing fine!

- Remember that it is not to test you or your abilities but the application.

POST TEST QUESTIONNAIRE

Then, this is a short post questionnaire. Please answer these based on your thought and feelings from your experience of the application.

→ Hand the questionnaire. (Modified ver. of IMI)

INTERVIEW

Now I am going to interview shortly about your app experience.

(Semi-structured interview)

Interview Frame:

Theme 1: Overall perception and feelings

- How do you feel about this application? The first impression?
- How easily could you understand the concept as a whole?

Theme 2: AR Interaction

- How did you enjoy the interaction on the AR view?
 - Open/close the pop-up screens? Scanning image (recognition)? Changing scenes?
- How easily could you interact? Did you have any difficulties to interact with the application? – which part specifically, why?

Theme 3: Information

- How did you understand the information?
- How interested are you in the local food or the origins of the food you consume while traveling?
- What kind of information did you like? Or not like? Why?

Theme 4: Game elements and motivation

- How do you feel about the game-like elements?
 - In which elements or features did you get interested or attracted? – how did you feel in the part?

(Closing Question)

- Would you keep using this application and consume more local food?
- Do you have suggestions for improving the application?

Now it's all done! I will stop recording.

→ **Stop recording video**

DEBRIEF

Do you have some thoughts or comments that you would like to share? Do you still have some questions?

Thank you very much for participating! 😊

Source: HTIS81 Usability Evaluation Methods 2017 - 2018 course material, <https://learning2.uta.fi/course/view.php?id=11160>

APPENDIX E: POST TEST QUESTIONNAIRES FOR EVALUATION IN INTERACTIVE PROTOTYPING PHASE

Below are some statements related to your experience with the app you tested. Please indicate how true it is for you, using following scale with the statement.

Evaluate the following statements		Not at all true		Somewhat true			Very true	
1.	I enjoyed using the app very much.	1	2	3	4	5	6	7
2.	I believe using the app could be of some value to me.	1	2	3	4	5	6	7
3.	I think that using the app is useful for local food consumption when I travel.	1	2	3	4	5	6	7
4.	Using the app was fun to do.	1	2	3	4	5	6	7
5.	I think using the app is important because it can motivate me to consume local food.	1	2	3	4	5	6	7
6.	Using the app did not hold my attention at all.	1	2	3	4	5	6	7
7.	I would be willing to use the app again because it has some value to me.	1	2	3	4	5	6	7
8.	While I was using the app, I was thinking about how much I enjoyed it.	1	2	3	4	5	6	7
9.	I think using the app could help me to consume local food.	1	2	3	4	5	6	7
10.	I thought using the app was boring.	1	2	3	4	5	6	7
11.	I believe using the app could be beneficial to me.	1	2	3	4	5	6	7
12.	I think using the app is important.	1	2	3	4	5	6	7
13.	I would describe using the app as very interesting.	1	2	3	4	5	6	7
14.	I thought using the app was quite enjoyable.	1	2	3	4	5	6	7

Which overall grade would you give to the application (on a scale from 1=poor to 7=very good)? _____

Thank you! Your responses will be processed confidentially.

Participant ID: _____

APPENDIX F: TABLES OF THE CONTENT ANALYSIS FOR USER STUDY

(Theme 1)

Theme 1: A desire to experience local food within the cultural context		
Condensation	Code	Categories
I try local food	Trying local food	Trying new/local/good food
I want to try local food and specialties in the destination		
Local food is the most important		
I look for special or local food in a restaurant		
I try local food outside		
I try to eat local food much		
I may go to some local restaurant for lunch		
I try local food to know the place and culture		
I want to try local food		
I want the most popular food in the destination.		
I try local food		
I always try local food		
I try local food at first		
I try local food that is only found in the destination		
I want to try local food and feel specialty		
They try to take local food		
They try local food much in travel		
I want the new food	Trying new food	
I feel risk for the food I don't know		
I want to try the new food as many as possible		
I want to discover new food		
I want to explore something new and I take a risk		
I also try my home food but with mixed with the local culture.		
I want the new food		
I want to try different food		
They wonder some new or interesting food and get food more information from the server		
They share the food and want to experience more different food		
They share the food and may want to try different food		
I try good restaurant	Trying good restaurant	
I want to know food-related story	Wanting to know cultural background	Extensive food experience

I want to learn cultures from food and talk with people for that
 I go the local market to see their culture
 I want to see the interesting food story
 I want different things and food in the destination
 I see culture differences from the food and how the food is served
 I want to discover new things in their culture and food is one of them
 Food present culture
 I want to know local people's life and experience through the food
 They get interested from the additional detail information for the food
 They want to know good combination with the food and drinks
 I want to know how to replicate the food at my home
 I want to know how to cook
 I want to know how to cook at home later
 I analyze the taste and want to replicate later
 I want to know how to cook
 I am curious about how to cook the food
 I ask to the server about how to eat
 I ask how to eat (sometimes)
 They do not know how to use the coffee machine in their way
 I want to know ingredient information if the food is special
 I can explore local ingredients in the local market
 I want to know ingredients inside
 I ask ingredients inside the food (sometimes)
 I go food market to see their original, fresh ingredients nearby the local place
 I want to know ingredients
 I do care much for ingredients
 I don't want to know all ingredients but main ingredients
 It takes quite much time to know what the food is in the menu
 It may take long time to understand the food in the menu
 They try to understand the food in the menu
 I want to know where the food comes from
 I am interested in how the food is produced ethically or organically.

Wanting to know how to cook
 Wanting to know how to eat
 Wanting to know ingredients
 Ethical/organic food production

I don't know how the food comes from		
I want to try the original taste	Trying original taste	Focusing on taste
I go for the original food restaurant		
I choose the unique, original food		
I want the real local food to experience their original home food		
I want the best traditional food in the destination		
I remember the impressive food by totally different taste		
I strongly expect the interesting food in the destination		
I prefer traditional local food in the destination		
I want to try special or traditional food		
I am curious about the taste of the food	Curious for the taste	
I am curious about new taste that I haven't experienced		
I talk about new and different tastes like spicy food		
I remember the impressive food by taste		
Taste is important to me rather than healthy concerns		
I remember the impressive food by taste		
I talk about the food portion and taste		
She may so curious for the food and want to get more information		
Curious for different taste of food		
He may wonder what the food/ingredient or taste is		
They enjoyed the food		
I need the real information from local people. I rely more on them.	Need real information from local people	Genuine local condition
I ask to local people for 'real' local food recommendation		
I use web service to dine(cook/eat) with the local people at their home		
I would like to the real local experience with the normal food for local people's daily lives		
I want the real local food that the normal local people eat because of budgets.		
I want to see the real information from the public users		
I want to know what the local people eat in the destination		
I want to know what local people eat differently		
Local friend gives opinions for the local drinks and her experience		

They try many local foods and they want to know what the local people really eat in the destination		
I take pictures if it looks good	Taking pictures	Memories
I take pictures of food to remember and use that for writing journal.		
I take a picture alone at first		
I take a picture of food		
I talk about previous memories related to the food that I am eating		
I take a picture for my memory		
I take a picture if it is special		
Taking picture with the food		
They take a picture with friends together		
They take a picture of the food		
They take a picture of the food		
They take pictures for the food and themselves together		
They take many pictures for food and themselves		
I try to remember the name of the food	Remember food name	
They may try to remember the name of the food they enjoyed		

(Theme 2)

Theme 2: Efforts to find out and to refine food information

Condensation	Code	Categories
I ask food information to server quite often.	Asking for food	Finding food information
I ask for food information to server as a last option to know ingredients		
I ask the ingredients to server (sometimes)		
I ask for the food		
I don't know how I can search for the food that I am eating		
They ask for the food to the server		
They ask for the food to the server		
They ask for the food(beer) to the server		
They ask for the food to the server		
They ask for the food to the server		
They ask for the special drink to the server		
They ask for a specific food with region name to the server		
I use different internet sources to find popular food information in the destination	Browsing for food on internet	Finding food information
I rely more on internet resources		

I browse travel experience and get recommendation through blog and social group pages	
It is easy to get food information through internet.	
I recognize the popular food from the repeated search result	
I need to see the menu of restaurant in advance	
I search traditional food in the destination	
I user internet to get information because it's convenient and updated	
I use diverse channel to get local food information.	Gathering food information
I get information for a good food and the place to eat	
I gather information before eating out in travel	
I use internet, application, and people to get local food information	
They planned the time and restaurant in advance	
They use different kinds of information both online and offline	
I see the detail information for food and restaurant in the website	Checking detail information
She go through menu closely	
She get detail information from the brochure and the server	
I do comparison for food or restaurant	Comparing food/restaurant
I compare/discuss each food each other	
They compare the different food package	
I think some application is touristic	Dislike touristic/advertising information
I do not ask waiter but did research before.	Keeping notes before eating
I use the searched information to choose food in the destination	
I have had language problems to get food information from the server	Language barriers
I need language translation to get food information	
I cannot understand menu in their language when ordering food	
I need language translation for the food information	
I search the food if I don't understand the name of the food in the menu	
I don't know what I order due to language problems	
I need to translate reviews from the local people in the application	
I search ingredients by picture at first	Searching for food

I search food by name if there is no picture.	
I use internet by phone the most to get food information	
I search the name on Google if I cannot understand the menu	
I know the ingredient if I search the food by name.	
I search the food information more after tried	
I want to get the local food lists	
I check famous food and place for that in the destination	
I get food information through internet mainly	
I search the food and ingredients only before eating.	
I use internet for food information	
I search the popular food closely and the place to eat	
I also look for food information through internet	
I need to know what the food is to order	
I know what I eat by going through the menu in advance	
I search food through 'image'	
I mainly use internet to get local food information	
I get general suggestions for local food easily by searching	
They may search something related food	
They search and plan for food in advance	
They may search some food in the menu	
The results from Google search is powerful to get food information I do not know	Searching information is useful
They may talk about food together	Talking about food
They discuss each other to choose their food	
They exchange their experiences related to their food	
They discuss each other to choose their food	
They discuss each other to choose their drinks	
They discuss each other to choose their food	
I don't like too many information on the web service	Too much information
I utilize different kinds of websites (general websites, TripAdvisor, Google Maps)	Utilize different applications
I use different application depending on context of use. (location: Google maps, reviews: TripAdvisor)	
I use different web sources to get insights for eating	
I use city-specific application to get food information	

I use some application to get food information		
I need many reviews	Need others' opinion	Others' opinion is of use
I see the reviews on websites/application		
I like the extensive reviews		
I follow a majority of opinion for the food		
I use reviews of travel websites		
I go for the highest rating among the list of websites of travel		
I need many reviews		
I rely on quantitative reviews		
I need other's opinion for the new food		
I like to get others' opinion freely as many as possible		
I want recommendation from others		
I see other's reviews which is important to me		
I like reviews on the application		
I need many more opinions from others		
I check reviews and photos of the food and restaurant		
I need many others' opinion from the public		
I want to get many different opinions from reviews		
recommendations for a restaurant is important when planning	Need recommendation	
I use a website for recommendation		
I use a local people's opinion for recommendation		
I ask recommendation to server if I cannot understand the menu		
I get recommended by my friends		
I choose the food by the moment feeling among recommendation and budget		
I ask recommendation to a server		
I ask recommendation for popular food in the restaurant		
I get recommendation from the server in the restaurant.		
I ask to people to get food information at first		
I see the recommendation in the menu		
Recommendations from local people (host) is important		
I like recommendation and reviews		
I see the TripAdvisor mark (offline) in the door windows		
I also use guide or recommendation from the local people (host)		
I ask recommendation to a server for the local food		
I get food information from my friends		

They get food information from other people	
I observe what other people eat/order to know the main food there.	Observing other people
I observe how local people eat in the restaurant to learn their right way.	
I observe what local people order and choose one food of them	
I observe the other people in the restaurant and do the same	
They observe other people in the restaurant	
She observed other people inside restaurant	

(Theme 3)

Theme 3: Considerations to plan/choose the food in travel

Condensation	Code	Categories
I see location of restaurants on map App.	Finding location of restaurant on map	Choice Restrictions
I plan location to eat out with map App.		
I also consider location to choose food		
I choose the food by location (if hungry)		
I do not plan for food but just find the restaurant near my place at the moment		
I use application to get information (location, route, price, review)		
I cannot take too expensive food	Not taking high price	
I cannot take too expensive food		
Sometimes, it's difficult to find the preferred food	Difficult to find my preferred food	Food preference
I look for some food in my preference and ask for that		
I have some food preference and go for that	Particular food preference	
I have some taste preference		
I have some taste preference		
I have vegetarian preference		
I try to avoid some types of food		
I prefer meat		
I want to avoid some type of food I dislike		
One member wants to order vegetarian food in the restaurant		
The other member order something memorable for him or something familiar (personal choice)		
I think what I will eat on the day without planning in advance	Not planning for food	Instant choice
I am attracted by food smell	Affected by instant senses	
The weather affects my choice for food		

I look at the restaurant from the outside and check their food and decide to go or not		
I eat normal breakfast	Normal meal in travel	Normal food consumption
I want my normal home food (sometimes)		
Simple or normal food is enough for me		
They eat and talk just like normal		
They eat and talk just like normal		
Picture is important to know and order what I will eat	Picture is important	Picture/Image merits
Images on the menu gives clue for ingredients. (more than texts on the menu)		
I utilize the food picture I took to find out what the food and ingredients are		
Picture is important to choose what I will eat		
Food is hard to recognize by reading		
I do not understand new food by reading		
I get ideas for food by image search to decide what to eat		
I prioritize image of food and menu information as pictures		
I enjoy the food visually at first	Enjoying food visually	
He may be curious for the food from the visual or smell		
He feels the food with his senses visually and with smell		
They look at other people, especially local people, and their food visually		
I share food with my friends	Sharing food	Social interaction
I share food with my friends		
I share food with my friends and try different taste		
They talk about and share the food		
They share the food		
They share the food		
They share the food		
I share pictures through social platforms	Sharing pictures	
I like to share food photo with my family and friends		
He share the picture with friends		
I take local food information by local friends if I have	Social connection (offline)	
I talk and share information with people in the same room in hostel		
I want to be connected with different people		
I get food information from the other travelers in the same hostel.		
I choose the food depending on the people I meet in the place		

I get points and compete with friends with the points in the application Social motivation
