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TAMPERE UNIVERSITY OF TECHNOLOGY

YUANYUAN GUAN

GAMIFYING A MAP-BASED FEEDBACK SERVICE TO SUPPORT YOUTH PARTICIPATION IN CITY IMPROVEMENT

Master of Science Thesis

Examiners: Prof. Kaisa Väänänen; PhD. Jari Varsaluoma
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ABSTRACT

YUANYUAN GUAN: Gamifying a Map-based Feedback Service to Support Youth Participation in City Improvement
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In recent years, youth has been recognized as an indispensable stakeholder of city environment. On the one hand, young citizens who have intentions to contribute their community should be given an opportunity to express ideas. On the other hand, it is necessary for city agencies to listen to the needs from young generation to create a more livable and friendly city environment. Since location is considered as an essential attribute of human activities, local knowledge of residents always has a direct relation with spatial data. Thus, utilizing Geography Information System (GIS) has been developed to help public to participant in improving city environment, that is, Public Participation Geography Information System (PPGIS). However, younger people are thought to be less attracted by traditional political engagement, and annoyed with authoritative and tough tone. Thus, gamification as an innovative and increase popular trend has been implemented in a variety of youth-related applications and projects. Gamification is proposed to fulfill the desires of young people in the aspects of achievement, social, and immersion. The effects of gamification individuals with different player types and preferences of games to some degree.

The research in thesis is conducted in connection with All-Youth project based in Finland, which is a multidisciplinary research project to enhance the connection with young people and their communities. This thesis focuses on applying gamification into digital public feedback service to motivate and sustain youth participation. Firstly, the discussion of related work includes status of youth participation in city planning, digital map technology used in public participation, and definition, content, and benefits of gamification. Secondly, three map-based tools for different purpose of public participation are studied to evaluate their usability and aesthetic quality. Thirdly, a gamified feedback service is prototyped based on initial user research and analysis. Finally, the effects of the gamified prototype are evaluated in user testing with the comparison to a control prototype without gamification. The results suggest that gamification can have positive effects on attractiveness and hedonic system qualities, while it may also influence on pragmatic quality. Overall, the research of this thesis can be considered as a successful attempt to gamify the public map-based platform which could have influence on youth engagement.

PREFACE

The basis for this research is originally stemmed from my passion of UX designing and evaluation. It gives me an opportunity to review my master studies in dear TUT. What I gained from this research is more than in the thesis.

I would like to express heartfelt thanks to my supervisor Prof Kaisa Väänänen, who patiently guided me with professional and helpful suggestions. I am extremely grateful to Jari Varsaluoma, who provided me continuous strong supports during the whole research process. Since gamification is a new research area for me, Jonna Koivisto warmly gave me useful guidance to help me learning the basic knowledge of gamification. Also, thanks to the help from Ilkka Pietilä when I was conducting the research in the laboratory. Besides, I appreciate all the volunteers who took time and efforts for my works of investigation and evaluation.

Finally, I would like to thank my families who raise me up and give me endless love. And thanks to my friends who always stand by my side. Their supports give me motivation of all the studies, researches, and works.

Tampere, 25.10.2018

Yuanyuan Guan

CONTENTS

1. INTRODUCTION

The work of this thesis focuses on gamifying a digital map-based tool, used to collect feedback of their living environment from the young generation. Gamification solution is the main innovative subject in this thesis to attract youth to participate.

This thesis work is done in connection to All-Youth research project[1], under the sub-project of Digital Solution of Digital Generation directed by Tampere University of Technology. The main goal of the sub-project is to explore and develop innovative digital models and services which promote youth active citizenship, social well-being and economic growth. The designed solution in this thesis is aimed to support to this goal.

1.1 Background and motivation

Cities are made up of citizens. As the direct beneficiary in built environment, individuals should be given an opportunity to discuss their opinions with the government, which is an essential component of democratic ideals. (Callahan, 2007) On the other hand, engaging citizen involvement is important and helpful for city officials to collect feedbacks of real situations and address the public issues. In addition, it is an efficient way to getting support and appreciation from citizens when making decisions. (Irvin & Stansbury, 2004) To construct and develop our city healthy and friendly, appropriate citizen participation can create positive outcome.

Nowadays, young generation as stakeholders has been paid increasing attention to be involved in urban planning process (Heinrich & Million, 2016). As the main group in future cities, the youth should be considered as an important planner to shape the environment they live today and tomorrow. Engaging the youth to participate city planning and improvement is a way to create the environment that fit the needs from different generations as equal. Our cities need novel ideas continuously to keep vitality. Youth is the group which can bring forward more innovative suggestions to improve their surroundings. From another point of view, it also benefits youth themselves in strengthen their influence and reduce prejudice among public. Through the process of express their own opinions to city officials, it has positive influence on youth when being taken seriously and being appreciated. (Heinrich & Million, 2016)

There have been many cases studied in youth participation in city designing: “Adolescents in Urban Neighborhoods” research program in Germany (Heinrich &

[1] ALL-YOUTH, http://www.allyouthstn.fi/

Million, 2016), “Lifting New Voices” community research in the United States (Frank, 2006), the EU-project “Fantasy Design in Community” (Million & Heinrich, 2014) and among others. According to previous research, the information generated by young citizens is worthy to be considered when shaping community and environment change, which proves the capability and potential for youth participation (Frank, 2006).

Thanks to the research plan on youth by All-Youth project in Tampere University of Technology, this thesis worked with a solution of youth participation stimulation. The target group in this thesis is young adults between 18 and 25 years old. This generation is growing up with cell phones and laptops, which makes them get familiar with internet and have at least basic digital skills from an early age. Thus, it is not hard to make them accept and learn to have their voice online. In addition, with well-educated background, they can bring forward valuable thoughts in a deeper level.

Map-based service is used in this thesis for an effective built environment engagement, using public participation geography information system (PPGIS). The term PPGIS is conceived by Brown (2012) to “describe how GIS technology could support public participation with the goal of including local or marginalized populations in planning and decision processes.” Advanced PPGIS technologies provide a potential way to achieve effective interaction between citizens and government to collaborate with wide range of natural, social and built environment solutions (Bugs et al., 2010). Over the past decades, PPGIS has been widely implemented on urban planning. In this thesis, PPGIS is used to gather public comments on interactive online map.

There have been plenty of map-based service or research tools to collect feedbacks from participants. In addition, there are feedback systems developed by Tampere city officials for the regarding streets and parks. Many customer cases benefited from these tools to receive insights of city planning from locals. Thus, their survey tool based on map marking can be considered as an effective way to collect ideas contributed from citizens in planning and improving process. As one part of the thesis, a group of tools are reviewed to test their usability, which is the foundation for the gamified design process.

The main goal of this thesis is to explore a solution of the map-based tool to motivate youth participation. Recently, the use of gamification strategies has been trading rapidly to engage the end users while implementing the system with playfulness. Considering game is friendly and always attractive to youth, thus, applying gamification can be considered as one potential approach to engage youth participation. The “gameful design” (“typically by using game design elements”) (Deterding et al., 2011) has been applied to many aspects of life, making positive effects on motivating individuals. In human-computer interaction, gamification is “an informal umbrella term for the use of video game elements in non-gaming systems to improve user experience (UX) and user engagement.” (Deterding et al., 2011) Using game design elements including interface design patterns and game mechanism under the premise of understanding the motivation

of youth to interact with the map-based survey tool, which is the emphasized point in this thesis.

1.2 Research objectives

The main objective of this thesis is to apply gamification strategy to a map-based public service in order to engage youth participation. The initial effort put in the thesis is studying currently available tools, in order to be proficient in system process and identify usability issues. The thesis is concentrated on human-centered design of the digital map-based tool to support youth, based on studying youth's preferences and needs of environment issues. Gamification is the main innovative approach in designing process. To validate the outcome from gamification, user testing is conducted to gather qualitative data, and to provide the improvements to iterate the design further.

This thesis addresses following two research questions:

1. How can a map-based tool be used to collect public feedback of city environment?
2. What kind of gamification mechanisms can be prepared for youth engagement?

The first research question addresses in inspecting existing solutions of public participation tools using digital maps. The geography information system reviewed in literatures is the foundation of these tools. Heuristic evaluation of a group of map-based survey tool is in order to analyze how it works to answer the question. The survey based on web questionnaire is used to support the basis of user needs.

The second research question refers to gamification in the design. The review of literatures gives the theoretical background about digital youth participation and gamification techniques. It included the gamified design process using appropriate game design elements, and evaluation process of the prototype to find both the beneficial and useless outcome brought from gamification.

1.3 Research process

The research process consists of five stages (see Figure 1): Related work, Map-based tools study, Design, Evaluation, and Reflection.

First, a literature review of potential of digital youth participation in urban planning, basis of map-based services, principles and applications of gamification in digital services and design for user experience are discussed. It provides a theoretical background of youth participation, map-based technology, and gamification in digital services. Specifically, the theories of gamification including definition, design elements, and perceived benefits are inspected. In addition, other gamification studies about the topic of youth participation enhance the potential of gamified service.

It is followed by a heuristic evaluation of a group of map-based tools (Maptionnaire, PublicStuff, and Happycity) to discuss the usability and user experience of them. The set of UX heuristics are adapted from widely adopted pragmatic and hedonic theories. The goal of the evaluation is to analyze the existing procedure of a public participation service using map source and review its user experience, which is to help the later design in this thesis. Particularly, the gameful elements involved in the services are reviewed in this chapter to validate their effects.

A survey based on web questionnaire is published to know how youth focus on different environmental issues from target group participations, which is the way to get insight into the user's activities and needs. The initial survey belongs to the user research in gamified design process. When consolidating and analyzing the qualitive data from the survey results, context of use creates to define the UX goals. The design process focuses on gamified the map-based public service. Three gamification components of achievement, social, and immersion are used in gamified prototype and expected to be perceived as positive motivation by the user.

For validating effects of gamification, the evaluation is based on User Experience Questionnaire (UEQ) to evaluate the quality and hedonic quality, and semi-structured interviews from individual participants to get ideas and insights when the participants answering the open-ended questions. Four hypotheses are proposed to guide the evaluation. For a more institutive result, a non-gamified version of prototype is designed as control.

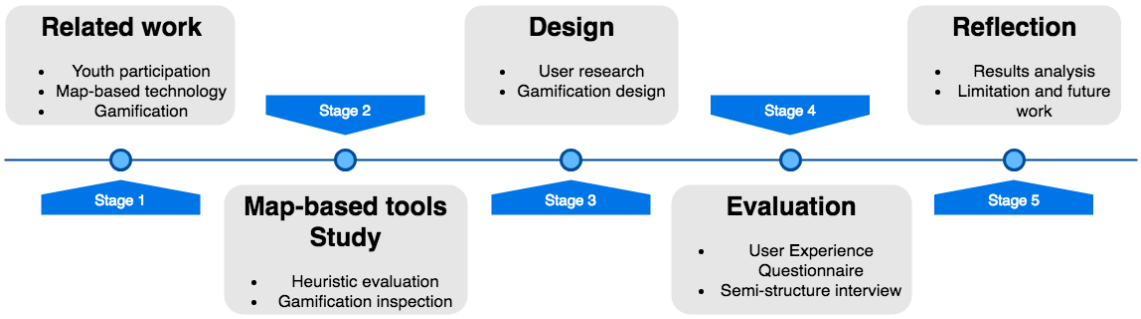

Figure 1. *Research process in the thesis*

1.4 Structure of the thesis

The rest of the thesis is structed as follows. The related work is discussed in Chapter 2 by reviewing literatures that provide a theoretical foundation to the thesis. Three existing map-based services for public participation are evaluated in Chapter 3 with UX heuristics and gamification components. Chapter 4 describes the gamifying process of public service for youth participation. And the gamified prototype is tested with a comparative non-gamified prototype in Chapter 5. In Chapter 6, expected contribution, limitation, and the future work are discussed.

2. RELATED WORK

This chapter focuses on the review of related literatures including current knowledge of youth participation, map-based technology, and gamification. The process of literature review as the preparation of this research contributes to provide a basic guide and build a theoretical foundation of this topic.

2.1 Digital youth participation in city planning

In recent years, youth has been recognized increasingly as a significant stakeholder group to be involved in city planning and construction process (Frank, 2006). Since young people are different from older adults in many aspects, the special needs and preferences in their surroundings are needed to be considered when planning city. In addition, youth has responsibility and right to shape and the environment they want to live in the future, which is also the way to develop the capability of young citizens in democratic society (Heinrich & Million, 2016). Due to the familiarity of internet, engaging youth to participant in city planning via digital services can be considered as an important way.

2.1.1 Youth involvement in citizen participation

Despite citizen participation is now a "contested concept" mostly has question of determining the proper extent of public participation in deliberative process, there is a belief that every individual live in our city should be given an opportunity to make voice for improving surroundings, which is an important component in democratic theory (Callahan, 2007). Hafer & Ran (2016) answered the questions about "why" and "how" for citizen participation. The need of public hearing is apparent. Along with the development of modern societies, the relevant public problems are increasingly getting complex. For better solutions to these problems, it is hard to ignore the potential contribution from citizens. In addition, engaging public participation is an opportunity to get fresh ideas that don't be considered previously. Rather than indirect participation ("e.g. relying on elected representatives, lobbyists, or interest groups to take actions on one's behalf"), the focus is on direct participation ("situations where individuals are personally and actively engaged in a process" either in person or based online") to achieve more meaningful involvement. The citizens in Finland have been given the rights to participate the process of planning of their living environment since the Land Use and Building Act commenced in 2000 (Nuojua, 2010).

However, as a significant stakeholder group of citizens, young people are usually neglected in community and environmental planning process in the last decades, according to Frank's (2006) findings. The needs from youth may not be specifically

addressed since the planners had little professional knowledge about youth and little cooperation with them. Even in youth-oriented projects planning process, there is little interaction between the serving target and managers and organizers. As one of the results, young people had the feeling of being aliened from their communities since facing "age-related discrimination and disrespect" (Heinrich & Million 2016).

While youth participation in urban planning process is still facing arguments and challenges (Heinrich & Million, 2016), the study by Schusler & Krasny (2010) revealed that involvement in local environmental action ("involves deliberate decisions, planning, implementation, and reflection by an individual or group intended to achieve a specific environmental outcome") has positive and valuable effects on youth development in the following features defined by Eccles & Gootman (2002), for instance: creating safe spaces, building respectful and trusting relationships, providing opportunities for meaningful contribution, supporting youth as they encounter new challenges, connecting youth with their community, expanding horizons through novel experiences.

Increasing communities and organizations have taken youth into account in city planning process. Taking "Adolescents in Urban Neighborhoods" for example (Heinrich & Million, 2016), which is a funding program with 55 pilot projects launched by German Federal Ministry of Transport from 2009, aiming to "give adolescents a greater say in urban development". Within the projects, young participants play different roles in planning at city and regional level, neighborhood level, public space design and site and building design. Youth showed highly enthusiasm with city issues and willing to be active in city development process as a "city builder". Despite there are some obstacles and challenges existing in every project, according to the results from the projects, the participation of young people is valuable to address on the concerns identified and pushed by them. Involving youth in urban planning process is a potential in "bridging the gap between abstract, long-term planning and the life of adolescents". In addition, public spaces are considered as an important level of action for young people, while joint building activities highly motivate them to take their ownership.

2.1.2 Internet use for participatory planning

Despite the rationality of public democratic rights has been confirmed, the actual outcomes and influence of public participation remained limited (Kahila-Tani et al., 2016). It may be hard for citizens to participate in planning process in traditional methods. They are always asked to read and comment on long official documents in legalistic language, which are usually far away from everyday experiences.

Multiple online forums have been developed for local people to discuss public affairs through posting blogs, sharing video clips and other medias. Wilson et al., (2017) indicated that digital platform can be beneficial for the official agencies to enhance public participation. Allowing for "lunchtime participation", the online official services engage

citizens in “quick, lightweight and situated interactions”, and contribute in removing the barriers of public engagements and increased the role of citizen in planning process. In addition, using the Internet is an efficient way to reduce the cost of collecting public concern and expand range of communication. (Lin et al., 2010) The importance of using the internet is to be a tool of e-democracy, which can be defined as “using information and communication technology (ICT) to connect politicians and citizens by means of information, voting, polling, or discussion” (Nuojua, 2010). Digital platform motivates and engages wider citizen to be involved in spatial planning while improving the traditional way, which is described as e-participation that defined by as “the utilization of information and communication technology in order to extend and deepen the political participation of citizens”. (Thiel & Fröhlich, 2017)

Younger people are thought to be less attracted by traditional political engagement (Bakker & de Vreese, 2011). However, the internet offers a potential engagement for youth in political activities including urban planning. In 2017, 92% of individuals aged between 16 and 24 years old has daily frequency of Internet access (Eurostat[2], 2017). The study by Lin et al. (2010) confirmed that the Internet has potential to promote young people to “become citizen”. They already have non-formal way to participate such as discussing public issues on social network, seeking for civic information and posting comments of city planning affairs. The online activities included by media use are augmented the positive effects on public participation for the future citizens, the young generations. (Bakker & de Vreese, 2011)

2.2 Map-based technology to support public participation

The local knowledge of living area from residents is often “invisible, qualitative and vague” (Rantanen & Kahila, 2009, p.1981). Since location is an essential attribute in human activities, using local spatial information can be considered to help citizens to express their preferences and complaints of their living area (Nuojua, 2010). There have been some approaches to connect local knowledge and spatial data twenty years ago, including “interacting groups, silent reflective techniques, surveys, focus groups, and dialectic groups”. (Talen, 2000) “Sticker map” method allows residents to use colored markers to mark locations on laminated maps and add comments (Nuojua, 2010). As a part of Kansas City’s Comprehensive Plan[3] adopted in 1997, Neighborhood Prototypes Plan encouraged citizens to show satisfaction about their neighborhood using local maps with street framework (Talen, 2000). However, the traditional practices have limited efficiency and participants, and cannot fulfill the requirements of new Land Use and Building Act. Thus, recent years, new methods of utilizing geography information system

[2] Internet use and activities, http://ec.europa.eu/eurostat/web/products-datasets/-/isoc_bde15cua
[3] FOCUS – The City’s Comprehensive Plan, http://kcmo.gov/planning/comprehensive-plan/

(GIS) based on the Internet have been put forward to make public participation process more interactive and transparent.

2.2.1 The role of Public Participation Geographic Information System (PPGIS) in urban planning

The term of Public Participation Geographic Information System (PPGIS) is convinced to "describe how GIS technology could support public participation with the goal of including local or marginalized populations in planning and decision processes" (Brown, 2012, p.7) in 1996 at the meeting of the National Center of Geography Information and Analysis. GIS is widely used to "collect, handle, store and visualize" spatial patterns and distributions (Rantanen & Kahila, 2009, p.1983). Currently only some limited functionalities of GIS have been utilized to PPGIS, mostly including "digital cartography that links local (qualitative) and expert (quantitative) knowledge" (Nuojua, 2010, p.5). According to Tulloch (2008), PPGIS can be outlined as a study focus on public application with geospatial technologies to participate in the different planning process.

In recent years, a variety of regional and environmental application have been implemented by PPGIS studies, ranging from national nature environment planning to urban park planning (Brown, 2012). GIS described by Talen (2000) as a valuable tool for residents to express inclination of their neighborhood in a simple but highly efficient way. With the ability to handle complex spatial data, GIS allows citizens to present their perceptions in a wide variety of aspects, range from local environment satisfaction (e.g. suggest to construction of neighborhood) to social issues result from human activities (e.g. figure out unsafe areas). Meanwhile, individuals can not only inquiry and add comments to existing base map, but also build future city outlines and land use. Further, residents' willing to express ambiguous local knowledge in a given area can be stimulated through GIS provides a specific spatial context for identifying the local elements, such as the location of a certain building, distribution of neighborhood and forest density. Compared to traditional paper map, GIS can respond to user's inquiry needs interactively, basically being able to change the scale of map. To handle residents' progressive and changing preferences, GIS allows residents to view a variety of distributed spatial variables with their desired coverages ("a theme or layer of data") to see the interconnection of issues, reflect their formulation and make the choices. (Talen, 2000)

However, residents' views of their living areas cannot be all expressed only via GIS, which has limitation to represent some certain qualities of meanings not related to spatial context. Thus, the purpose of using GIS is to enhance the "quality and depth" of native views collection of living environments from citizens rather than to alternate the other communication methods. (Talen, 2000) Since GIS is still complex and expensive tool to use at the moment, there should be experts to employ the technology in planning process. (Tulloch, 2008)

2.2.2 Web-based Public Participation Geographic Information System (PPGIS) approach

Talen (2000) described a bottom-up GIS concept (BUGIS) in the planning process, which allows residents to express their perception of neighborhood, since the traditional top-down GIS is a controversial way which may ignore some types of local knowledge from certain groups. In BUGIS, residents' local knowledge is respected as equally as expert knowledge in urban planning process. (Nuojua, 2010) As illustrated in Figure 2, public participation starts from individual expression, and the final goal is to reach a consensus. The typical public participation in planning process from identifying to resolving certain issues, can be described as "description, evaluation, and prescription" listed below:

- Description: Residents can use GIS to describe their daily life activity patterns, such as the places for working, shopping and services and for social activities. GIS functions including drawing and selecting can be used in the description, specially the linear features can be used to outline the routes by usual travel methods.
- Evaluation: Residents are allowed to evaluate the given area in both positive and negative aspects, including transport, spatial distribution, city views, natural environment among others. These images can be recorded by GIS.
- Prescription: Residents can express the expects of the local environment. For example, the potential area for particular function and improvement option for space can be identified with GIS tools.

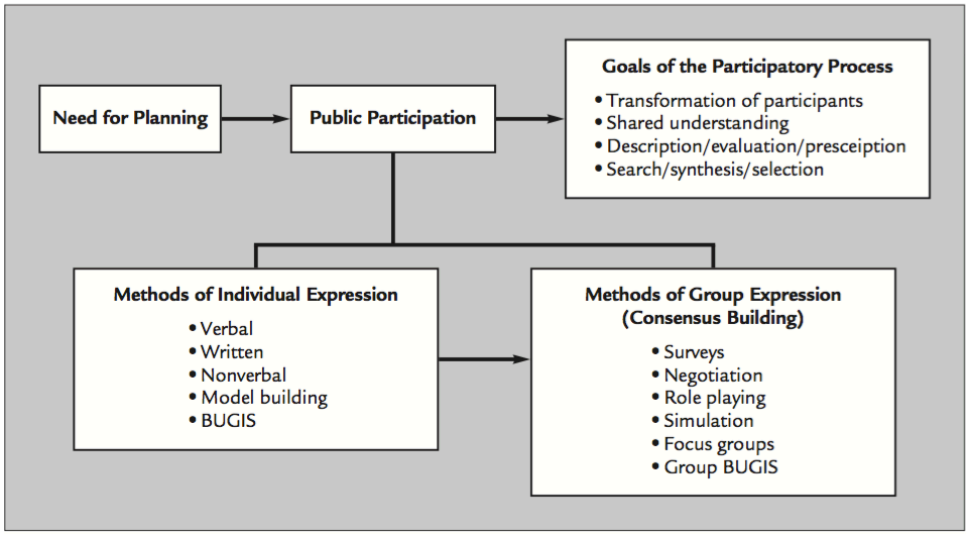

Figure 2. *Conceptual model of BUGIS in planning process (Talen, 2000, p.238)*

Since the Internet has been creating a more gainful environment for mapping applications (Brown, 2012), SoftGIS method is proposed based on bottom-up approach, utilizing potential of the Internet to map local knowledge from citizens (Nuojua, 2010). Relying on "Web 2.0" technology, mapping applications can be accessed by anyone who has internet connection and web browser at anywhere (Jankowski et al., 2016). The aim of

SoftGIS approach is to assimilate local knowledge into planning process and support it, and the essential tool is interactive map with highly usable interface. SoftGIS can be implemented in two basic ways in urban planning process:

- Online questionnaire: In SoftGIS research, the online questionnaire with mapping tool can be developed to gather public perceptions. Citizens can respond the open and closed questions related to their living area step by step, thus the planner can get known about the attitudes from public via analyzing the GIS data.
- Development forum: It provides a continuous cooperative platform between residents and city planners. It combines interactive map and content management system, to contain local knowledge from local users together with formal knowledge from authority. (Rantanen & Kahila, 2009)

SoftGIS approach emphasizes the value of utilizing local knowledge in planning process. Cooperation is required for both the urban professionals and the citizens. The scientific methods and forums to handle local knowledge vary in the factors of versatile local perception, intention of multiple stakeholders and certain situation of cases. (Rantanen & Kahila, 2009)

2.3 Gamification in digital services

Gamification as a trending design strategy including gameful elements has been increasingly applied to engage the user and enhance the user experience in various system and services, among the areas of health, education, commerce, government services, environmental behaviors, marketing and advertising and etc. (Koivisto, 2017). Due to powerful and positive effects that gamification mechanics can bring to the non-game applications, integrating game design elements into e-participation system can be seen possible to create an attractive and novel platform for citizens (Thiel, 2016a).

2.3.1 Defining gamification

The term of “Gamification” was first coined by British programmer Nick Pelling in 2002. When he thought whether the user interface from games he committed to develop can be applied on commercial electronic devices, he created the “ugly” word that was described as “applying game-like accelerated user interface design to make electronic transactions both enjoyable and fast.” (Pelling, 2011) Despite the consultancy he founded to develop gamified platforms for manufactures didn’t attract customers at that early moment, gamification starts to be widely adopted around 2010 when researchers noticed gamified mechanism as a new trend to generate user engagement (Deterding et al., 2011).

Before the academic definitions of “gamification” established within the research field, there are two main ideas using this word (Deterding et al., 2011). The first view is concerned about the influences taken from video games and game elements to change our

daily life. American game designer Schell (2011) declared this condition of "where every second of your life you're playing a game in some way" as "gamepocalypse". Same as game designer, McGonigal (2012) discussed the topic of "gaming can make a better world" and pointed how games affect player's traits such as "urgent optimism", "social fabric" and "blissful productivity", which are positive humanity in future. The second idea is to use the design approaches of games in non-game products and services to motivate the user and get desirable and enjoyable experience (Deterding et al., 2011). Zichermann & Linder (2010) treated game as a "proven, effective and ever-more pervasive marketing tool" and coined a marketing term "Funware" to explore the way of using game mechanics and elements to influence customer behaviors.

Nowadays, the concept of gamification can be formulated broadly in cultural and social aspect. On the other hand, it can be narrowed to the perspective of "human motivation and experiences in gameful interactions", which is the most frequently referred currently. (Koivisto, 2017) Gamification is defined by Deterding et al. (2011) as "the use of game design elements in non-game contexts", which is unpacked into four factors in details – "game", "elements", "design" and "non-game contexts". Deterding et al. (2011) made a distinction between the concept of "game" and "play", "gaming" and "playing" and "gamefulness" and "playfulness". As gamefulness denotes the experiential and behavioral quality of gaming, playfulness denotes the quality of playing. The concept of gamification is often coincided with gameful design, which refers to the use of game design elements for gameful experiences. Further, gamification and gameful design can be relative intentional properties as the strategy and goal respectively of using game design elements.

Level	Description	Examples
Game interface design patterns	Common, successful interaction design components and design solutions for a known problem in a context, including prototypical implementations	Badge, leaderboard, level
Game design patterns and mechanics	Commonly reoccurring parts of the design of a game that concern gameplay	Time constraint, limited resources, turns
Game design principles and heuristics	Evaluative guidelines to approach a design problem or analyze a given design solution	Enduring play, clear goals, variety of game styles
Game models	Conceptual models of the components of games or game experience	MDA; challenge, fantasy, curiosity; game design atoms; CEGE
Game design methods	Game design-specific practices and processes	Playtesting, playcentric design, value conscious game design

Table 1. *Levels of game design elements (Deterding et al., 2011, p.12)*

Deterding et al. (2011) propose that artifactual game design elements should concentrate on affording gameful expressions rather than being gameful. In addition, the elements related to social interaction in game should be considered as well. Game elements can be

treated as “a set of building blocks or features shared by games”. To describe the methods of gamification deployment, the game design elements can be identified in a “level mode” listed in Table 1, which is ordered from concrete to abstract.

A gamified system is built up with the intention of using several elements in game, which provides the user a gameful experience while using the system. The use of gamification should take place in the non-game context regardless of specific usage intention. Deterding et.al (2011) opposed that games can be gamified, since using any game design element as a part of game is to design game rather than gamification.

While the definition from Deterding et.al (2011) is involved only the systemic perspective to games, Huotari & Hamari (2012) defined gamification theoretically in the field of service marketing as, “a process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation”. Huotari & Hamari (2012) arranged the definitions of game and gamification conditions from past researches into three levels of abstraction in Table 2. The “game design elements” labeled by Deterding et.al (2011) are under the second level of systemic conditions including conflicting goals, rules and uncertain outcomes.

Level of abstraction	Systemic conditions	Experiential conditions
1st level (common to all games)	Games as systems	Requirement of player/user voluntary involvement
2nd level (characteristic of games but not necessary in all games)	Conflicting goals	Hedonic pleasure
		Mastery/achievement
	Rules	Relatedness
		Suspense
	Variable and uncertain outcomes	Competence
		Flow
		Immersion
3rd level (unique to games)	-	-

Table 2. *Game conditions (Huotari & Hamari, 2012, p.18)*

From marketing services perspective, as games are treated by Huotari & Hamari (2012) as service systems, game design elements can be treated as service. This description is supported by Table 2 that in the first level, game can be considered as systems that require the user voluntary participation. Hence, games are “co-produced by the game developer and the player(s)”. While the game developer contributes the “co-production” in games design process, the players participate and generate values through interacting with games. The game services aim to support the players with a “hedonic, challenging and suspenseful experiences”. The quality of game services is determined by their function and the values is influenced by player’s subjective perception.

Huotari & Hamari (2012) emphasized the goal of gamification in their definition. Instead of focusing on game design elements, gamification can be comprehended as a process of affording the service with gameful experience, for the purpose of value creation.

Other than the two definitions above that are adopted widely, there are also multiple other valued academic formulations of gamification with varied emphasis. Koivisto (2017) came up with a conceptualization in a general level based on the understanding of current notable theorizations of gamification (see Figure 3).

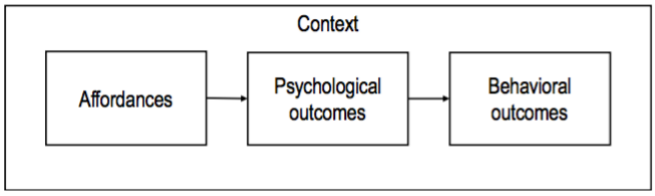

Figure 3. *The central elements of gamification (Koivisto, 2017, p.33)*

Within this conceptualization, gamification is considered to contain four core elements. Gamification takes place in certain context. The affordances refer to the elements designed for gaining gameful experience that consistent with the term of psychological outcomes. The goal of a gamified system reflects in behavioral outcomes, which is to support the specific activity in interaction.

2.3.2 Game orientation and components

Despite the fact that gamification is applied in different context with game design, it relies on the elements sourced from game design. The psychology of individuals when playing a game is seen to influence them when using a gamified application.

Indeed, players tend to be addicted to different gameplay types and styles. Bartle (1996) indicated four typical psychologies when people playing games: 1. Achievement within game context, 2. Exploration of game, 3. Socializing with others, 4. Imposition upon others. Naturally, players' interests are not strictly stable when playing different types of games with changeable mood. Even though, individuals always have their "primary style".

Based on the preferences of game styles, Bartle (1996) defined four principal player types which is presented in Figure 4. Within the graph, x-axis specifies the emphasis in the system: Players (left) and World (right), while y-axis goes from the interests of Acting (top) and Interacting (bottom). Four player types can be detailly explained as following:

- Achievers

An achiever enjoys doing actions in the game world. To treat game environment as a full-fledged world that players tend to be immersive, the achievers want to become master in the world. Hence, they focus on pursing higher levels and accomplishing ongoing tasks.

- Explorers

They are interested in interaction with the game world. The explorers desire to experience wonders in the virtual world. They are proud of their large amount of knowledge.

- Socializers

The socializers like interacting with other players. They have a strong willingness to get connection with others and keep in touch with them. The talking action can be further extended to exotic behavior like collaboration and sharing.

- Killers

A killer tends to act on other players. The killers are highly competitive and get a thrill from winning. They would like to show their excellent skills in the game world and care about their ranking and reputation.

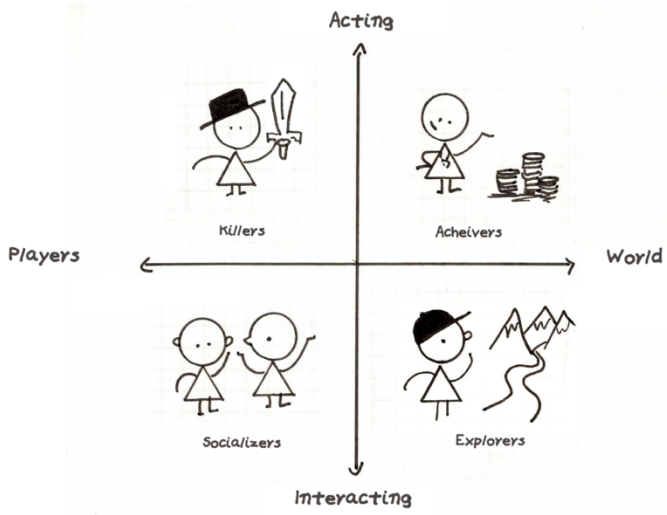

Figure 4. *Bartle's taxonomy of player types*[4] *(Bartle, 1996)*

Bartle's taxonomy labels players with different interests and motivations in simple categories, meanwhile, it is emphasized an individual should not be measured with one independent type. Through the data collected from the qualitative survey generated from Bartle (1996)'s player categorization, Yee (2006) analyzed multiple game elements and grouped them into three components that include ten subcomponents (see Table 3): Achievement (advancement, power, accumulation, status), Social (socializing, relationship, teamwork), and Immersion (discovery, role-playing, customization, escapism).

This study provides a foundation to clarify different player motivations related to the subcomponents. On the other hand, the effects of these motivation components could be correlated to age and gender of the player. For instance, though male players have the

[4] Illustration by Christina Wodtke, https://medium.com/@cwodtke

needs of relationship as female players in gameplay, the detailed factors they focus on may be different. The diversity based on players' age seems to appear more obviously. In addition, demographic variables are existing because of some usage differences like frequency of playing game. (Yee, 2006)

Achievement	Social	Immersion
Advancement Progress, Power, Accumulation, Status	**Socializing** Casual Chat, Helping Others, Making Friends	**Discovery** Exploration, Lore, Finding Hidden Things
Mechanics Numbers, Optimization, Templating, Analysis	**Relationship** Personal, Self-Disclosure, Find and Give Support	**Role-Playing** Story Line, Character History, Roles, Fantasy
Competition Challenging Others, Provocation, Domination	**Teamwork** Collaboration, Groups, Group Achievements	**Customization** Appearances, Accessories, Style, Color Schemes
		Escapism Relax, Escape from Real Life, Avoid Real-Life Problems

Table 3. *The subcomponents revealed by the factor analysis grouped by the main component they fall under (Yee, 2006, p.773)*

Apart from the achievement-oriented, social-oriented, and immersion-oriented components, Majuri et al. (2018) suggests several non-digital elements that could afford gamification: location data usage, motion tracking, real finance reward, and physical game resource. In addition, there are some miscellaneous elements that may orient multiple components or have no specific target, such as assistance, virtual currency, adaptive difficulty, game rounds, onboarding, remainders and cues, and penalties. These elements can be considered as the supplement to Yee's (2006) categorization.

2.3.3 Perceived benefits of gamification

The purpose of implementing gamification in technical systems is to increase motivation and engagement of using service and then to support achieving the goals of the service (Koivisto, 2017). There is a distinction of service targets based on the use orientations and objectives. Van der Heijden (2004) classified two types of systems as utilitarian and hedonic. While the mission of utilitarian systems is to serve the user with instrumental value, hedonic systems aim to supply self-fulfilling value. It is a consensus that individual's motivation is sourced from external and internal factors. The use of utilitarian property aims to motivate the user with an external goal. On the other hand, the systems draw support from hedonic characteristics to promote a usage willingness intrinsically (Hamari & Koivisto, 2015).

A utilitarian system is designed for supporting productive use to enhance the user's job performance. The objective is to increase the user's motivation to use the service under the influences of perceived usefulness, efficiency and ease of use (Davis, 1989). In

contract, the design of hedonic system focuses on giving the user an enjoyable experience while using the service. Unlike using a utilitarian system is always treated for an external purpose, the pleasurable design of a hedonic system draws attention to give the user intrinsic motivation and encourages a prolonged intention of use. (Van der Heijden, 2004) Due to the multiple nature of system, the willingness of using the services can be influenced by the designs aiming to different system objectives. Hamari & Koivisto (2015) suggest that gamification is expected to support both utilitarian systems and hedonic systems. Thus, the aim of considering gamification as a design solution could be "motivating the user toward utilitarian goals via hedonic means".

Despite perceived usefulness is an essential determinant of user belief in job performance mostly in particular contexts such as organizational environment, it is indicated by Van der Heijden (2004) to have less influence on use intention of a hedonic system. But a gamified system has to contain essential usefulness to keep a continued use. Moreover, the gamification strategy which supports the attribute of easy to use could enhance efficiency of the system and reduce possible obstacle of use (Hamari & Koivisto, 2015).

Although individuals feel a sense of challenges and get more skilled experiences in the context of serious work, they acquire more motivation during the time of leisure and play (Atkinson & Kydd, 1997). Hence, natural hedonism is considered to affect the job performance. Higher cognitive playfulness is found by Martocchio & Webster (1992) to result in positive involvement and satisfaction, which encourages individuals to give a higher performance in human-computer interactions. Playfulness as an essential motivation-relevant attribute contributes a creative and explorative behavior. The use of gamification is claimed to create a playful experience through interacting with the system. In addition, the enjoyment in gamified system is expected to influence use intention positively (Hamari & Koivisto, 2015). Enjoyment as an intrinsic factor affects motivation is instrumental for individuals to perform valued outcomes (Atkinson & Kydd, 1997).

Zhang (2008) summarizes design principles for motivational affordance as presented in Table 4. Since the need is one of the essential influencing factors of human behaviors, gamification could potentially support motivation. In information and computer technology, one of the user's motivation resource is the needs for "the maintenance of life" and "the nurturance of growth and well-being". A psychological need is fulfilled the individual's desire to pursue personal development in lifetime. A social need is to reach the requirement of an active interaction with social environment. (Zhang, 2008)

In addition to utilitarian and hedonic characteristics contained in the system, different game mechanics implemented in the system are claimed by Amir & Ralph (2014) to cause effectiveness in intrinsic motivation dynamics (e.g. feelings of autonomy, competence and relatedness), extrinsic motivators (e.g. points, levels and badges), core game mechanics (e.g. objects, actions, rules and skills) and immersive dynamics. The intrinsic motivation dynamics refer to psychological and social needs.

Motivational Needs	Design Principles
Psychological: **Autonomy and the Self-identify**	Principle 1. Support autonomy. Principle 2. Promote creation and representation of self-identity.
Cognitive: **Competence and Achievement**	Principle 3. Design for optimal challenge. Principle 4. Provide timely and positive feedback.
Social & Psychological: **Relatedness**	Principle 5. Facilitate human-human interaction. Principle 6. Represent human social bond.
Social & Psychological: **Leadership and Followership**	Principle 7. Facilitate one's desire to influence others. Principle 8. Facilitate one's desire to be influenced by others.
Emotional: **Affect and Emotion**	Principle 9. Induce intended emotions via initial exposure to ICT. Principle 10. Induce intended emotions via intensive interaction with ICT.

Table 4. *Summary of design principles for motivational affordance (Zhang, 2008, p.2)*

However, the benefits of gamification depend on the system type as well as the context of use. Moreover, it has been proved that there are individual differences in gamification effectiveness. (Hamari & Koivisto, 2015)

2.3.4 The potential of gamified participation approach

People are lack of time and interests to put efforts in the political participation with low efficacy. Due to this public apathy to politics, there could be an obstacle to engage citizens with the traditional participation methods. With the development of modern information and computer technology, e-government has becoming popular and has been widely adopted to create web-based public platforms to support transparent and effective official institutions. (Thiel, 2016a) Despite these digital services developed by majority of agencies in the last decade provide citizens an interactive and communicative platform to discuss urban planning situations, it has been noticed that some of these tools are not efficient to expand public participation in a certain degree (Thiel & Fröhlich, 2017).

Apart from the indifference of public affairs, the usage of technology can be considered as one complication of e-participation. It is seen as a challenge to eliminate distrust from public since digital services are open and accessible for everyone. In addition, although the novelty effect from e-participation platforms may attract technology-affine people only to explore the tool with the innovation of communication technology, the benefits of public feedback are limited. (Thiel, 2016a)

To reduce the knowledge gap between the city professionals and the citizens is not the only solution to encourage more people to participate. People need some motivation to participate actively apart from altruism, such as positive feedback, easy access of public platforms and trust the adoption of the platforms. (Thiel, 2016a) Since gamification is designed for the purpose of motivation and the efforts of public participation relies on a

continued interaction with the local people, gamified application can be considered as a possible appealing mechanism to contribute stimulate and retain voluntary citizens (Bowser, 2013).

Thiel (2016b) suggests two core types of gamification for public participation namely reward-based gamification and social gamification. The reward-based gamified mechanics focus on giving the participants rewards to response their contribution. Citizens can submit missions provided by city officials and also give their active input in order to get points, advanced progress and badges on leaderboard. The social gamification can be described to combine reputation system and virtual interaction service. On the one hand, the user has opportunities to connect with other users directly or indirectly. It means there is a communicative platform open for citizens. On the other hand, this gamified system can create social effects including self-identify, recognition and relatedness. People tend to feel self-value in community when others appreciate their contribution.

Taking the project of Community PlanIt[5] as an example of gamified public platform that aims to provide an opportunity for citizens to learn the community issues and promote them to suggest solutions. A series of missions can be challenged by answering the questions based on their local knowledge (see Figure 5). The user earns virtual rewards like coin bonus and is allowed to compete with other users. Through the gameful cooperation with city planner and other citizens, the user can contribute in planning process as a problem-solver.

Figure 5. *Challenge question in Community PlanIT*[5]

Gamified public systems encourage citizen involvement to occur in a playful and enjoyable democracy environment. However, gamification in city planning system has to be designed carefully and properly, in order to get meaningful responses. In addition, gamified solution cannot cover all types of social and political issues. And it needs to be noticed that possible gradually decrease of participants over time. (Vanolo, 2018)

[5] Community PlanIT: https://elab.emerson.edu/projects/community-planit

2.3.5 Gamification for youth engagement

Morris & Venkatesh (2000) indicated that age is an essential factor to influence the degree of technology acceptance and usage. As a result of growing up with information technology, the young generation tend to rely on the modern technical solutions to support individual life and work. On the other hand, the age-related biological factors of both physiology and psychology effect the perception obviously. Younger people have less difficulties of learning how to use the new technology effectively under the guidance.

As an innovative trend of technical approach, gamification is continuously popular to emerge into digital applications related to youth. Youth including well-educated young adults are founded that most of them are annoyed with authoritative and tough tone. The elements and mechanics of gamification used in digital platforms can possibly balance this information and encourage young people. (Nour et al., 2018) Bringing more pleasure using experience, gamification reduces bored sentiment in the serious context to a certain degree (Al-Azawi et al., 2016).

On the other hand, the gamified application can be accepted to young people for building a long-term behavior and promoting self-regulation (Nour et al., 2018). In school and at university, gamified educational systems have been validated their effects on learning engagement and behavior development (Al-Azawi et al., 2016). Young people express interests in rewards for their efforts as positive feedback in gamified system. Setting challenges is seen to be effective to encourage a continued use. Also, gamification caters to the natural instincts of competition. (Nour et al., 2018)

In addition, gameful digital services fulfil the needs of young people to cope with social communication in different patterns. The social-related applications not only enhance the connection with familiarity, but also create opportunities to meet strangers (Yoon & Jin, 2016). Young people has strong expectation of online social media for daily interactions. Emerging gameful design elements into social aspects of digital platforms increases communicating motivation and interests to a certain degree (Al-Azawi et al., 2016).

Apart from actual gameplay strategies, appealing and emotional interfaces of the gamified applications are preferred by a number of young people, especially female users. The feature of customization tends to be attractive to the user who desires an aesthetic and visual system. (Yoon & Jin, 2016)

2.4 Summary

It can be seen in the literature reviews that the local knowledge from citizens is based on its location to a large degree, so the map-based technology matters the public platform. Thus, Geography Information System (GIS) is implemented to support public participation, that is Public Participation GIS (PPGIS). The previous researches and

projects indicate the potential of youth participation. Young people should be given an opportunity to participate in the process of improving city environment. However, younger people are thought to be less attracted by traditional political engagement, and annoyed with authoritative and tough tone. Thus, gamification as an innovative and popular trend has been implemented in a variety of youth-related applications and projects. The potential benefits of gamification motivate to gamify the public feedback service for young people.

3. RESEARCH PROCESS AND METHODS

This chapter describes the overall process of the thesis research and the methods used. The main goal of the research is to design the youth-target public feedback system with gamification mechanism. Literature reviews in Chapter 2 serve as a theoretical basis of the research process development in this thesis.

3.1 Overall research process

The whole process of research in this thesis is presented in Figure 6. Each step is explained as following.

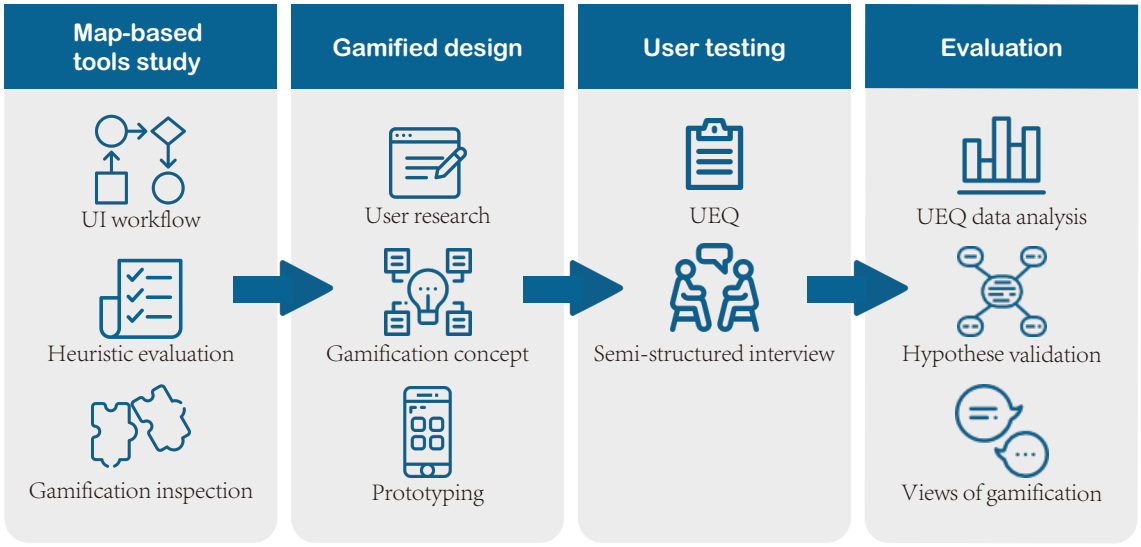

Figure 6. *Research process in this thesis*

Map-based tools study

As was presented in Section 2.2, location is an essential attribute to describe the soft knowledge from the local residents. Thus, PPGIS is a basic tool used in the public platform. The first step of the research is to study three existing map-based public services as examples. UI workflow for each service is created to explain its interaction process with mobile application. Building UI workflow is the process to figure out how every element on the screen works to support the user tasks related to public affairs. In addition, it is to inspect how digital map can help the task performance.

Ten user experience heuristics integrated from previous researches are prepared to evaluate these three map-based services. Heuristic evaluation is conducted to inspect the pragmatic and hedonic quality of the example services. Meanwhile, it is a process of summary positive and negative findings of user experience.

Also, the potential gamification usage in the three services is inspected in the study. Based on the researches in previous literatures mentioned in Section 2.3, the game design elements are categorized into three components: achievement, social, and immersion. Each component presented different motivation of game is also prepared to support next gamified service designing process.

The main goal of this step is to understand how a public platform with digital map works, and to evaluate their user experience quality to support following design process. Thus, the three typical and available services with different target public goals are chosen. The expert evaluation is conducted by the author of this thesis. This step is described in detail in Chapter 4.

Gamified design

Before the actual service design, the initial survey based on an online questionnaire is conducted to collect the ideas from young people living in Finland. The content of survey is mainly relevant to the responds' concerns about their living environment. The results of the survey gain the insights into the user and their needs, and support the quality analysis of young people's intention of use.

The context of use and design goals are identified based on user research data. In the process of gamification, the gameful motivating experience is described with the help of skill atom. The components include goals, actions, object, rules, feedback, challenge, and motivation. Based on the analysis, several game design elements are chosen from Section 3.4.3 to support the gameful user experience. Different game design elements are expected to be perceived as efficient motivation by the young users. A dynamic chart is built to describe how these gameful elements emerge into interaction process. The design concepts of gamification are explained in Section 5.2 and 5.3.

The high-fidelity prototype is developed with Sketch[6]. It provides the functions of answering survey, submitting feedback, and explore nearby ideas. Customized characters, points and badges, virtual market, and social features are used in the design. The prototype is presented in Section 5.4.

User testing

In order to get a more intuitive insight of the effects of gamification, a control non-gamified prototype is created with basic functions. In the testing process, the participants are asked to compare the two versions of prototypes.

The one-to-one user testing contains two components: questionnaire and semi-structured interview. There are three questionnaires needed to be fill in the testing process. Before

[6] Sketch, https://www.sketchapp.com/

evaluating the prototype, the participant answers the background questionnaire to express their opinions about public participation and preference of game elements. The participants are asked to interact the two prototypes presented in mobile device. The post-testing questionnaire is to collect the comments about gamified prototype. 13 statements in post-questionnaire based on gamification components need the participants to identify. User Experience Questionnaire (UEQ) focuses on the pragmatic and hedonic quality comparison between the two tested prototypes. After completing the questionnaires, in the interview process, questions about preferences of two versions of prototype, future intention of use, and suggestion for improvement are asked to collect more detail insights from the participants.

The user testing process is organized by the author. Used questionnaire materials are presented in Appendix and the participants status is described in Section 6.3.1.

Evaluation

In order to clarify the effects of gamification, three hypotheses are prepared to support the evaluation process. The hypotheses are defined with the aspects of pragmatic and hedonic quality, influence on future use, and perception of gamification.

The evaluation process is based on the results of user testing. UEQ data analysis sheet created by the developer of UEQ is used to evaluate the pragmatic and hedonic quality of gamified service and compare to non-gamified service and the benchmark. The results of post-testing questionnaire from each participant aim to figure out how he/she perceives different game elements and how the game elements motivate him/her. Both positive and negative views from the interviews can be used as the evidence of gamification effects. The evaluation results are presented in Section 6.2. Based on all the analysis of user testing results, the defined hypotheses can be considered to be supported or not supported. The analysis process is presented in Section 6.3.

The evaluation process is the way to validate how gamification motivate and sustain young people into public participation. In addition, the participants' insights from user testing will be considered into future improving process of the gamified service.

3.2 Expert evaluation method

This section explained the methods used in the process of expert evaluation of existing map-based services. Although user experience of is abstract and dynamic, there have been a variety of researches that developed persuasive user experience evaluation criteria. In this section, the author integrates the previous heuristics of user experience to support the expert evaluation in this research.

3.2.1 Evaluation criteria

User experience (UX) as a comprehensive concept reflects all aspects of perspective on the interaction between users and technology. The ISO norm defines the term user experience as "person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service" (ISO, 2010). Although UX is abstract and dynamic, researchers have developed several theories and models to quantify the concept to make it measurable and understandable.

Hassenzahl (2008) assumed the origin of UX is consist of two dimensions: pragmatic quality and hedonic quality. The pragmatic quality of a product supports the user to achieve "do-goals", thus, it concentrates on the utility and usability of the product. In contrast, the hedonic quality focuses on creating motivation and stimulation for the user, which fulfils their "be-goals".

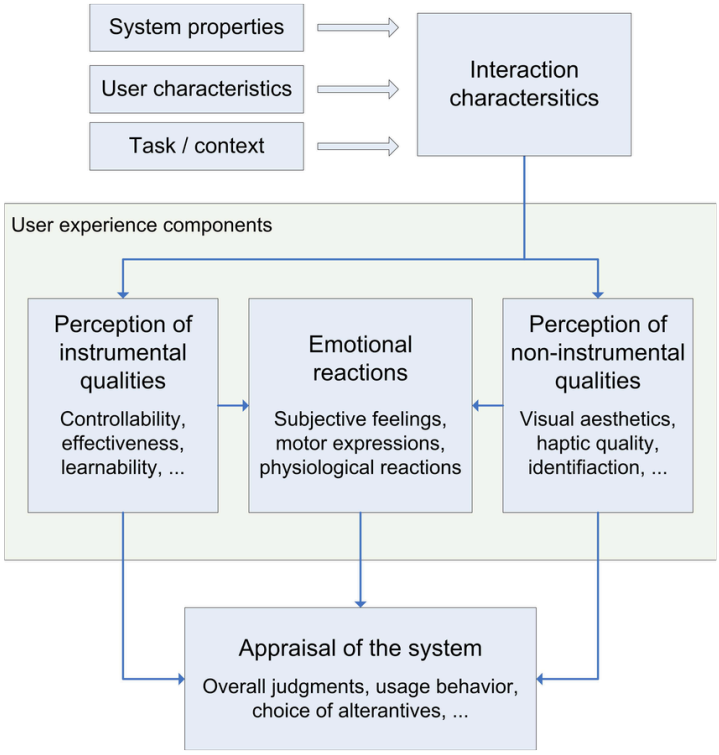

Figure 7. *Components of User Experience (CUE model) (Thüring & Mahlke, 2007, p. 262)*

Thüring & Mahlke (2007) propose Components of User Experience (CUE) model (see Figure 7), indicating the interaction between the user and the system can be affected by user characteristics, contextual components and system properties. User's attitudes and even mood may determine the result of using the system. Physical and social environment constitute interaction context. CUE model distinguishes two inherent qualities of system as instrumental quality and non-instrumental quality, which correspond to the components of pragmatic quality and hedonic quality suggested by Hassenzahl (2008). Specifically, instrumental qualities related to technical features involve controllability,

effectiveness and etc., which support the system easily to be used. On the other hand, non-instrumental quality concerns design features including visual aesthetics, haptic quality, identification and etc. The third components of emotional reactions from users can be also influenced by the perception of both two qualities. (Thüring & Mahlke 2007) The perception of two qualities and emotions of the user jointly determine the consequences of the interaction, including user's reviews and possibility of future usage.

According to CUE model, UX is gained from emotion and perception of both two inherent qualities of the system in the interacting process. Hence, UX of an interactive system can be measured via instrumental quality and non-instrumental quality. From instrumental aspects, the feature of usability plays a significant role in the whole interacting process and determines task completion. Since the user's attention is highly attracted by visual appearance, aesthetics as a non-instrumental quality strongly influence the user's impression to the system. (Minge & Thüring 2018) In this chapter, system usability and visual aesthetics are used as major elements of UX evaluation.

3.2.2 Heuristic evaluation

There have been a variety of theories to quantify system usability. Norman (1990) propose six fundamental principles of interaction, providing the basic outline for a better user experience of a product:

- Affordance: It refers to the relationship between the system and the user. Visible affordances provide a clue to operation for the user to figure out how to use the system.
- Signifiers: A signer is used to communicate with the user for indicating possible action, which must be perceivable.
- Mapping: It is layout of controls and displays. Grouping and proximity are important mapping principles.
- Feedback: Feedback happens to immediately communicate the results of an action.
- Conceptual model: A conceptual model is to provide explanation of how the system works and allows the user to predict the effects of their action.

Norman's core set of principles is long used as an accessible guide of designing everyday products easy and effortless to use. It is a fundamental approach to enhance user experience of interactive interface. Specifically, to identify the problems associated to user interface (UI) design, Nielsen (1994) developed an inspection method of heuristic evaluation that includes ten general usability principles (called "heuristics"):

- Visibility of system status: An open and continuous communication is encouraged to keep the user informed the state of system through appropriate feedback.
- Match between system and the real world: The system interface design should follow real-world conventions to give the user natural and logical information.

- Use control and freedom: The system should give the user a chance to undo and redo easily.
- Consistency and standards: The system should not use different words, situations and actions to present one thing.
- Error prevention: Good design would prevent the problem before it is caused by users.
- Recognition rather than recall: Interfaces that promote recognition help the user to minimize the information that needed to be memorized.
- Flexibility and efficiency of use: Accelerator speeds up the interaction with the system in a smoother way.
- Aesthetic and minimalist design: It should be prevented to use extra design elements like unnecessary dialogues and irrelevant animations.
- Help users recognize, diagnose, and recover from errors: The user should be given suggestions to recover their mistakes.
- Help and document: The system is better to give a help guide which is focused on users' tasks for searching.

These heuristics are naturally wide rules of thumb rather than specific usability guidelines. The method of heuristic evaluation involves evaluators judging interface with recognized usability principles. (Nielsen 1994)

Bertini et al. (2006) described a set of usability heuristics for mobile computing. Considering mobile conditions of use, the system should support the user in an easy way to input data and read screen, especially the user should be allowed to get essential information with general views by glancing ("Heuristic 5 - Ease of input, screen readability and glancability"). Mobile system should keep a minimalist design without irrelevant and unnecessary information since available screen has limitation of objects presentation ("Heuristic 4 - Good ergonomics and minimalist design"). Due to mobile devices are always private, the system should support the user to tailor frequent actions and utilize functions according to contextual situations ("Heuristic 6 - Flexibility, efficiency of use and personalization").

Usability requirements leads to complement of user's goals, while aesthetics can enhance learnability and understandability of the system and task performance ability. (Norman 1990) Visual aesthetics affects emotion of the user in the process of interaction with the system from the first glance. Lavie & Tractinsky (2004) termed two main dimensions of users' perceived aesthetics: "classical aesthetics" and "expressive aesthetics". The former notion refers to clear and orderly design for supporting usability, while the latter emphasizes designers' originality and creativity. Despite the measure of classic and expressive aesthetics provides a rough visual and sound assessment instrument, Moshagen & Thielsch (2010) claimed its limitation in several aspects and summarized widely aspects of visual aesthetics from previous researches in human-computer interaction. Four facets of visual aesthetics are proposed: simplicity, diversity, colorfulness and craftsmanship. Simplicity and diversity are treated as formal attributes

of simple layout and visual complexity, while colorfulness emphasizes the effects of color. The factor of craftsmanship refers to skillful design with available modern technologies.

The screen-based interaction between system and the user takes place in limited space, thus, how information presented and organized determines the user's judgement largely. Ngo et al. (2000) defined four measures of graphic screen layout:

- Balance: In each side of the horizontal and vertical axis, all the components should maintain an equal weighting.
- Equilibrium: There should be an equal balance among the opposing forces provided by different visual objects.
- Symmetry: The equivalent elements should be arranged in vertical and horizontal axis.
- Sequence: The elements should be sorted naturally following eyes movement.

Color is an important visual element in most of user interfaces to enhance visual messages and clarify elements that presented. Based on a science understanding of color sensation and visual system of human beings, Murch (1995) derived some guidelines for effective color usage on a visual display separately in the aspects of psychology (e.g. to avoid visual fatigue, highly saturated and spectrally extreme colors should not be used simultaneously), perception (e.g. different colors may not be discernible equally) and cognition (e.g. warm and cold color can be used as action levels indicator).

3.2.3 Integration of user experience heuristics

Based on the reviewed researches of usability and visual aesthetic theories in Section 3.2.1, a set of evaluation heuristics is adapted in Table 5, to evaluate the services from user's perspective and to define usability problems.

In general, the components of system usability focus on supporting pragmatic aspect of the service, while the visual aesthetic components support hedonic aspect. The user experience of the evaluating services can be measured from pragmatic aspect and hedonic aspect. The personal factors including age and gender of the evaluator who is the author of this thesis, are not considered. The general criteria are described below:

- **Pragmatic quality:**
  - The service can support the user to accomplish the task. (Usefulness)
  - There are no existing obstacles through using process. (Ease of use)
- **Hedonic quality:**
  - The service provides a satisfying interface for the user. (Enjoyment)
  - The user can be attracted by some design elements in the service. (Attractiveness)

The pragmatic quality of the service refers to its usability that influence on how the user performance complete tasks with it, while the hedonic quality of the service refers its visual aesthetic that influence on how the users feel when using it.

Component	Element (ID)	Description
System usability	**Informativeness** (U1)	Guidance and signifier to give the user necessary information and help to complete the tasks.
	Visibility (U2)	To keep the user informed system status and result of their action, including visible progress bar and feedback dialog.
	Learnability (U3)	Time and efforts required to learn how to use the service.
	User control (U4)	Flexibility for the user to use, pause and stop the service, and provide the way to change, check and track the tasks.
	Error management (U5)	Design to prevent errors before the user causes, and help the user recover from errors.
	Efficiency (U6)	Extent to the service enables the tasks without wasting time or efforts.
	Consistency (U7)	Match to the social conventions.
Visual aesthetic	**Simplicity** (V1)	Arrangement of screen layout, including the overall balance, grouping for relevant elements and objects orderliness.
	Diversity (V2)	Usage of visual elements of color, icons, font and even animation, reflecting visual coordination and richness.
	Attractiveness (V3)	Degree to the service interface is pleasing and arousing.

Table 5. *The set of evaluation heuristics used in this thesis*

3.3 User research method

Questionnaire is a relatively quick and cheap way to gather information from respondents. To understand the public participation intention of young people between 16 to 25 years old who are living in Finland currently, an initial online survey is conducted to gain insights of target users. The participation is voluntary and anonymous.

The personal information of the age and citizenship of the respondents (if the responder is not Finnish, he/she should answer the duration of staying in Finland) are collected. The individual background data of age and citizenship are prepared to be as the variables of comparing participation intention. In addition, the respondents are asked to rate their current living environment and indicate their general attitude about youth participation.

The respondents are asked to identify their attitudes of five different topics related to city environment: safety, local transport, social life, city planning, and care of the environment. Each topic focuses on two aspects of statements: interests of the topic (I think this topic is worthy to encourage public participation.), and intention of participation (I would like to give my feedback related to this topic.). Each statement is rated on a 5-point Likert scale from “Strongly disagree” to “Strongly agree”.

In addition, there are open questions of previous participation experience and reason of participation. The respondents can answer if they have reported city issues or answered public surveys by certain ways, which is to know the current status of youth participation. Also, the respondents need to answer why they would/wouldn't participate in city improvement, which is to know the motivation of youth participation.

3.4 Gamified design method

The method of service design with gamification is described in this section. After analyzing the results of user research, design process is started with defining user scenarios, UX goals, and skill atom. These designing concepts are considered to be the background supports. As an essential part in the designing process, gamification aims to emerge potential game design elements which are called affordances in this thesis into the visual and interaction design.

3.4.1 Human-Centered Design (HCD)

The role of Human-Centered Design (HCD) is defined as "the process that ensures that the designs match the needs and capabilities of the people for whom they are intended" (Norman, 1990, p.9). HCD emphasizes the understanding of people and their needs and desires. The process of interactive design process is presented in Figure 8.

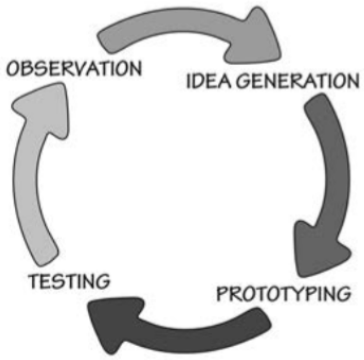

Figure 8. *The Iterative Cycle of Human-Centered Design (Norman, 1990, p.222)*

The step of observation focuses on target user group. It aims to get connection to the user and consider their interests and motivations into designing. In this thesis, the understanding of users is based on the initial user research.

In the step of idea generation, to illustrate the potential gamified solution, scenario as an analysis tool in HCD is used to specify the context of use. A scenario presents the action sequence of the user and events occur in the interaction process, which are included in the usage context. Scenarios are considered to direct attention to the usage scenes and provide thinking from the users' perspective. (Rosson & Carroll, 2002)

In addition, to understand and describe the user experience requirements, UX goals are defined in this thesis to guide the design. The goals are the designer's intention of experiences perceived by end-users. The operationalized UX goals are defined as experiential requirements for the design. (Väätäjä et.al., 2015)

The prototyping in this thesis is an attempt of gamifying the mobile public feedback service. To present the game design elements better, high-fidelity prototype is built with high level of details and functionality. The participants can interact with the prototype on mobile device. The usability and visual aesthetics of user interface are considered into the prototyping.

The step of testing is described in Section 3.5.

3.4.2 Skill atom for gameful design

Cook (2007) describes the player's process of interacting with game as the acquisition of new skills (see Figure 9). A skill refers to a behavior of manipulating the world. The players are driven consciously or subconsciously to learn new skills. On the one hand, "play is instinctual." People tend to purse some meaningful stimulation when they are in a dull or depressed situation. On the other hand, the rewards from the process of learning and understanding skills and knowledge bring the enjoyable experience. Cook (2007) claims that games can serve the positive emotion of players. In addition, players are considered to prefer the skills with higher perceived value.

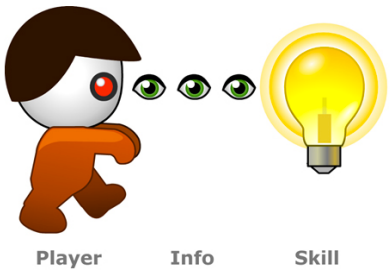

Figure 9. *The player follows clues to the acquisition of a new skill (Cook, 2007)*

Based on the player model, the process of gaining a new skill via gaming can be described as an "atomic feedback loop called a skill atom". The loop is comprised with four elements of player action, stimulation, feedback, and modeling. The skill atom can be described as: based on the player's action, the game performs ongoing stimulation with different forms of feedback to indicate situation changes. The modeling refers to the final step that the player perceives the feedback and expresses psychological changes. The whole process is considered to be looped before the player grasp this skill. (Cook, 2007)

Deterding (2015) amended a more structured skill atom (see Figure 10) for feedback loop of user identify, goal, actions, and motivation between the user and the gamified system. The feedback loop is organized around a certain challenge (or skill). The intention of

users is considered to be motivated and directed by their psychological needs. For achieving the goal, the user attempts certain actions upon the objects. There are some rules refer to the specification that the user needs to obey when doing actions. To response the actions from the user, the system should give feedback that informs the user the changing system states.

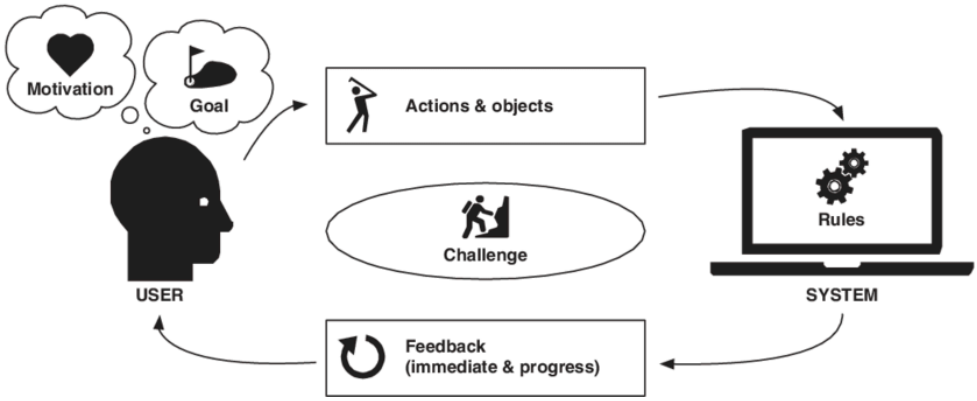

Figure 10. *Schematic of a skill atom (Deterding, 2015, p.314)*

3.4.3 Gamification affordances

The gamified systems build up from multiple game elements that help the user to achieve planned tasks with aimed actions. Based on the literature review in Section 2.3.2, the potential gamification used in the services would be described empirically within the elements summarized in Table 6, which is mainly adapted from gamification affordances studied in the empirical research papers by Majuri et.al (2018), and game components proposed by Yee (2006).

Components	Elements
Achievement	Progress (Levels, points, scores, badges, certificates) Challenge (Missions, tasks, goals, quests) Status (Leaderboard, rankings)
Social	Socializing (Casual social networking features) Cooperation (Teamwork, assistance, group achievements) Competition (Peer-comparison) Interaction (Peer-rating, collective voting, domination)
Immersion	Customization (Avatars, characters, virtual identity) Discovery (Storytelling, game rounds, virtual world exploration, adventure) Role-playing (Dialogues, roles, storyline, character history) Virtual support (Virtual currency, pets)

Table 6. *The set of gamification elements used in this thesis*

The use of gamification is expected to support both pragmatic and hedonic aspects of the system. The main objectives of implementing gamification can be described below:

- **Pragmatic quality:**
  - The gameful design element should help the user to do the tasks in a more effective and efficient way. (Usefulness and Ease of use)
- **Hedonic quality:**
  - The gameful design elements can support to create a pleasure using experience. (Enjoyment)
  - The gamified system can be used in a playful game environment. (Playfulness)

3.5 User testing method

The qualitative data is draw upon from evaluation process. A background questionnaire is given to the participants for their participation experience and preference of game. A set of tasks are prepared to ask the participates to perform within both the gamified service and non-gamified service. The service provides three types of interaction for participation: submitting feedback, answering survey, and interacting with others (only in the gamified version). All the three interactions are evaluated with given tasks. In addition, other features implemented such as personal profile and submitted history in the prototype are evaluated. There is also a task related to virtual market and planting simulation designed in the gamified prototype. The planned tasks are presented in Appendix G.

3.5.1 Comparative test

For a more intuitive insight and understanding of gamification effects in youth participation, the user testing is conducted as a comparative test between the gamified prototype and the non-gamified prototype. The control variable is gamification. The participants are given these two prototypes to evaluate their attractiveness and intention of use. The comparison performed in the process of conducting User Experience Questionnaire (UEQ) and interviewing. With UEQ, the pragmatic and hedonic quality can be compared with intuitive data. The process of interview aims to collect details of preference of two versions of prototypes. With a control testing object, it is expected that the participants would have direct comments of motivation and attractiveness from gamification.

3.5.2 User Experience Questionnaire (UEQ)

While observing the participants to perform the given tasks, the overall usability and user experience of designed prototype can be understood roughly. For a broad and measurable view of pragmatic and hedonic aspects of the gamified prototype, the User Experience Questionnaire (UEQ) developed by Schrepp et.al (2017) is conducted (see Appendix H).

UEQ aims to inspect UX of the interactive product with a benchmark quickly and directly. The questionnaire consists of 26 items grouped into 6 scales, and each item consists of a pair of opposite terms:

- **Attractiveness** (6 items): annoying / enjoyable, good / bad, unlikable / pleasing, unpleasant / pleasant, attractive / unattractive, friendly / unfriendly.
- **Perspicuity** (4 items): not understandable / understandable, easy to learn / difficult to learn, complicated / easy, clear / confusing.
- **Efficiency** (4 items): fast / slow, inefficient / efficient, impractical / practical, organized / cluttered.
- **Dependability** (4 items): unpredictable / predictable, obstructive / supportive, secure / not secure, meets expectations / does not meet expectations.
- **Stimulation** (4 items): valuable / inferior, boring / exciting, not interesting / interesting, motivating / demotivating.
- **Novelty** (4 items): creative / dull, inventive / conventional, usual / leading edge, conservative / innovative.

The scales influence the user's impression of the product, and the effect from each scale is not assumed to be independent. Each item is rated on a 7-point Likert scale. The value is ranged from -3 (totally meets the negative term) to 3 (totally meets the positive term). The relationship between the 6 scales and product quality is presented in Figure 11.

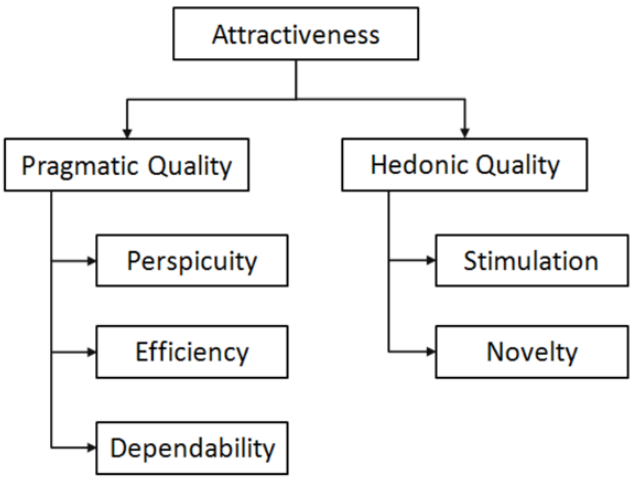

Figure 11. *Assumed scale structure of the UEQ (Schrepp et.al., 2017, p.41)*

Based on the data from previous UEQ evaluations, a benchmark is created to judge UX quality of the evaluated product in general. However, the benchmark has the limitation of non-distinguish types of evaluated product. The benchmark is explained as below (Schrepp et.al 2017):

- Excellent: The evaluated product is among the best 10% of results.
- Good: 10% of the results in the benchmark are better than the evaluated product, 75% of the results are worse.

- Above average: 25% of the results in the benchmark are better than the evaluated product, 50% of the results are worse.
- Below average: 50% of the results in the benchmark are better than the evaluated product, 25% of the results are worse.
- Bad: The evaluated product is among the worst 25% of results.

Since the experience perceived by the user is highly subjective, UEQ provides a simple and efficient method for the user to measure and indicate their feelings and impressions of the evaluated product. (Schrepp et.al 2017)

3.5.3 Gamification inspection

The semi-structured interviews are organized for explore the subjective feelings and thoughts of using the service with gamification elements from the participants. The participants will be asked about personal preference of gamified service or non-gamified service. General motivations of the participants are assessed with the open-ended questions, such as “What would motivate you to use the public service for participation?”. In addition, the participation will answer the question about the intention of continued use and voluntary participation.

To inspect the match between the specific motivation and game elements, 13 statements in post-questionnaire based on gamification components need the participants to identify. The questionnaire aims to validate the perceived motivation from gamification. The statements target to the game design elements used in gamified prototype, thus, it is a progress of validating the perceived motivation from gamification. The statements related to different game elements are described as below:

- **Achievement**:
  1. I can get positive feedback with virtual rewards.
  2. The points I got give me a sense of competence.
  3. I feel satisfied when I earn the badges.
  4. I like to the challenge from missions/quests/tasks.
- **Social**:
  1. I feel connected to peer in my community.
  2. I like to explore others’ ideas and find the people with similar thoughts.
  3. I need social interaction with others for communicating and supporting.
- **Immersion**:
  1. I like to choose the avatars and characters based on my preference.
  2. I enjoy virtual world.
  3. It is fun to purchase virtual goods with virtual currency.
  4. I like to feed virtual pets or planting.

In addition, there is one statement related to contribution: “I would like to contribute in city environment improvement” and one related to general pleasurable impression: “Using the service is fun and pleasurable”.

3.5.4 Semi-structured interview

The semi-structured interview is the final step of user testing in this research, which is used for a qualitative analysis. Some open questions are prepared to collect the detailed opinions from the participants:

- Do you prefer the gamified version or non-gamified version? Why?
- What game elements do you think attract you to use mostly? Why?
- Would you like to use the gamified service in the future? In what kind of situations?
- What do you think is the most important factor that motivate you to participate in your city improvement?
- Do you have any suggestions for improving the gamified service?

The questions focus on the preference of gamification, intention of use, and potential improvement. However, there is freedom of adapting questions in the actual interview process and allowance for the participants to bring up new ideas.

4. EXPERT EVALUATION OF EXISTING MAP-BASED SERVICES

Since location is a significant component in human activities, digital map-based technology with mature GIS has been widely utilized for public engagement. Currently, there have been various online services using map platform like giving feedbacks to a certain place and creating neighborhood social media. In this chapter, three typical and available map-based services with different purposes are chosen, including Maptionnaire for responding to public survey, PublicStuff for reporting city issues, and Happycity for sharing neighborhood ideas.

For the evaluation process, a set of user experience heuristics and gamification mechanics is integrated from related theories. The goal of the evaluation is to analyze the existing procedure of a public participation service using map source and review its user experience, which is to help the later design in this thesis. Additionally, the services are evaluated for their possible gamification elements.

4.1 Results of expert evaluation

Each part of this section contains three aspects of each service: introduction, UI workflow, and summary of heuristic evaluation.

4.1.1 Service 1 - Maptionnaire

Maptionnaire[7] is developed for the urban planners based in Helsinki, Finland to engage local residents to influence the future of their surroundings. The team of Maptionnaire studied SoftGIS that use opinions and subjective data in GIS applications, whose concept has been discussed in Section 2.2.2. It helps the urban planners to create a public participation platform of map-based surveys for a certain case or project.

Community engagement often face the problem of reaching local residents, which takes up a lot of resources but gets limited benefits. Through the online spreadsheet with map, Maptionnaire helps to gather the “personal-experience-based data” marked on the map of city by massive local residents. The solution from Maptionnaire helps the respondents to acquire a more detailed and intuitive sense of the city project and allows them to freely point out the locations involved with their ideas.

Maptionnaire provides the features of export and analyze map-based data collected from questionnaire. But the target user group in this thesis is citizen, thus, the evaluated feature

[7] Maptionnaire, https://maptionnaire.com/

would be answering a survey rather than creating questionnaire or analyzing results. The case of Green Space & Well Being Interactive Map Survey – Helsinki and Vantaa Region[8] is evaluated as an example. The content of questionnaire is not included in the evaluation.

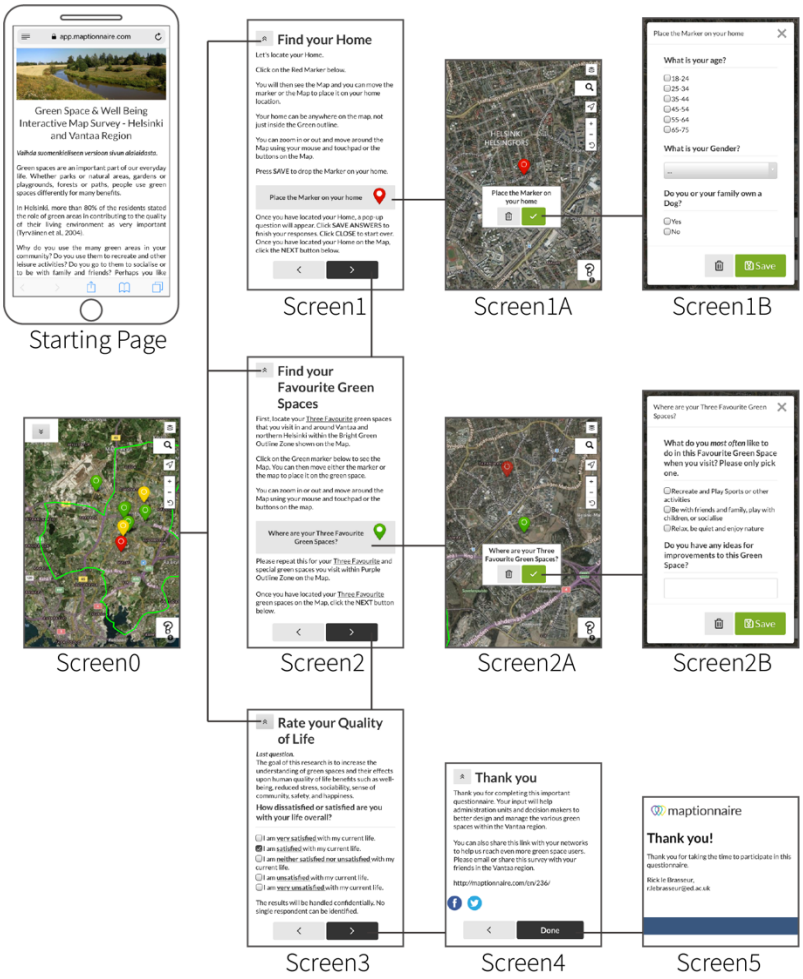

Figure 12. *The UI workflow of Maptionnaire*

The whole process of completing the tested survey is presented in Figure 12. As a fast way to collect general ideas from respondents, this survey does not need any register to participate. It starts with a purpose and context introduction of this project. In this questionnaire, the user needs to mark two types of locations on the map, home and three favorite green spaces. Each location marking is followed by a short spreadsheet with several relevant questions, including multiple choice questions and short answer questions. After saving the answers attached to marked location, it can be continued to the next question. The survey ends with appreciation message to indicate completion.

Through heuristic evaluation, 12 usability problems are found. The questionnaire gives basic guidance for the user, which abide by the heuristic Informativeness (U1). For

[8] Green Space & Well Being Interactive Map Survey - Helsinki and Vantaa Region, https://app.maption-naire.com/en/236/#

example, there is the instruction of “Click SAVE ANSWERS to finish your responses.” and “Click CLOSE to start over.” in Screen1. However, the feature of button with trash bin is “cancel” rather than “delete”, which is inconsistent with regular usage habit (U7). When locating three favorite green spaces on the map, the second one needs to start over from Screen2, which makes the efficiency lower (U6). More serious problem is that there is no feedback to indicate how many locations have been marked already (U2). The total locations on map can be found by clicking the button on the top. However, it needs the user to guess and try its feature rather than getting a more obvious indicator (U3). There is a usability problem which severity is marked as 5 – “The locations which have been marked cannot be deleted.” It means the respondent cannot make mistakes when locating the places and answering the questions, otherwise, it has to start from the beginning (U5).

The service uses satellite view of map, which helps the respondent to distinguish different types of area, such as agricultural areas, residential areas and industrial areas. The zoom level of map can be changed with button “+” and “-”, meanwhile, it can be also controlled by two-fingers movements. The marker that cannot be moved is always in the center of screen. The place should be marked with moving it to the center. There is also “Search” feature for finding a certain place, but the suggest address is not satisfied.

Yet, there is no gamification strategies implemented in Maptionnaire. The advantage is the respondent can complete some simple surveys fast. Despite a specific survey related to a specific project is one-time-use for the respondents, the attraction of the questionnaire can decide to some degree whether they would like to share the survey with their networks. In addition, an appealing questionnaire with incorporating gamification can help to encourage people who are tired with answering questions.

4.1.2 Service 2 - PublicStuff

PublicStuff[9] based in New York City, has been acquired by Accela[10] that provides cloud-based civic engagement solutions for government. PublicStuff offers local governments digital residents engagement platforms to extend access to city services. For the citizens, PublicStuff provides them a direct connection with government agencies in an easy, responsive and transparent way.

As a provider of citizen relationship management (CRM), Accela focuses on a solution of processing service request from citizens. With direct online interaction with city agencies, making requests for services can be more convenient and efficient. It enables an automated transfer of request data and report of processing status. In addition, PublicStuff also provides an access to other city information such as community announcements, public transport and local business.

[9] PublicStuff, http://www.publicstuff.com/
[10] Accela, https://www.accela.com/

Since the set of PublicStuff mobile applications based in different cities is developed in a unified user interface, the evaluation is implemented with Williamsport311[11] (version 3.9.6) for the City of Williamsport downloaded from the App Store. In order to avoid spam feedback to disturb the city agency of Williamsport, the request made for testing is not be submitted. Thus, the tracking process will not be evaluated.

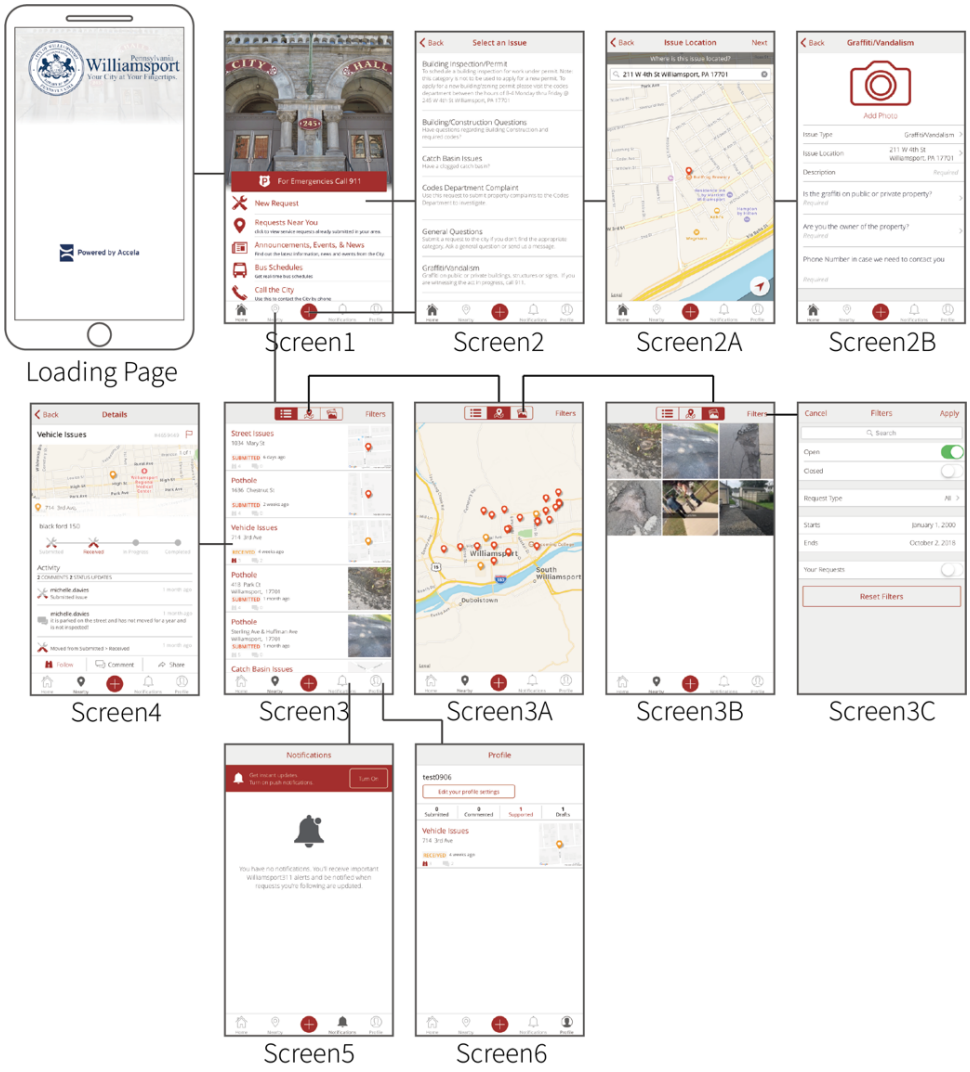

Figure 13. *The UI workflow of PublicStuff*

Figure 13 shows the interaction with Williamsport311. On the home page in Screen1, it provides an access of dialing emergency call 911, which button is in the center and emphasized with color red. The important information links for citizens is sorted by initials below, such as city events and news, bus schedules, police announcements and official website pages. A new request of service can be made via clicking "New Request" or "+" button on the bottom menu bar. The first step is to select the type of issue from the list in Screen2. And then the exact location of issue should be marked on the map. It is also required to describe the issue briefly and answer relevant questions. Phone number

[11] Willaimsport311, https://itunes.apple.com/us/app/williamsport311/id1144599376?mt=8

is needed for contacting. In summary, a complete request of service needs details of issue type, location, description, relevant property and contact information.

There are three views of checking the requests nearby – list sorted by time (Screen3), map (Screen3A) and photo (Screen3B). The filter can be applied for searching results. The details of request in Screen4 include photo, location and description of the issue. The updated status of process is showed in a line. The request can receive supports by "Follow", "Comment" and "Share".

There are totally 8 usability problems found in the process of heuristic evaluation, and most of them violate the heuristic of Efficiency (U6). The overall user interface is simple and clear with contrast colors – red and white (V2). As an official feedback service, PublicStuff guides citizens to give all the essential information that city agencies need to deal with the issues (U1). The process of filling the request form is in accordance with the regular way of thinking (U3) – what is the problem about (issue type), where is the problem (location) and why the problem needs to be reported (photo and description). Due to direct connect with government, PublicStuff allows the user to track their progress of requests with updated status (U2). Despite the current service can handle user's request adequately, there are still some improvement to enhance user experience. For example, in the step of selecting issue type, all the options are showed in text and sorted by initials, which increases the user's time to find the needed one (U6, V1). Moreover, each option is given short description that makes the list longer. If jumping to another page when filling the request, the unfinished form would be automatically saved to draft box in Screen6 without any warning. It prevents the user losing draft in progress (U5), but on the other hand, the user would not get feedback that the draft has been saved (U2). What needs to be mentioned is that the colors (red, orange and etc.) of markers on map indicate the status of progress (V2).

PublicStuff uses several social gamification elements, which supports user's interaction with other users. The requests submitted by the users can be commented and followed by others. It gives the user a sense of attention and a chance to discuss the issues in a transparent platform.

4.1.3 Service 3 - Happycity

Happycity[12] is a public participation tool developed by CHAO Architects[13] for gathering insights with location data during the city activities of citizens to contribute community improvement. In order to response increasing population in multiple facets of modern city life, there has been a high trend of citizen engagement to consider the creativity of citizens into smart city contribution. The mission of CHAO platforms is to mix raw data (security,

[12] Happycity, https://www.chaosarchitects.com/happycity
[13] CHAO Architects, https://www.chaosarchitects.com/

energy, transport, infrastructure, healthcare and building) with inspiration from citizens, which provides a hard base for city plan decision-making.

The user of Happycity is empowered to actively take part in city decision making process, through the use of simple and lean technology. Geolocation technology allows Happycity to deduce the location where the user is sharing the city ideas. A hotspot is created while posting a new idea to get notifications of reaction from others including vote, comment and share. CHAO also provides the solution of data dashboard as a platform for stakeholders to analyze soft data and forecast cities, which is not included in the study. The evaluated iOS version of Happycity[14] (version 3.0.0) is downloaded from App Store.

Figure 14. *The UI workflow of Happycity*

The application interaction takes place as presented in Figure 14. Happycity collects user data of basic information including age, gender, household, level of education,

[14] Happycity, https://itunes.apple.com/us/app/happycity/id1350412145?mt=8&ign-mpt=uo%3D4

employment status, main mode of transport and educational background. The options are represented by vector icons (Screen5A). A photo, tile, description and location are needed for posting a new idea (Screen4). It allows the user to add stickers to the photo for the purpose of indicating the type of idea, including place making (housing, retrofit, pavement, urban objects and greenery), traffic and mobility, services of culture and welfare, and surrounding environment. There are also optional stickers to express emotion. The stickers will be attached to the idea when other users read it. It provides two views to find interesting ideas come up by other users – List (Screen1) and Map (Screen2). In the List view, nearby ideas are sorted by popularity, which is decided by the amount of “Likes” and comments received. In the Map view, all the ideas are presented on the map with the sticker markers. The detail page of an idea as showed in Screen3, in where there is a chance to leave comments to this idea and save it as favorite.

Overall 8 user interface problems are found in heuristic evaluation process, and most of their severity are marked as 1. The way of login to Happycity is Facebook account. But on the profile page (Screen5A), there is only "Delete the account" function without "Log out", which means users cannot remain their account information if they have to change account for login (U4). In addition, no feedback is given when clicking “Like” button (U2). The whole space on a mobile screen is limited for presenting all the visual elements. However, the large size of optional stickers in Screen4B makes the list longer and needs more time to scan all the stickers (V1). Other than this, the overall visual design of Happycity is pleasant (V3), including clear layout, clean colors and especially icon usage.

The special usage of map is to make the markers signed with characteristic stickers. It gives the user a chance to customize. Also, the user can indicate the personal status such as age, gender, and preferences of transport with graphical icons. Happycity provides a platform for the communication among citizens. The ideas posted by the users can be discussed with other people about its rationality and severity. The user can also express their agreement by “Like” it.

4.2 Summary of expert evaluation findings

In conclusion, all the three services can support a complete task in public participation, based on the use of interactive map. They can be described in general from pragmatic and hedonic aspects below.

- **Maptionnaire:**
    - Pragmatic quality: It support the user to complete the survey basically, but there are some features like changing location that has been marked, should be improved to make the using process more efficient and reduce user errors.
    - Hedonic quality: Its interface is very simple with a balanced layout. There are little graphical objectives in the survey, which may reduce the participation interests of the citizens.

- **PublicStuff:**
  - Pragmatic quality: The user can use the service to submit and track the request. It provides also a platform for the user to interact with other users. But the process of submit a new request can be simpler.
  - Hedonic quality: It has clear and simple interface. But as an official service platform, there are no attractive visual elements.
- **Happycity:**
  - Pragmatic quality: The functions of posting of an own idea and reading others' ideas can be completed quickly. But some details like profile editing and logout feature needs to be improved.
  - Hedonic quality: It is designed with a simple but pleasure interface. Some characteristic stickers are used in marking location, which enhance playfulness.

Despite Maptionnaire and PublicStuff have high pragmatic quality, the hedonic aspects are less emphasized. Happycity tries to give the user more hedonic experience in comparison to the two other evaluated services. The main positive (+) and negative (−) findings associated to the pragmatic (P) and hedonic (H) heuristics from expert evaluation are summarized generally for map-based public services in Table 7.

UX finding from the expert evaluation	P/H	+/−
A reliable and easy way of login and logout should be provided for the user. (U4)	P	+
It should be avoided for the user to repeat same actions for an iterative task. (U6)	P	−
Too much information on one page may cause difficulty of searching. (V1)	H	−
The proper usage of icons is helpful for the user to navigate. (U3)	P	+
It is easier for the user to accept a regular using method of map. (U7)	P	+
The basic information needed to submit request/idea/feedback include photo, description, and marked location. (U1)	P	+
The major color with low brightness and saturation is friendly to the eyes in a mobile application. (V2)	H	+
The user needs chance to correct the error – when the wrong location is marked, and wrong photo is uploaded, there should be a way to change. (U5)	P	−
Comprehensible signs help the user to identify the information without much text explanation. (V3)	H	+
The user should be always told the status – there should be an accessible way to check the location marked, and information inputted. (U4)	P	–
There could be auto-save feature for processing feedback. (U6)	P	+

Table 7. *The main UX findings from the expert evaluation*

It seems from Table 8 that limited gamification elements are used in the three services. The most frequent usage is social-oriented gamification, which is used in PublicStuff and

Happycity. It can be seen that a more critical issue submitted in PublicStuff is followed by more users, meanwhile an interesting idea posted in Happycity receives a lot of "Likes" and supportive comments. It indicates that social gamification can motivate people to participate in the public discussion. In addition, customized stickers used in Happycity enhance a pleasurable and potentially efficient experience.

Gamification component	Usage
Social	Interaction (Support other user's post by following and giving comments)
Immersion	Customization (Virtual identity with personal information, Marking own ideas with relevant icons)

Table 8. *Gamification used in the services evaluated*

5. GAMIFIED SERVICE DESIGN

According to related literature review, gamification as a new trend is considered to have powerful potential to engage young generation to take part in public participation. Thus, gamification is used as an innovative attempt to explore its relationship with motivation of young people. Based on the study of existing map-based tools for citizen affairs, the pattern of map usage and public data collection can be built in an efficient way. Moreover, the usability problems found through the heuristic evaluation would be avoided in the prototype design process.

5.1 Analysis of user research

Total 24 young people are invited to answer the questionnaire. There are 10 responders who are between 16 and 18 years old, while 14 are over 18 years old and under 25 years old. In general, most of young people in this survey are seen with a positive attitude of living environment and city development. A linear scale from 1 to 5 for the responders to indicate their agreement with each statement, that is, 1 presents “Strongly disagree” while 5 presents “Strongly agree”.

A large majority of responders (83%) are very satisfied with their overall living environment (over degree of 3). Most of the young participants (71%) expressed highly carefulness of city development. Nobody thought it is unnecessary for the citizens to participate in city environment planning and constructing process (under degree of 3).

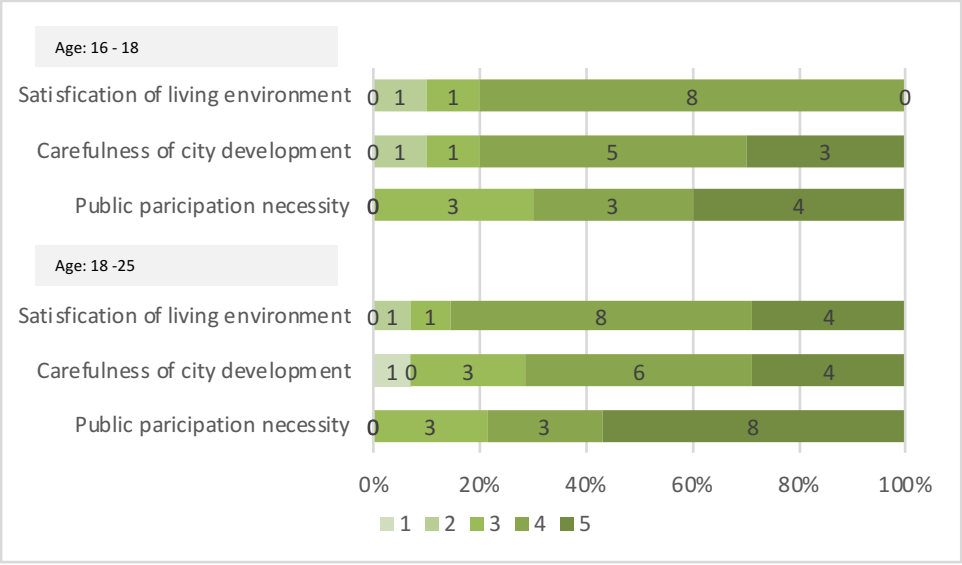

Figure 15. *Results of general environment attitude with age classes*

The results of general environment attitudes in the survey is presented in Figure 15 with the subgroups of age. It can be seen that there is no obvious difference of environment attitudes between teenagers (age-group of 16 – 18) and young adults (age-group of 18 – 25). Young adults showed slightly higher sense of responsibility of public affairs. In addition, there are no teenagers under 18 years old in this survey showed the highest satisfaction (degree of 5) of their living environment, however, all of them considered public participation is needed in city planning process (over degree of 3).

Figure 16 shows the results of this part in the survey with the subgroups of citizenship. Total 15 local young Finnish people answered the questionnaire, while there are 9 responders with foreign citizenship including China, Russia, Germany, South-Korea and etc. It is good to see not only the most of local youth (80%) feel highly satisfied with their living environment (degree of 3), but also the majority of young foreign people (89%) said they enjoy living in Finland (degree of 3). Though responders showed different in the degree of how they care about city environment, all the responders thought citizens should express their opinions in the process of city planning.

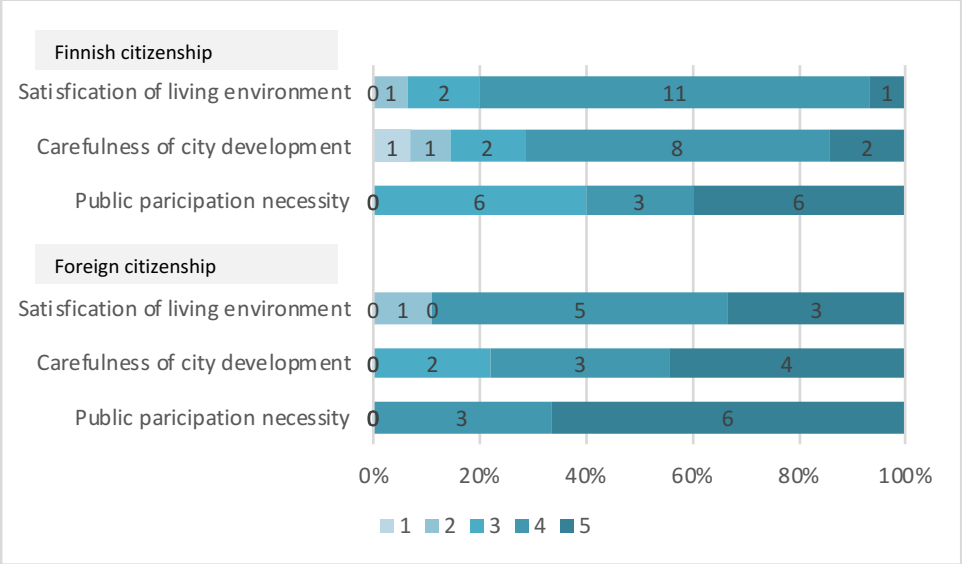

Figure 16. *Results of general environment attitude by citizenship class*

With the question of "Do you think ideas from young people are important to improve city environment?", most of the responders gave the affirmative answers. Based on their responses, the reasons can be given as following:

- "City development is strongly connected to the young people" in current growing age, thus, creating a healthy and friendly environment is essential and beneficial to youth.
- Since the young generation will be the majority of city population, "the future should be shaped for those who will be using it", that is youth.
- Young generation have a willing to improve the city and would like to provide some good ideas.

- Young people are considered to have more “fresh and creative ideas” and “usually dare to throw in more daring ideas than the older citizens”.
- The city officials are lack of young generation who “may not know youth’s needs and interests”.
- Youth should be given a sense of value that “they are listened”.

However, despite young people have intention to participate in city planning process and make their efforts for city development, some difficulties are found based on the survey results:

- There is no proper and easy way to give feedback, which is mentioned mostly by the responders. Especially for the foreigners without fluent Finnish language skills, it is hard to find correct channel to express their ideas. Communication between the city government and the citizens is not strong enough.
- Some responders think ideas from them may not be respected and valued by the older people including the city officials.
- Due to personal characters, there are responders feel their ideas would bother the city officials, and also someone thinks he has no skill of identifying issues.

The survey collected the attitudes of five specific city issue types from responders: Safety, Local transport, Social life, City planning and Caring for environment. Every topic is split into two parts: “Do you think this topic is important for public to give feedback?” and “Would you like to give feedback related to this topic?”. The responders indicated their attitudes to each statement with a scare of 1- 5. Based on the results that are presented in Appendix C, the findings for each topic are listed below:

Safety

The majority of responders thought it is important to manage the unsafe areas in neighborhood. Over half of responders (54.2%) indicated the highest degree of 5. Total 66.7% of responders would like to report the dangerous conditions to city official to a highly degree of 4 and 5.

Local transport

The number (52.5%) of the responders who concern about local transport a lot (at the degree of 4 and 5) is slightly more than the ones who (47.5%) do not care that much. Most of the responders (87.5%) would like or do not mind giving feedback of transport issues (over degree of 2).

Social life

It is the topic that the responders pay the least attention on. 40% of responders expressed highly interests in public events like park concert, open-air ice rink and craft workshop.

A large number of responders (45.8%) indicate degree of 3 to the willingness of suggesting social events.

City planning

None of the responders thought public ideas should not be considered during city planning and constructing process. The percentage of the responders who indicated the degree of 4 and 5 reaches 91.7%. 62.5% of responders strongly like to take part in planning public environment.

Caring of the environment

Over half of the responders (54.2%) think citizens should take actions to protect urban areas and help surrounding natural environment to the highest degree. 62.5% of responders would highly like to report the environmental issues (over degree of 3), such as litter in the forests, emissions from industrial facilities and insufficient garbage cans for classification.

In addition, some responders showed interests of politics and leadership of the city. Student social benefits is also concerned. The responders mentioned some city environment improvement like traffic noise control, city lights management and planning of sidewalks and bicycle lanes.

5.2 Design strategy definition

It can be seen from the results of user research that most of young people living in Finland would like to provide their opinions to city officials if given a simple and accessible feedback system. Young people seem to have less patience to read long formal text and use complicated progress. Thus, the basic designing objective for a public feedback system is to make the service tool effective. Also, as younger generation, they have a willingness to participate in public affairs and they wish their voice can be respected. In other word, the platform has to give a positive feedback to the inputs from the young participants. In addition, there is a goal of building a stronger connection between the young participants and the city officials.

5.2.1 Context of use

Young people tend to have more fresh and creative ideas that may generated in multiple situations in city life, which needs the convenience of usage. Considering the context of service from the user's perspective, basic user scenario is created by the author as Figure 17, to describe the scene of using mobile application to submit feedback. The whole user journey can be briefly described as when the user finds an issue or has a new idea in the city, he/she can submit the feedback with the service. Submitting feedback needs to take

a photo, add some description, and mark the location on the interactive map. After submitting, the progress of the city agencies process with the feedback can be tracked with the service.

Figure 17. *User scenario in general context*

In this thesis, gamification is considered to support the youth participation in city planning. On the one hand, game design elements tend to attract young people in a novelty and friendly platform rather than a serious and normal one. Gamification possibly enhance a more pleasure experience in the participating process. On the other hand, gameful mechanic is a potential solution of building a long-term behavior and motivating continued use, which is beneficial for the city agency to receive more feedback.

Thus, from the users' perspective, with gamification strategy, there can be more interactions with the feedback system. The user scenario with the gamified service is created as Figure 18 with some potential game design elements. The process of finding an issue, describing it, submitting and tracking it is just the same as basic scenario in Figure 17. The difference is after submitting the feedback, the user will get rewards (points) that can be used in this virtual world. The user can create and decorate his/her own character, and even have a virtual pet. The gamified system provides a social platform for users to discuss and vote other's ideas. The user has a chance to compete points with others.

Figure 18. *User scenario with a gamified service*

To the city agencies, the objective of the gamified system is not limited in collecting ideas from young people, but also giving virtual rewards for encouraging their contribution. With social interaction, more ideas can be found in the comments to other's feedback. The amount of voting on specific feedback presents the degree of public concern and popularity to a certain degree.

5.2.2 UX goals

Based on the theoretical support from related literature reviews, design specification of public map-based services and user research data, the UX goals that aims to guide the

gamified design in a general level can be identified as following, from the user's perspective:

- **Stimulation**: There are some appealing aspects in the service to attract the user.
- **Enjoyment**: The user has a pleasurable and even playful experience.
- **Competence**: The user can perform planning tasks with a sense of success.
- **Efficiency**: The service is easy to use without wasting time and effort.
- **Relationship**: The social needs of the user can be satisfied.

Specifically, the social needs of the user involve a feel of listened and respected, an opportunity to communicating with others, expressing supports or objects.

The UX goals reflect the expected user's perception in the interaction with the service. The design aims to attract young people to participant in and enjoy a continued use in daily life. Gamification would be designed to support all these UX goals.

5.2.3 Skill atom

Based on the understanding of the user and context of use, a synthesis of skill atom that suggested by Deterding (2015), the components of a gameful motivating experience can be described briefly as following:

- **Goals**: Voluntary participation in city improvement process.
- **Actions**:
  - Submitting feedback about city environment based on own experience.
  - Answering survey of public ideas collection.
  - Interacting with other young citizens for agreement and inspiration.
- **Object**: Gamified mobile feedback system.
- **Rules**:
  - The feedback should be contained the sections of photo, description, marked location, and identified issue type.
  - The system enables the user to interact with "Like" button and comments.
- **Feedback**:
  - Tracking the progress of issues submitted.
  - Getting reaction from other users.
  - Receiving virtual rewards for their actions.
- **Challenge**: Energizing an initiative and prolonged youth participation in city improvement.
- **Motivation**: Self-expression, Self-accomplishment, Social relationship.

Hence, gamification is to afford the interaction between the user and the system. On the one hand, the gamified system should support the user's actions for task performance. On the other hand, the gamification is expected to contribute attractiveness of the system.

The citizen platform can be treated as a utilitarian system more than for hedonism. Gamification should support the usefulness of the platform to help the user's task performance, but meanwhile, the hedonic benefits brought from gamification are considered to solve the problem of low enthusiasm of young people to the public affairs to a certain degree.

5.3 Gamification ideation

Despite limited gamification elements are used in the three evaluated services, there can be a chance for this thesis to explore the potential effects of gamification emerged in digital citizen platforms. Based on the definition from Deterding (2011), the gamification process described in this section is to use the game design elements to e-participation platform, the non-game context. Gamification is designed for the purpose not only of supporting usefulness of the citizen platform that is basically a utilitarian system, but also engage youth participation in a hedonic way.

5.3.1 Gamification affordance and perception

As described in Section 2.3, every individual tends to have own preferences of game elements. Thus, the effects of different gamification strategy depend on the user's player type to a large extent. In addition, it can be seen from early survey, instinct characters of the user such as environment carefulness and expression ability affect the willingness of participation. Despite the target group in this thesis is youth, slight difference of age and gender can be seen as influencing factors in the gamified system.

Thus, in order to attract different young people and fulfil their different needs, the gamification elements with three game orientation – achievement, social, and immersion are planned to afford the gamified service for youth participation. The gamification is expected to be precepted as pragmatic aspects and hedonic aspects. These elements aim to support task accomplish and give an enjoyable e-participation experience to the young people. But each element is not strictly target to one perception. In addition, the usage of gamification would ensure usability and user experience of digital platform, in other words, achieve the UX goals defined in Section 4.2.

Based on the understanding of gamification trend and theories, and as a results of user research and context analysis, multiple gamification elements (see Figure 19) are selected to afford gamifying the public service. The adapted components categories are presented in Section 3.4.3. In general, the mechanism of gamification can be described with the components of skill atom, that is, in the gamified system, the user can achieve his/her goals with gaming actions and receive positive feedback for the actions. The mechanism of gamification is expected to enhance the motivation and overcome the activation challenge.

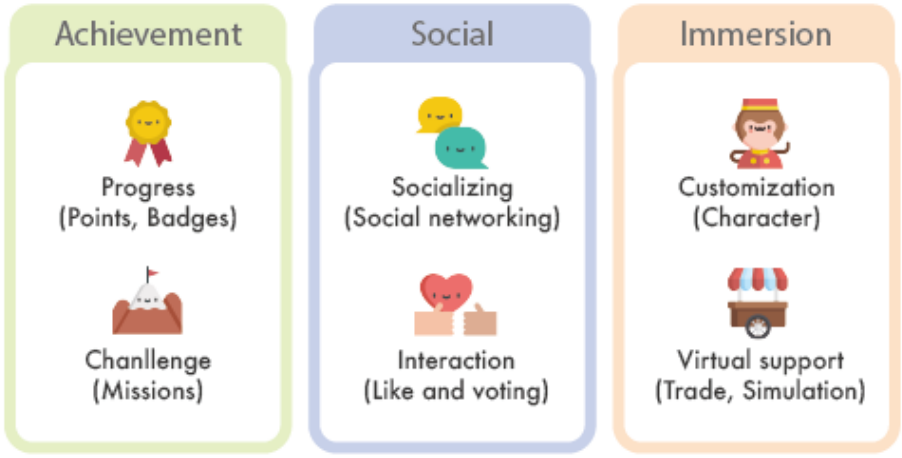

Figure 19. *Gamification elements used in the design*

In detail, in *achievement orientation*, progress provides the user a sense of competence when finishing a task. Points and badges as feedback mechanics reward young people for their contribution. Badges as virtual status symbols can be used as self-identify and goal setting function. (Sailer et al., 2013) Preparing missions for challenging stimulate the natural desire of competition. Achievement-oriented gamification elements support the user action and feedback in a usability way. And also, the progress and challenge emerged in the e-participation system increase the level of fun and entertainment. Achievement element is excepted to be easily accepted by most of young people because a lot of games use it as the scoring mechanism.

Social-oriented gamification elements aim to fulfil the social needs of young people in a transparent way. There is expected to be an accessible and easy-to-use networking platform for all the young users to post their ideas equally and discuss the topics they are interested in. Also, young people hope to find the partners who hold same opinions and get peer-supports, that is, to be commented and "Liked". On the one hand, social gamification can be perceived by the user as self-expression. Young people would have a platform to express their think of city environment. On the other hand, it relates to a positive social interaction as peer-support and peer-voting.

The gamification of *immersion* provides a playful experience. Users are enabled to create their own preferred character and name it, which helps a self-identify in the virtual world. Free choice of avatars can foster a sense of autonomy. (Sailer et al., 2013) The points got from their inputs can be spent as virtual currency to purchase virtual goods. The virtual trade mechanism can satisfy young people who have collecting hobbies. It is not only perceived by users as the feeling of being valued but also stimulate them to give more inputs. Another element for immersion is virtual simulation that is designed close to the real world. Due to results from simulation are totally decided by the user, it allows the user to control freely.

Hence, with the gamification elements oriented to achievement and social, young people using this gamified service are expected to perceive freedom of self-expression and respects for their contribution. The gamified platform is trying for strength the connection between young residents and their community based on the accessible social networking. Apart from instinct sense of social responsibility, one goal of gamification is to encourage young people to participate in improving city environment because they think the process is fun, pleasure, and enjoyable. The immersion elements help the service not only for supporting tasks but also generating a playful experience.

5.3.2 Game dynamics

From the user's perspective, the interaction sequences of different tasks can be described as the following (the caption of rectangle refers to the user action, while the oral caption refers to reaction of gamification elements):

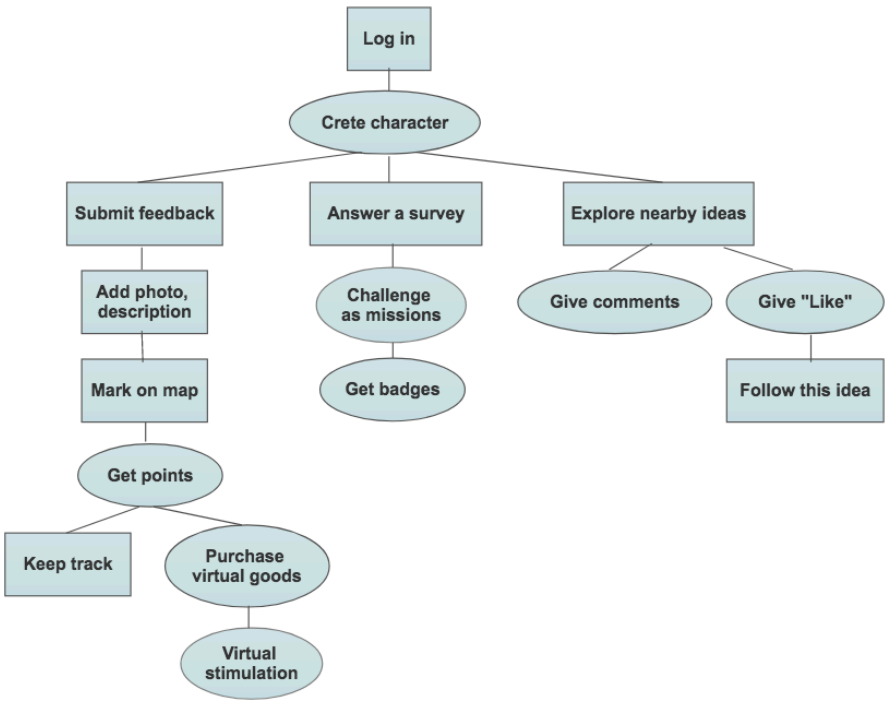

Figure 20. *Game dynamics of the designed service with user*

The user logs in with creating his/her preferred virtual character. Then he/she has three tasks can be done in the public platform: submitting new feedback, answering a survey, and exploring nearby ideas. (1) The photo and description should be provided to submit feedback. And the exact location should be marked on the interactive map. When submit successfully, some points will give to the user as reward for contribution. The points can be used as virtual currency to purchase goods for virtual planting or pets. (2) The process of answering a survey about city environment is designed as a challenge of mission. After completing the mission, badges will be the virtual reward. (3) In addition, the user can explore interesting ideas come up by other users. He/she can express agreement or

disagreement by commenting. The “Like” is seen as voting. The user can also follow the discussion and progress of this idea when “Like” it.

5.4 Designed service vision

This section is prepared for presenting the prototype of public feedback service and describing the interaction. There are two versions of prototypes including basic one and gamified one. The non-gamified prototype is designed without gamification elements, that is prepared for the comparison with gamified service in following evaluation process.

To present gamification better, high-fidelity prototype is built with high level of details and functionality. The participants can interact with the prototype on mobile device. The usability and visual aesthetics of user interface are considered into the prototyping.

5.4.1 Non-gamified version of prototype

The non-gamified prototype with basic functionalities is presented in Figure 21. The bottom-menu includes the icons of home, feedback history, notification, and profile. The user can perform basic tasks of submitting and keep tracking of feedback. Although there is an access to check nearby ideas, the user cannot do any actions with the ideas.

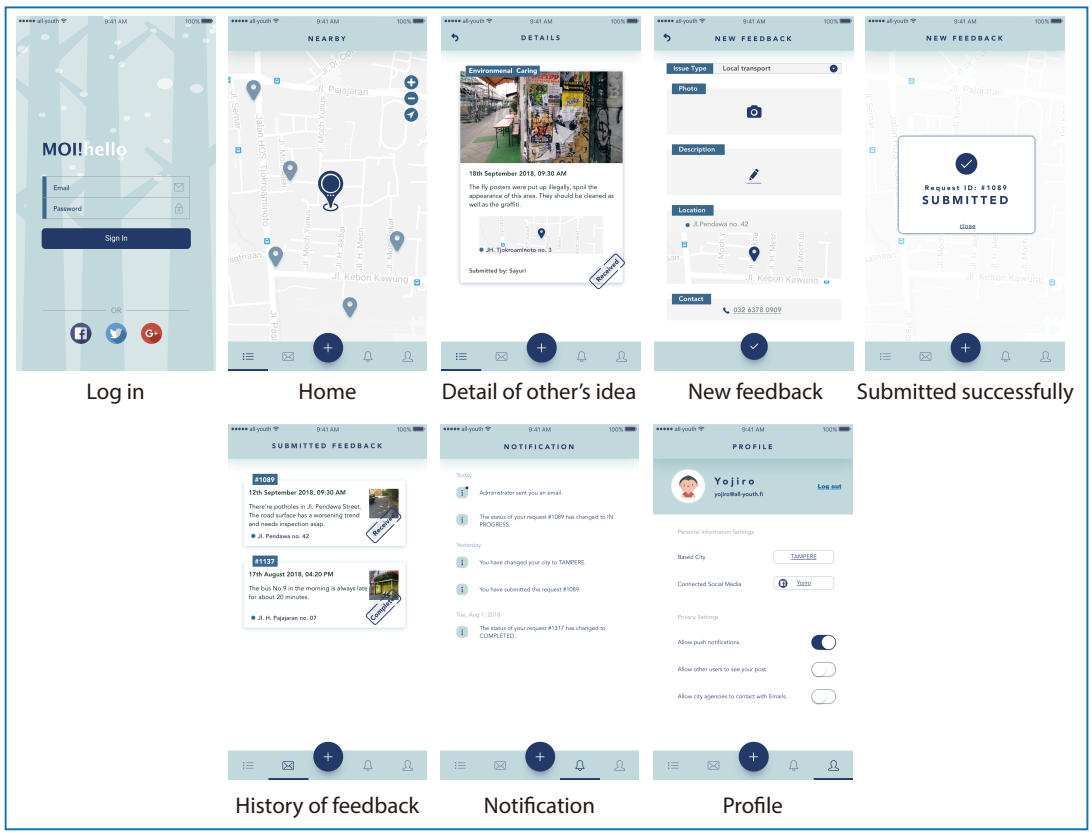

Figure 21. *Screens of the non-gamified prototype*

5.4.2 Gamified version of prototype

The whole prototyping emerges planned gamification elements of achievement, social, and immersion into public participation process. The prototype design process is guided with the set UX goals, that is, (1) to stimulate young people to participate in with appealing design elements, (2) to provide a pleasure and enjoyable user interface, (3) to give the user a sense of competence due to their contribution, (4) to make the service easy and efficient to use, and (5) to build and enhance the relationship between young citizens and city agencies. Below is the presentation of screens in gamified prototype.

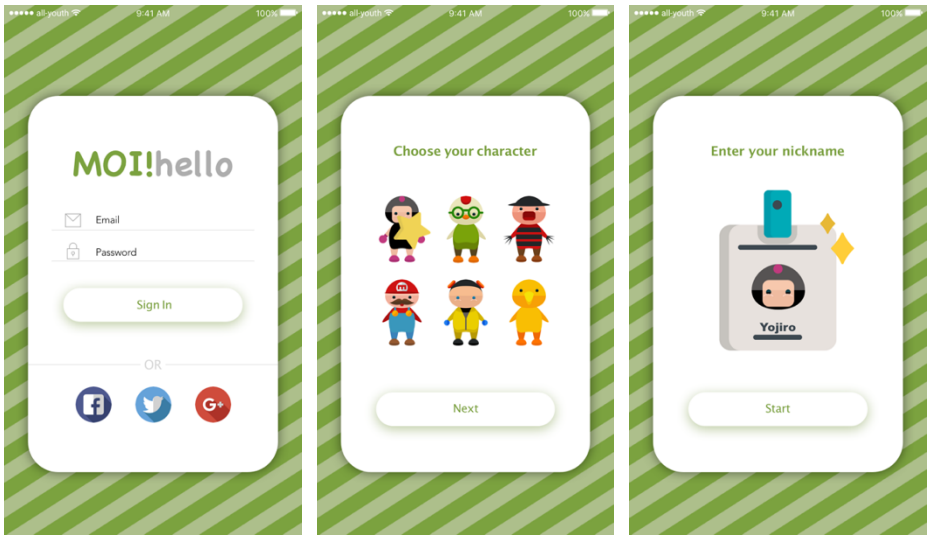

Figure 22. *The process of signing in the prototype*

The prototypes of sign in process are presented in Figure 22. The account is created with preferred character and nickname, which is a customization process.

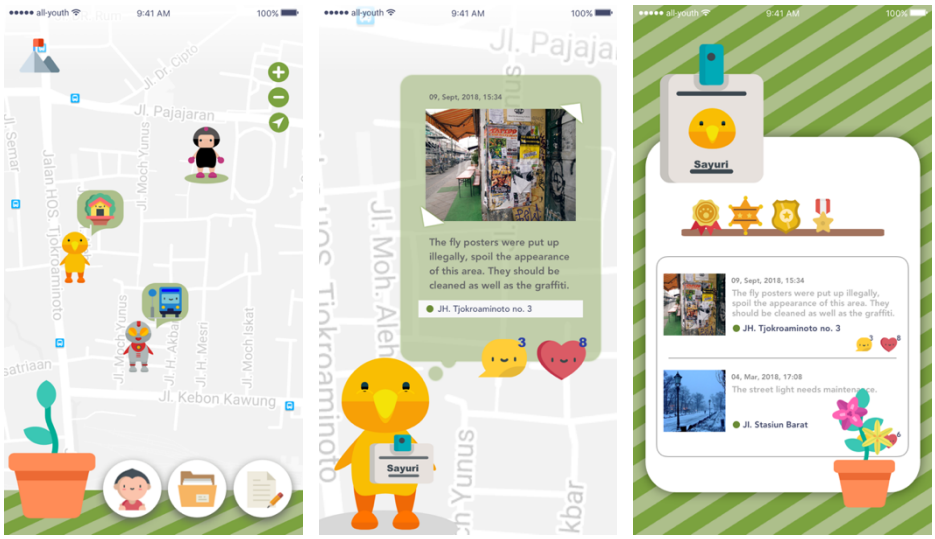

Figure 23. *Home page, nearby idea detail page, and the user profile page*

The main part on the home page of first screen is an interactive map and location marker is presented by the user's character. The issue types of nearby ideas are showed with relevant graphical icons in bubbles. When checking the specific bubble, the details will be shown in the third page in Figure 23. In this page, the user can give comments and "Like" to interact with other users on this topic. The user's profile including badges, submitted ideas, and planting can be checked.

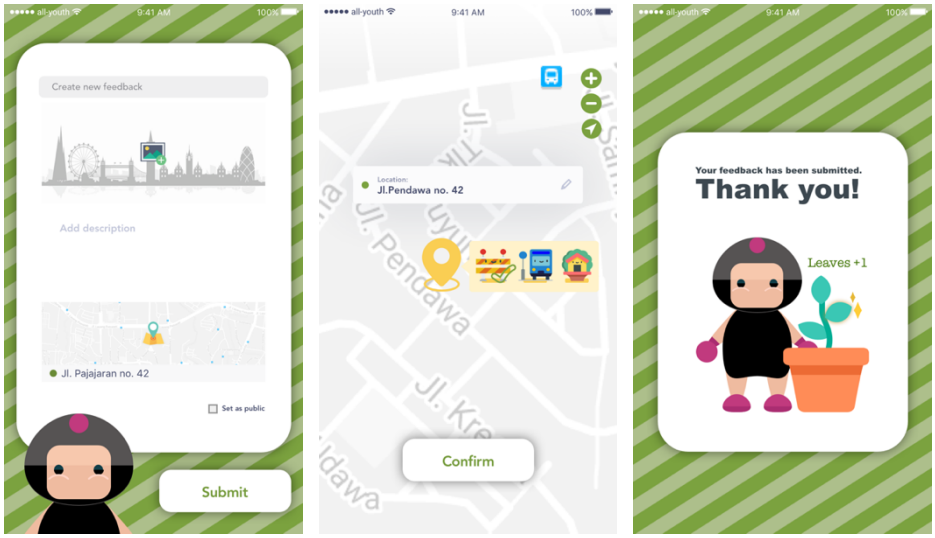

Figure 24. *Submitting feedback prototype*

The process of submitting new feedback is presented in Figure 24. The needed information includes issue's photo and description. The location should be marked on the map with its type. Once submit successfully, the user will get one "leaf" as points.

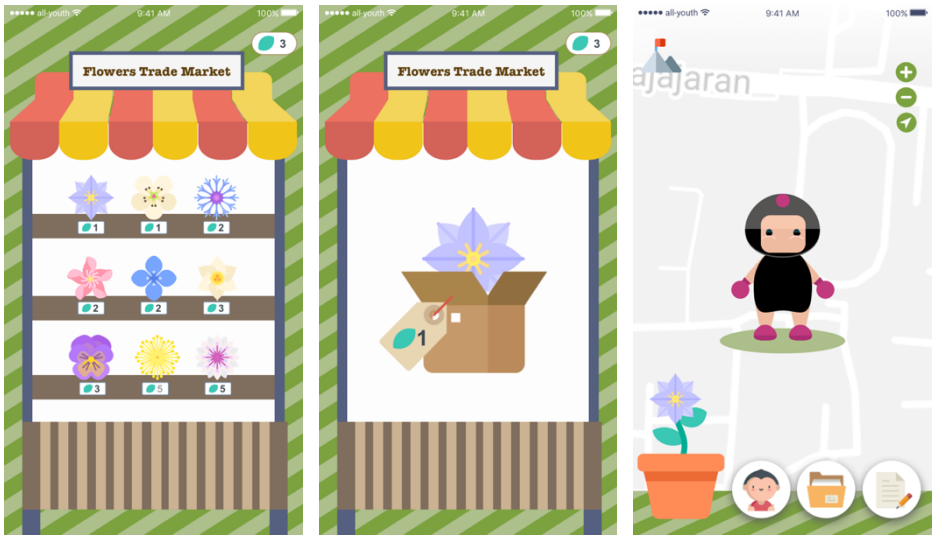

Figure 25. *Virtual market prototype*

The got "leaves" (points) can used as virtual currency to purchase virtual flowers in the "Flower Market" in the first two pages in Figure 25. The "flower" is used to decorate the planting on the home page which can be seen in the third page.

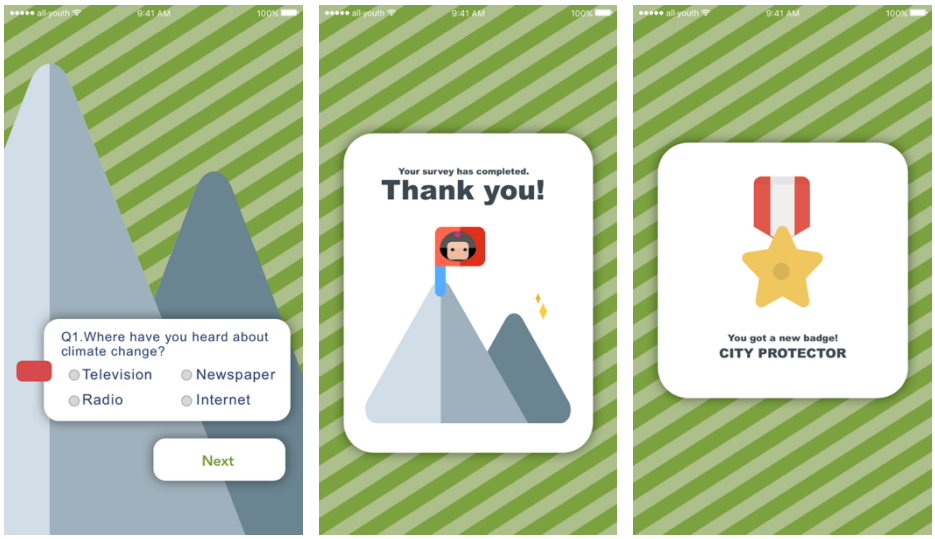

Figure 26. *Answering survey prototype*

Another way of citizen data collection is answering survey, which is presented in Figure 26. The process is designed as challenging missions. And after competing one mission, the user will get a badge as virtual reward.

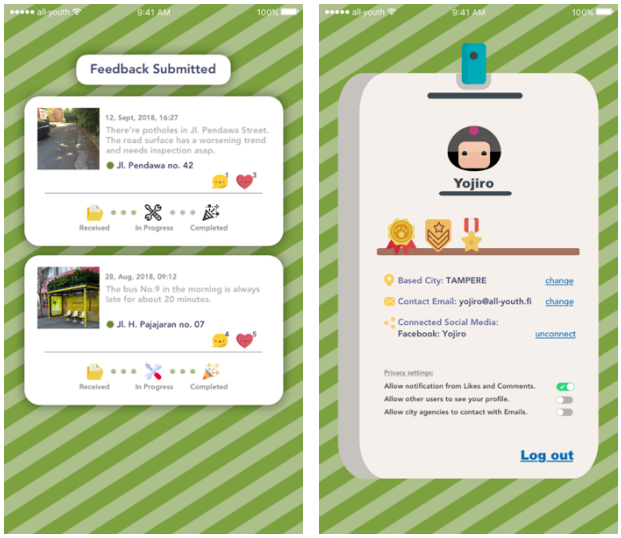

Figure 27. *Profile page and submitted history prototype*

As presented in Figure 27, the user can check the submitted feedback. Apart from the details of feedback, the history page shows comments and "Like" from other users. In addition, the user can keep track on their submission. The progress is marked as "Received", "In Progress", and "Completed". In the profile page, the user change settings of based city, contact information, and connected social media, as well as privacy settings.

6. USER TESTING RESULTS AND ANALYSIS

In this chapter, the gamified prototype presented in Section 5.4 is evaluated, comparing with the non-gamified prototype. The purpose of this evaluation is to investigate the effects and benefits of gamification for youth participation, and what elements can actually play important roles in motivation. For a more intuitive result of gamification effects in youth participation, it is a comparative test with the non-gamified prototype. Four hypotheses are defined to be proved in the evaluation process. User experience questionnaire (UEQ) developed by Schrepp et.al (2017) is conducted to inspect the pragmatic and hedonic quality of the gamified service. The semi-structured interviews are conducted to collect the qualitative data from participants. During the evaluation process, both positive and negative influence of gamification are found. The hypotheses could be validated to a certain degree.

6.1 Hypotheses definition

The motivation of individual use of information technology in is considered to source from external and internal. The external instrumental factors of job performance and promotion drive the user's extrinsic motivation of these outside goals. In contrast, intrinsic motivation refers to the behavior for self-purpose. (Davis et al, 1992; Hamari & Koivisto, 2015) It is suggested by Atkinson & Kydd (1997) there is a mutual positive influence between extrinsic motivation and intrinsic motivation. While the utilitarian system is considered to meet extrinsic motivation, the hedonic services motivate in intrinsic factors. Hamari & Koivisto (2015) suggest that gamification is expected to "motivate the user toward utilitarian goals via hedonic means".

Within a utilitarian system, the perceived usefulness and ease of use motivate users with external goals achievement. (Van der Heijden, 2004) The foremost determinant of system usage intention from users is that they believe the system has positive influence on their job performance, which is refer to the usefulness of the system. (Davis, 1989) Meanwhile, the systems tend to serve instrumental purpose better with usage efficiency, that is, needing minimal time and effort. (Hamari & Koivisto, 2015) The perceived ease of use is defined by Davis (1989) as "the degree to which a person believes that using a particular system would be free of effort".

Considering utility as precondition of the public platform usage and continued usage, gamification is expected to support usefulness and ease of use. Thus, the first hypothesis is related to pragmatic quality of the service. On the one hand, the gamified service needs to help the user to achieve the goal of participation. On the other hand, gamification can enhance the efficiency and reduce obstacles in service usage.

- **Hypothesis 1**: The users considered the gamified service to be better suited for the participation tasks compared with the non-gamified service.

A service with high hedonic qualities focuses on satisfying the user purpose of entertainment and enjoyment. The value of hedonic aspects in a system is seen to create a pleasure using experience. The hedonic aspects in a system benefit the intrinsic motivation of users, which is associated to usage intention and also prolonged use. (Davis, 1989) Gamification is expected to make positive influence on the creative and exploratory user behaviors. On the one hand, gamification is a potential mechanism to make the using experience enjoyable and pleasure. On the other hand, with game design elements, the gamified system is expected to be playful.

- **Hypothesis 2**: The user has more pleasurable user experience with the gamified service than with the non-gamified one.

Based on the types of players suggested by Bartle (1996): achiever, killer, explorer, and socializer, the basic mechanism of gamification is to use the different motivational pull from games for engaging different users. The gamification elements used in the design process are grouped with the category proposed by Yee (2006), that is, achievement, social, and immersion. When designing a gamification environment, it is important to inspect the relationship between the motivational mechanisms and corresponding specific game elements. In other words, the perceived gamification from the user is expected to be effective and attractive as planned.

- **Hypothesis 3**: The gamification elements perceived by the user match with his/her motivational mechanisms.

This hypothesis consists of three aspects as three used gamification components. (1) Achievement-oriented elements including points and badges as positive feedback mechanism refer to the user needs of competence. The set of missions provides a sense of challenge and competition. (2) Social networking enhances the online interaction with other young citizens. It provides a transparent platform for the user to express ideas and supports freely. (3) Immersion-oriented elements including avatar and character support self-identify in digital service. The virtual currency and goods, and virtual simulation mechanism aim to create a playful game environment for public participation.

6.2 Results of user testing

The purpose of this section is conducting evaluation method to understand the voluntary motivation of young people who are living in Tampere, Finland currently, and presenting the pragmatic and hedonic quality evaluation results via UEQ data analysis tool and qualitative results from semi-structured interviews. The participants are asked to compare two versions of the prototype: The non-gamified service version (presented as “Version

A" in user testing) and the gamified service version (presented as "Version B" in user testing).

6.2.1 Participants

The user testing was conducted in October 2018. Total 10 participants range from 16 to 25 years old were invited to the evaluation (see Table 9). From responses of background questionnaire, 8 participants showed positive attitudes of city development, and 9 participants thought young people should take part in improving city environment. The results are consistent with the response from the initial survey.

The participants were asked their frequency of playing video games. Only one participant plays games daily, while three participants never play. Most of the participants play video games occasionally (weekly or monthly). Despite every participant has his/her preference of game aspects, the points/level/scores and connection with other players are valued by most participants. Specially, one participant indicated that only character creation is attractive for her.

ID	Age	Citizenship	Frequency of playing game	ID	Age	Citizenship	Frequency of Playing game
P01	18	Finnish	Weekly	P06	23	Irish	Weekly
P02	22	Finnish	Never	P07	22	French	Weekly
P03	24	Chinese	Monthly	P08	20	Korean	Never
P04	23	Finnish	Daily	P09	23	Mexican	Monthly
P05	18	Vietnamese	Monthly	P10	24	Chinese	Never

Table 9. *Participants description*

Due to the limited number of the sample, the comparison between different groups of age, gender and citizenship is not implemented.

6.2.2 UEQ data collection

With the help of UEQ data analysis sheet developed by Schrepp et.al (2017), the overall results of the data collected from the ten participants for the gamified service version is presented in Figure 24. The width of error bar is based on the number of participants and the degree of the agreement of their answers. Schrepp et.al (2017) stated that observed values are most in a restricted range of -2 to +2, because different people usually hold different opinions and avoid extreme answers.

The UEQ scores of the gamified service version are presented in Figure 28, and the values of attractiveness, pragmatic and hedonic quality are presented in Table 10.

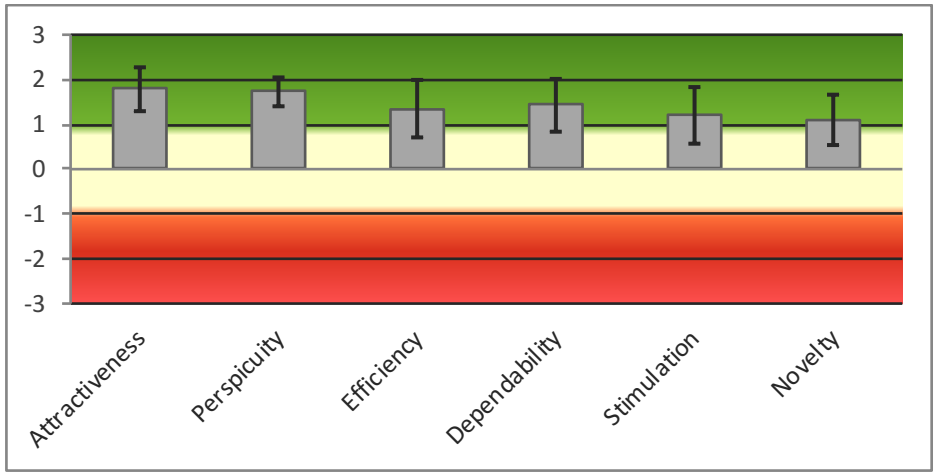

Figure 28. *Participants' UEQ scores of the gamified service version*

Pragmatic and Hedonic Quality	
Attractiveness	1.78
Pragmatic Quality	1.50
Hedonic Quality	1.15

Table 10. *The values of pragmatic and hedonic quality for the gamified service version*

Thus, the gamified service version created a quite possible impression from all the six scales. Attractiveness is a pure valence dimension, and its scale of the evaluated prototype reached a high value of 1.78. The result explains that the participants found it was strongly pleasurable to use the gamified service which is friendly and attractive. The scales of perspicuity, efficiency and dependability are grouped into the category of pragmatic quality. The overall value of pragmatic quality of the gamified service version is 1.50 (see Table 10). The value of perspicuity (1.72) denotes it is very easy and clear for the user to understand and learn how to use the service. Also, the gamified service version seems to have high dependability (1.43) with sufficient support and meets the expectation of the participants. Additionally, the participants leaved a possible rate on the efficiency (1.35) of the gamified service version. On the other hand, the scales of stimulation and novelty describe the hedonic quality of the evaluated service. Despite the overall observed hedonic quality of the gamified service version is positive (1.15), it can be found that the gamified service version is creative and motivative to a limited extent.

Schrepp et.al (2017) provides a benchmark created from a large sample of UEQ evaluation results from science studies and industry projects. The comparison of results with benchmark from the existing data set of UEQ is presented in Figure 29 and explained in Table 11. From the results compared with the benchmark, all the scales are above average. Specially, the scale of Attractiveness of the evaluated gamified service is rated as "excellent" compared with other products. The pragmatic quality concerning the perspicuity, efficiency and dependability of the gamified services seems comparable with other evaluated products. In addition, the novelty of the gamified service is quite better

than most evaluated products. Despite the data set of the benchmark consists of different types of products, it proves the high attractiveness, pragmatic, and hedonic quality of the gamified service designed in this thesis.

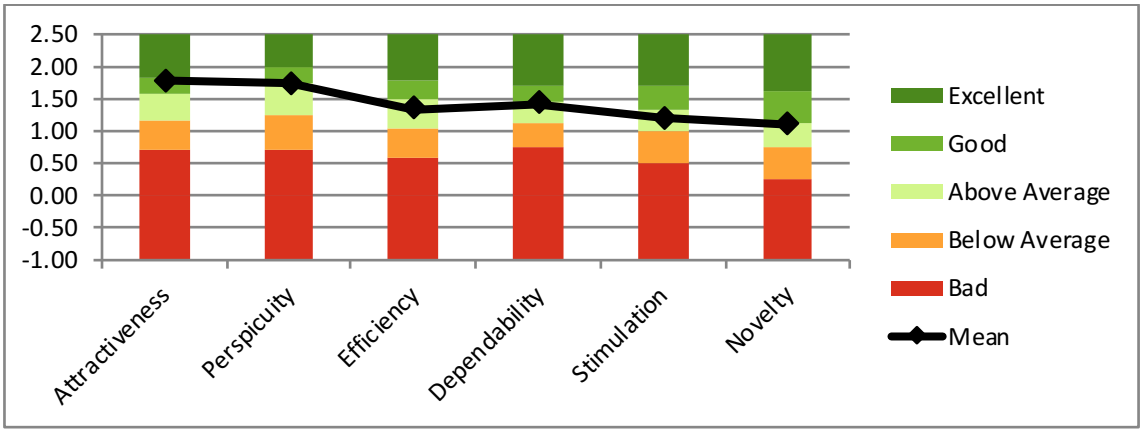

Figure 29. *Results from the gamified service version against UEQ benchmark set*

Scale	Mean	Comparison to benchmark	Interpretation
Attractiveness	1.78	**Excellent**	10% of results better, 75% of results worse
Perspicuity	1.73	**Good**	25% of results better, 50% of results worse
Efficiency	1.35	**Above Average**	25% of results better, 50% of results worse
Dependability	1.43	**Above Average**	25% of results better, 50% of results worse
Stimulation	1.20	**Above Average**	25% of results better, 50% of results worse
Novelty	1.10	**Good**	25% of results better, 50% of results worse

Table 11. *Explanation of results from the gamified service version against UEQ benchmark set*

Figure 30. *Comparison of UEQ data between the non-gamified service version and the gamified service version*

From the UEQ data comparison (see Figure 30) with the non-gamified service version, the gamified service version is better in terms of attractiveness score. However, when

considering the pragmatic quality of the service, the non-gamified service version seems to support efficiency better than the gamified service version. Without gamification, the non-gamified service version is slightly easier for the participants to learn how to use, and supports more efficient and fast task performance. On the other hand, the gamified service version has higher hedonic quality than the non-gamified service version, especially with higher value of novelty scale. As a result, the gamified service version gives a more exciting and interesting experience to the participants.

6.2.3 Findings of gamification

In the post-testing questionnaire, the participants were asked to rate the gamified service version (the gamified prototype) in general, and indicate the degree of how likely they would like to use The gamified service version in the future. The results are presented in Figure 31. Most of the participants (80%) gave positive ratings to the gamified service version.

*Weighted average rating of the gamified prototype = **5.30** (out of 7).*

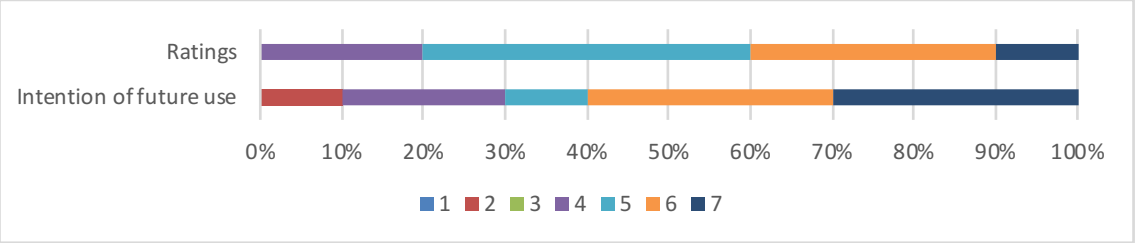

Figure 31. *Results of ratings and intentions of future use of the gamified service version*

More than half of the participants (70%) expressed high intention of future use of the gamified service version. 30% of them would like to use it to the highest degree. Since there is no available efficient and reliable public feedback system currently, most of the participants thought this service would be useful when they have issues about city environment to report. Additionally, several participants would like to explore other's ideas occasionally.

The motivation factors of the gamified service version for different participants seem to be different. According to the discussion of game orientation and player types in Section 2.3.2, people are addicted in various game elements and pursue different goals in the game world. From collecting agreements of the statements that listed in Section 3.5.3, the perceived motivation of game design elements (achievement, social, and immersion) used in the gamified service version depends on individuals subjectively and complicatedly.

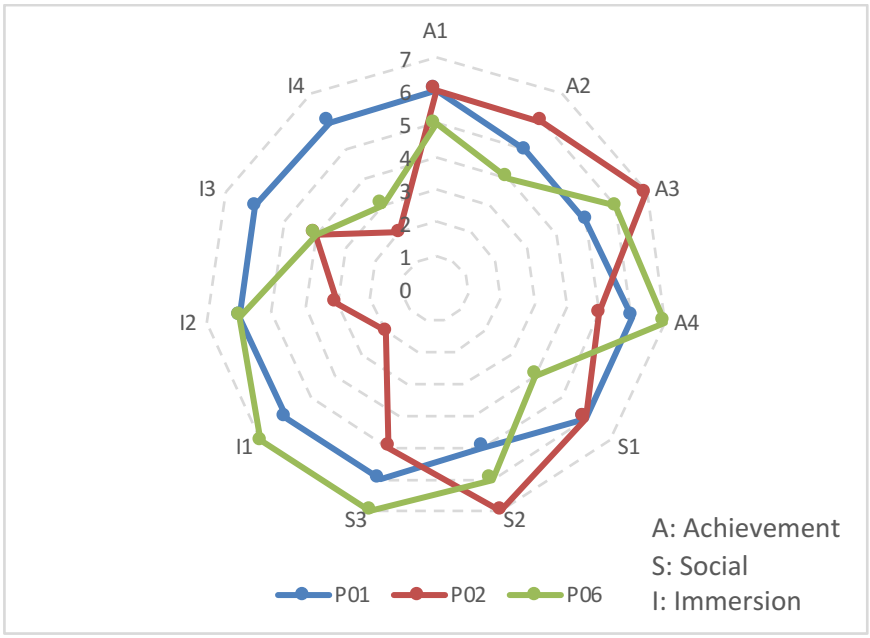

Figure 32. *Three examples of preference degree of gamification elements*

Taking three results from the participants as examples (see Figure 32), P01 as a fan of gamified applications has a quite equal preference of three types of game elements. P02 has more interests in the elements of achievement and social, while having negative response to the immersion elements. P06 holds different ideas of different statements regardless of gamification elements. For instance, P06 feels satisfied with earning badges but has less interests in getting points. Meanwhile, P06 likes creating own characters in the virtual world but thinks feeding virtual pets or planting is boring. There is no absolute conclusion of the popularity of three gamification elements. Basically, the perceived motivation depends on individual preferences of different game design components. On the other hand, half of the participants express inconsistency preference between game elements in general (in background questionnaire) and game elements used in the gamified service version (in post-testing questionnaire). Hence, the perceived motivation of different game elements may differ in particular situation of gamification use.

The participants reported more subjective impression and opinions in the interview section. Based on the answers of comparison of two prototypes, 7 participants like using the gamified service version, while 3 participants prefer the non-gamified service version. The valued comments about gamification used in the gamified service version are summarized below, with the categories of positive views and negative views.

Positive views of gamification

Pleasure

Some participants reported that compared with the non-gamified service version, the gamified service version with the cuter and colorful interface attracts young generation

more. Without gamification, the non-gamified service version looks traditional and serious, which can be considered to create a sense of distance with young people. The game elements used in the gamified service version makes the using process relaxing and enjoyable:

> "Unlike the boring the non-gamified service version, the gamified service version has a cute interface. I think young people would like to accept the more novel design rather than a very formal one." (P10)

> "The gamified service version gives me a more active feeling. It feels like it welcomes you to open this application." (P09)

Game design elements presented in the user interface break traditional way of tasks performance. Thus, some participants reported that a gamified service would make the feedback process friendly and interesting.

> "The gamified service version is more user-friendly to me. The tasks are basic, so it feels nicer to use an application looks better and with more interesting design." (P07)

Most participants preferred a graphical user interface with more aesthetic design elements, especially for the young female. They thought it is more pleasing to use the gamified service version than the non-gamified service version.

Achievement with progression

Some participants reported that with the increase of points it would make a sense of achievement. The process of using their points to buy something is a prove that they have contributed a lot to their community:

> "I like the idea of progression. Collecting virtual currency and then being able to buy stuff seem interesting to me." (P01)

> "It could be like interesting to have some kind of aesthetic thing that you can customize, and other people can see if you have something very expensive on your plant for example, and they will know this guy contributed so much." (P07)

Some participants reported that they like the idea of points and badges. Even though as virtual reward, it gives the participants a feeling that it is worthy to contribute, and their contribution is valued.

> "It gives me a sense that I'm doing a meaningful thing and I can get some rewards in return." (P04)

Customization

Some participants reported that creating own character freely could make some differences with other users. Young people have the willingness to be unique and special. Having personalized items satisfy their demand of choice:

> "The user account can have diversity between characters. It makes the difference of your profile with others if you buy different flowers. The uniqueness between other players and myself is nice." (P01)

> "Choosing characters makes me feel more personal. To customize the plant, I feel that my impact is a bit more important, then I can have special plant." (P07)

Immersion

Since gamified service describes the tasks in a simulated way, it allows the user to interact in a more natural and institutive way. Some participants reported that they enjoy this kind of gaming environment:

> "I feel like I'm a police officer when I got the badges one by one for my every contribution." (P10)

In addition, some participants thought the idea of virtual simulation gives them a motivation of continued use because of increased stickiness:

> "I think having a virtual plant is a nice idea. When you put more efforts on it, you'll find it becomes more important to you." (P09)

Social influence

Most of the participants gave positive evaluation to the social feature in the gamified service version. One of the effects with online social connection is to influence more people to use this service. And it supports individuals with confidence that they are not alone:

> "I think a big thing for me that motivates to do stuff is seeing other people do stuff., It feels a little bit like a waste of time if I'm the only one doing it. But knowing other people and your friends are doing it would make me feel more inclined to do it as well." (P01)

The gamified service version allows the user to explore others' ideas and discuss the topics they are interested. Some participants reported that it enhances the relatedness with others in their community:

> "It can get some feedback from other peers when you post your idea. It gives me a sense of connection with the community." (P10)

Some participants reported that they are used to be in touch with other people. They would like to know the status of other people and even compete with them:

> "It would be nicer if you can compare points and badges with other people and see if this person contributed a lot when you check the profile." (P07)

There are some participants who concern about living environment and want to know the issues and ideas come up by others:

> "I care about my living environment a lot. So, if someone comes up with an interesting idea, I'd like to keep track with how this idea is going." (P03)

One participant thought giving the crucial issues more supports by comments and likes can promote the solution progression:

> "I think if more people discuss in one particular topic may draw more attention from the government and promote the progression of solving the problem." (P03)

More than a half of participants reported that they would like to give their comments and likes to the interesting ideas. And getting supports from other users can give them confidence and recognition for their contribution.

Negative views of gamification

Over-childish

Some participants thought that the style of the gamified service version is too childish for them. Since the target user is youth from 16 to 25 years old, it may be hard to make the grown-up to accept childlike design elements. Some participants thought the interface of the gamified service version is too garish, which makes it more suits children:

> "Some of the characters and the styles is a little bit too cartoony for me but I do like the idea of it." (P01)

> "I think the gamified service version is really good for younger generations, the teenagers. To be honest, I'm a moldy and I have little interests on the game world." (P08)

Complexity

With the game design elements, some participants thought the gamified service version requires extra efforts to learn how to use. It is less efficient than the non-gamified service version which presented all the checkpoints clearly. Some participants reported that they would like to use the non-gamified service version only with the basic functions:

> "I think the non-gamified service version is definitely the kind of traditional. It's easier to use even though the gamified service version doesn't take much time to learn also. But personally for me I don't care about much those nice features like having characters, especially just basic applications." (P02)

> "The non-gamified service version looks more pleasing especially it feels less cluttered compared to the gamified service version. I do think the non-gamified service version is clearer." (P01)

For some participants who are not a game fan, designing the service as a game world may confuse them:

> "The gamified service version is for me was kind of complicated because I'm not a game player. So, having that kind of character gives me some confusion honestly." (P08)

De-interests

Some participants thought the used game elements in the gamified service version is not attractive enough to motivate a long-term use, and the interests will decrease over time:

> "I can play it for a while, but it is not enjoyable enough for long lasting I think." (P05)

Compared with virtual rewards in the gamified service version, some participants thought the physical returns may remain people's enthusiasm for a long time.

> "Like some game players also want to get physical money out of their game items. These virtual badges are not really a big thing but like some coupons with collaboration with some cafeteria or whatsoever would be really great." (P08)

Low quality of feedback

One participant reported that there could be some users submitted spams to the city agency for the purpose of points and badges. It may cause decrease quality of feedback:

> "I'm worried about someone maybe give useless feedback just for getting the points." (P04)

Redundancy of extra design elements

Some participants thought it is unnecessary to use gamification to attract and motivate the young people to participant in city improvement. One reason is the action of giving city feedback depends on own sense of responsibility and willingness. Another reason is that this kind of public service is not for daily use. The most important goal of this service is to support basic use when needed:

> "If I have intention to help improving the environment, and I have willingness to give my feedback, I don't care much about how the interface looks like." (P04)

> "But personally, I don't care about much those nice features like having character, especially just in this basic application. I would like to use a simple service when I meet issues." (P02)

One participant thought more important feedback than virtual reward is to see the progress of solving surrounding issues:

> "Comparing with getting these features like points and badges, I concern more about the actual solution of the issues I report." (P03)

However, there is a potential obstacle that gamified service attracts technology-affine people only to explore the tool with the innovation of communication technology. (Thiel, 2016a) For a citizen platform that needs a long-term public participation, the purpose of using gamification is not only for affect the temporary motivation for the first glance, but also for developing the usage behavior. Thus, the gameful elements implemented in the service are expected to increase the awareness level of city environment and encourage a prolonged use. Unlike the non-gamified service, the gamification elements are predicted to keep attraction of young people with their concern of points, willingness of social interaction, and etc.

From the results of post-testing questionnaire, most of the participants expressed high intention of future use of the gamified service version. In the interview process, some participants felt motivation from game elements. They thought the gamified platform encourage their continued use with stickiness of customization. The sense of achievement can be another factor for a long-term use. Half of the participants reported that they would use the service not only when reporting issues, but also checking surrounding ideas come up by other users. Thus, it is suggested that three game elements including achievement, social, and immersion can support continued use of gamified application to some degree. However, there seems to be some exception for this particular service for public participation. On the one hand, most of the participants would not use the public platform regularly in daily life. The most potential intention of use could be the individuals have ideas to submit rather than "play" game on the platform. On the other hand, game elements increase complexity of the service, thus, it causes some obstacles for the immediate report in future situations.

In addition, some participants concern about security and privacy issues. Most of the participants would like to submit their feedback with anonymous account. On the other hand, some participants came up with some suggestions to improve the service. For example, some participants mentioned that they want to enhance social connection with their friends, even have competitive mechanics. One participant suggested that apart from points and badges, it would be better to get some random rewards for surprise.

6.3 Conclusion

Based on the results of user testing, the effects of gamified prototype are demonstrated. The evaluation process support to validate or refute the four hypotheses defined in Section 6.1 (see Table 12).

	Description	Supported
Hypothesis 1	The users considered the gamified service to be better suited for the participation tasks compared with the non-gamified service.	No
Hypothesis 2	The user has more pleasurable user experience with the gamified service than with the non-gamified one.	Yes
Hypothesis 3	The gamification elements perceived by the user match with his/her motivational mechanisms.	Indirectly

Table 12. *Hypotheses support*

UEQ data is conducted to support Hypothesis 1 and Hypothesis 2 with pragmatic and hedonic quality. From the comparison between the non-gamified service version and the gamified service version, the pragmatic quality of the non-gamified service version is higher than the gamified service version. Thus, this result refutes Hypothesis 1. The results suggest that the non-gamified service version has better efficiency and perspicuity than the gamified service version. Based on the responses in the interview, some participants reported that the gamified service needs more time and effort to learn how to use. The non-gamified version seems to support clearer checkpoint present and more institutive task performance. In addition, since the public feedback service is not prepared for daily use, some participants reported that they need an available access to report their feedback to city agency, while complicated features are unnecessary for them. Practicality is a more important factor for them. However, the comparison with UEQ benchmark proves the gamified prototype is designed with good pragmatic quality to support task performance.

On the other hand, the gamified service version has a good rating in hedonic quality evaluation, which validates Hypothesis 2. UEQ result shows the gamified service has a strongly high attractiveness. The participants reported that the gamified service version gave them a more pleasurable and interesting using experience than the non-gamified service version. As an increasingly popular trend in human-computer interaction design, gamification enhances novelty of a traditional service. Some participants mentioned that compared to a serious and formal interface, young people would like to interact with a more user-friendly and creative platform. The game elements of virtual rewards and customization support an explorative and positive user experience.

Hypothesis 3 is defined to evaluate the effects of three gamification elements of achievement, social, and immersion. The evaluation supports this hypothesis indirectly in

a qualitative way. The results of post-testing questionnaire and responses from the interview show complicated motivations of different participants. The social interaction seems to meet the instinct motivation of most young people. They would like to have a platform to share their ideas with others and express supports for agreement. Social elements support their connection with peers in community. Despite they also have security request, most of them prefer anonymous way to report issues about city environment. Thus, the game elements of avatars and characters provide the virtual self-identity. Additionally, freedom of customization enhances their uniqueness with others. The virtual characters in the gamified service create a pleasurable real-like using environment. The points and badges give them positive feedback for their contribution. They feel a sense of achievement that they have done a meaningful thing to their community. However, there are some disagreements of virtual purchasing and simulation. Some participants thought it could enhance their stickiness, while some thought it doesn't attract them. Also, few participants like the challenges in answering survey. A simple progress bar could be better for them.

Hence, according to the findings from evaluation, some motivations for supporting youth participation through gamification are suggested as following:

- Virtual rewards can provide young people positive feedback for their contribution, and create a sense of achievement.
- The feeling of progression is beneficial for encouraging young people to participate.
- Customization enhances self-identity and self-uniqueness.
- Social connection is important for young people with the sense of relatedness.
- Virtual simulation seems not attractive enough for young people, which may suit children and teenagers.

In addition, gamification enhance aesthetic aspects of user interface, which can be an important factor of pleasurable and enjoyable experience for young people. But since gamification increase learning efforts of using to some degree, at the same time of designing fancy game elements, the simplicity and practicality should be considered to enhance the pragmatic quality.

7. DISCUSSION

In this chapter, expected contribution and limitation of this thesis are discussed. It is a summary of how the objective questions that proposed in the beginning are answered in the research process. Although the research reached its aims in general, there were some avoidable and unavoidable limitations. Thus, reflection of research process and future work for improvement are presented.

7.1 Expected implications

This thesis focuses on the two objectives proposed in Section 1.2: map-based tool for public participation, and gamification for youth engagement. If comparing the research process to making a cake, the map-based tool is like a naked cake while gamification is like the cream. That is, the purpose of using gamification is to support a more motivative and attractive public feedback service for young people. Moreover, the effects should be evaluated by user testing, like the process of tasting the cake.

To concentrate on the first objective, this thesis answered the question of "How can a map-based tool be used to collect public feedback of city environment?". As the main user of city environment, citizens have both civil rights and responsibility to protect and improve their surroundings. Since the local knowledge from citizens is based on its location to a large degree, the map-based technology matters the public platform. Thus, Geography Information System (GIS) is implemented to support public participation, that is Public Participation GIS (PPGIS). This thesis studied three public tools with PPGIS for collecting different local knowledge from citizens. As a result, all the three tools can get effective responses, requests, and ideas based on digital map from the user. Different types of information are needed for different purposes. For answering a survey, it may only need to answer the questions and mark question-related location on the map. Submitting a request for fixing issues requires the photo, detailed description, and maybe contact information. If it is an idea as a topic for discussion, the service should consider social aspects into the design. The study of existing services is helpful for figuring out workflow of public feedback system, and the usability problems can be avoided in later prototyping process.

The thesis answered the following objective question "What kind of gamification mechanisms can be prepared for youth engagement?". It has been suggested by many specialists of citizen science that young people should be given an opportunity to participate in the process of improving city environment. It can be seen from the results of initial survey, most of young people have intention to report their ideas about city environment. However, younger people are thought to be less attracted by traditional

political engagement, and annoyed with authoritative and tough tone. Thus, gamification as an innovative and popular trend has been implemented in a variety of youth-related applications and projects. The potential benefits of gamification motivate to gamify the public feedback service for young people. This thesis discussed definition of gamification, different game orientation and player types. Three gamification elements were used in the service prototype: achievement, social, and immersion. Their effects were evaluated in user testing with the comparison with a control prototype without game design elements. The results from evaluation showed that gamified service could support a more pleasurable and enjoyable using experience. Despite some elements related to immersion do not suit this particular service or not attract young people in this age, social-related elements benefit a more active public platform. Virtual rewards seem to give young people a sense of achievement with positive feedback. Character and customization enhance self-identity and self-uniqueness of young users. However, gamification can be a double-edged sword to decrease the pragmatic quality of the public platform. With careful design, gamification can be beneficial for motivating and sustaining youth participation.

It can be seen that young people have a positive attitude of expressing their ideas to city agency and look forward to having an accessible and effective feedback system. Overall, the research of this thesis can be considered as a successful attempt to emerging gamification into public map-based platform and getting a satisfactory result of youth engagement.

7.2 Limitation and future work

Despite the research achieved its goals and the whole thesis writing processed smoothly, there are some inadequacies that can be considered to support a better research result. Firstly, due to time limitation, only ten participants were invited to test the prototype. The number of samples limited the validity and reliability of evaluation result. In addition, the expected comparison between different groups of age, gender, and citizenship was not able to be implemented. Secondly, more concrete questions can be asked in the interview process, to get a better inspire of the motivation with specific gamification elements. Thirdly, apart from gamification aspects, the way of utilizing digital map with PPGIS should be described and evaluated more detailly.

Thus, based on current user testing results, the gamified service can be improved from these aspects: redesigning the style of interface in a less childish way, enhancing the freedom of character creation, designing random rewards for user's contribution, and coming up with another virtual goods for purchasing. In addition, for those young people who are not game player, the service should provide some tips for first use. And for those young people who have few interests of gamified application, it can be considered to provide optional features. After the process of re-designing, it is needed to have more representative participants for user testing to get more reliable and strong results.

Since several participants mentioned that physical rewards give more motivation for participation, coupons and shop points can be considered to reward meaningful and valuable contribution. Thus, getting support from local restaurants, cafes, theaters, and shopping malls is a potential cooperation way.

In addition, this public platform aims to enhance the connection between young citizens and city agencies. However, in this research, all the studying efforts are concentrated on the input part of feedback, young people. Actually, the opinions from the receive part of feedback, city agencies, are also important to be considered. Specifically, there are many questions need to be answered by city agencies to get more effective feedback from young citizens: what kind of ideas are needed to improve the city environment, how to deliver the progression of solving issues to the user, how to judge false and useless reports, who needs to be in charge of checking the feedback, and etc. As some participants noticed in the interview process, they concern about how the reported problem being solved and how their ideas being dealing with. To make this public platform to truly contribute environment improvement, there should be some related discussion with city officials in the future.

Despite the research in this thesis is completed, All-Youth as a multidisciplinary research project is continuously exploring the capabilities of young people and obstacles of their engagement, and creating more possibilities for youth participation.

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APPENDIX A: RESULTS OF HEURISTIC EVALUATION

Heuristic Evaluation 1

Maptionnaire

Title	Heuristic violated	Severity
There is no obvious sign to indicate how to check the places have been marked on the map, which showed on Screen 0.	U1, U2	4
The places marked by mistake cannot be deleted.	U5	5
The button signed with a trash can has the function of "cancel" rather than "delete". (Screen1A, 2A)	U1, U7	3
Multiple options can be selected for one-choice question. (Screen 1B, 2B)	U5	3
When marking three different locations on the map, the second and third selection should be repeat from Screen 2.	U6	2
There is no notification for peak the limit of "zoom in" and "zoom out".	U1	1
The location out of "outline zone" can be marked without warning.	U5	4
There is no setting for "must answer" questions.	U6	1
The buttons on the left side of map have no description of their use. (Screen 1A, 2A)	U1	2
There is no feedback for clicking the first button on the map. (Screen 1A, 2A)	U2	4
The "Search" button cannot be used to search a certain place.	U6	3
The pages in survey can be skipped by clicking "Next" button without any marking on the map.	U4	4

Heuristic Evaluation 2

PublicStuff

Title	Heuristic violated	Severity
There is no classification for the information presented on home page. (Screen 1)	U6	1
There are repeated features of "New request" and "Nearby request" in both information list and bottom menu bar. (Screen 1)	U6	1
The types of issue are sorted by their initials, which is not easy to find. (Screen 2)	U6	3
Each type of issue is given detailed description, making the list longer. (Screen 2)	U6, V3	2
If added a wrong photo, it should be deleted first and then add the correct one. (Screen 2B)	U6	1
When filling a new request in Screen 2B, the unfinished request form would be automatically saved in draft box in Screen 6 without notification if clicking another button in the bottom menu bar.	U2	3
If need to change issue type in Screen 2B, it would be repeated from Screen 2. In other words, the location has to be confirmed again.	U6	2
The issue which is selected to "Follow" in Screen 4 is saved to "Supported" box in Screen 6.	U2	1

Heuristic Evaluation 3

Happycity

Title	Heuristic violated	Severity
There is only "Delete the account" function rather than "Log out". (Screen 5A)	U4	4
There is no feedback when clicking "Like" button in Screen 3.	U2	3
The comment cannot be given to another user's reply. (Screen 3)	U7	1
The map to indicate location in Screen 3 cannot zoom in or out.	U6	1
The presented ideas would be randomly changed when the map zoom in and out. (Screen 2)	U6	1
The sticker which need to be showed on the map cannot be decided. (Screen 4A)	U4	1
The map cannot return to original scale with "Location" button after zooming out. (Screen 2)	U6	2
The optional stickers are over large in the limited screen. (Screen 4B)	V1	1

APPENDIX B: INITIAL SURVEY OF YOUTH PARTICIPATION

How do you care about your living environment?

Thanks for your participation. Your answers will be used as a base for master thesis work of designing a public participation tool to improve city environment, which refers to the project of All-youth in Tampere University of Technology (http://www.allyouthstn.fi/en/all-youth-2/). The target group is youth (age 16 to 25). It would take around 10 minutes to complete this questionnaire. The answers will be used anonymously. We appreciate all your honest answers. =)

If you have any concerns about the survey or project, please contact:
Yuanyuan Guan, yuanyuan.guan@student.tut.fi
Kaisa Väänänen, kaisa.vaananen@tut.fi

*Required

Basic background

1. **Age** *

_____

2. **Citizenship** *
Mark only one oval.

- ◯ Finland
- ◯ Other: _____

3. **How long have you been in Finland? (if not a Finn)**
Mark only one oval.

- ◯ Under 1 year
- ◯ 1 to 3 years
- ◯ Over 3 years

What do you think about participation in local environment improvement?

4. **I'm satisfied with my current living environment in general.** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

5. **I care about my city development.** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

6. **I think citizens should make voices of city environment?** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

7. **Do you think ideas from young people are important to improve city environment? Why or why not?** *

What city issues do you care about AND would like to give feedback to city official?

Safety

8. **It is important to manage unsafe areas in my neighborhood, such as street light issues, broken equipment in park and icy sidewalk needs to be cleaned.** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

9. **I would like to report the dangerous conditions to city official.** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

Local Transport

10. **I concern about local transport, such as bus schedule, taxi order service and traffic congestion.** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

11. **I would like to give feedback of transport issues.** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

Social Life

12. **It is great to take part in some public events like park concert, open-air ice rink, craft workshop and interactive games.** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

13. **I would like to provide my ideas of the social events organization in public areas.** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

City Planning

14. **I think public ideas should be considered during city planning and constructing process.** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

15. **I would like to take part in planning public environment. For example, I want to suggest a space for building a dog park. Or I want to share my ideas while government is drafting the plan for tramway.** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

Caring for Environment

16. **I think citizens should take actions to protect urban areas and help natural environment surrounding us.** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

17. **I would like to report the environmental issues like litter in the forests, emissions from industrial facilities and insufficient garbage cans for classification .** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

18. **What other topics do you care about?**

19. **Did you ever express your opinions about city environment, such as reporting issues and answering an official survey?** *

20. **Why would/wouldn't you like to give feedback to city official in general?** *

APPENDIX C1: CONSENT FORM IN USER TESTING

CONSENT TO USER TESTING

Thanks for your participation. We appreciate your help for evaluating the public feedback service for youth. It belongs to the master thesis work of designing a public participation tool to improve city environment, which refers to the project of All-youth in Tampere University of Technology (http://www.allyouthstn.fi/en/all-youth-2/).

The participation in this user testing is voluntary and you can raise any concerns or areas of discomfort immediately during the session with the evaluator.

You will be asked to perform different tasks using the service version A and version B for comparison. In addition, we will ask you to fill in questionnaires and we will interview you about the use of the service. The test will be recorded.

The results of the test will be reported anonymously. A summary of the main results will be delivered to the project and referred as thesis foundation. Audio recordings or participants' personal data will not be revealed.

If you have any concerns about the survey or project, please contact:
Yuanyuan Guan, yuanyuan.guan@student.tut.fi
Kaisa Väänänen, kaisa.vaananen@tut.fi

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

Date and place: _____

Signature: _____

Name clarification: _____

Evaluator fills in:

Participant ID: _____

APPENDIX C2: BACKGROUND QUESTIONNAIRE IN USER TESTING

All-Youth

BACKGROUND QUESTIONNAIRE

Background Information

Age: _____

Citizenship: [ ] Finnish [ ] Other: _____

Caring about the city environment

Please indicate the degree in each statement.

I am concerned about the city environment in my city.
Completely disagree [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ] 6 [ ] 7 Completely agree

I think young people should participate in city environment improvement.
Completely disagree [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ] 6 [ ] 7 Completely agree

Have you ever expressed your opinions about city environment? such as reporting issues and answering an official survey?
[ ] Yes, I reported the city issues.
[ ] Yes, I answered the official survey.
[ ] Yes, Other: _____
[ ] Not yet.

Game preferences

How often do you play video games in general?

[ ] Daily [ ] Weekly [ ] Monthly [ ] Never

What following aspects are important to you in games in general?
Check all that apply
[ ] Getting the top score/level/points.
[ ] Achieving the missions in game world.
[ ] Feeling connected and interacting with other players.
[ ] Creating your own character.
[ ] Having a virtual pet to simulate.
[ ] Other: _____

Evaluator fills in:

Participant ID: _____

APPENDIX C3: EVALUATED TASKS IN USER TESTING

TESTING TASKS

Version A

Task 1: Checking the feedback marked on the map.

Task 2: Submitting new feedback.

Task 3: Checking the submitted history.

Task 4: Checking notification.

Task 4: Checking your profile.

Version B

Task 1: Checking the feedback submitted by Sayuri (the character of duck).

Task 2: Checking the profile of Sayuri.

Task 3: Answering a survey related to climate change.

Task 4: Submitting feedback of street potholes with adding photos and description, marking location on the map, and identify the issue type.

Task 5: Purchasing a flower with one point you got.

Task 6: Checking the status of the feedback you submitted on 28 Aug, 2018.

Task 7: Checking your profile.

APPENDIX C4: UEQ IN USER TESTING

Please make your evaluation now.

For the assessment of the product, please fill out the following questionnaire. The questionnaire consists of pairs of contrasting attributes that may apply to the product. The circles between the attributes represent gradations between the opposites. You can express your agreement with the attributes by ticking the circle that most closely reflects your impression.

Example:

attractive	○	⊗	○	○	○	○	○	unattractive

This response would mean that you rate the application as more attractive than unattractive.

Please decide spontaneously. Don't think too long about your decision to make sure that you convey your original impression.

Sometimes you may not be completely sure about your agreement with a particular attribute or you may find that the attribute does not apply completely to the particular product. Nevertheless, please tick a circle in every line.

It is your personal opinion that counts. Please remember: there is no wrong or right answer!

Please assess the product now by ticking one circle per line.

	1	2	3	4	5	6	7		
annoying	○	○	○	○	○	○	○	enjoyable	1
not understandable	○	○	○	○	○	○	○	understandable	2
creative	○	○	○	○	○	○	○	dull	3
easy to learn	○	○	○	○	○	○	○	difficult to learn	4
valuable	○	○	○	○	○	○	○	inferior	5
boring	○	○	○	○	○	○	○	exciting	6
not interesting	○	○	○	○	○	○	○	interesting	7
unpredictable	○	○	○	○	○	○	○	predictable	8
fast	○	○	○	○	○	○	○	slow	9
inventive	○	○	○	○	○	○	○	conventional	10
obstructive	○	○	○	○	○	○	○	supportive	11
good	○	○	○	○	○	○	○	bad	12
complicated	○	○	○	○	○	○	○	easy	13
unlikable	○	○	○	○	○	○	○	pleasing	14
usual	○	○	○	○	○	○	○	leading edge	15
unpleasant	○	○	○	○	○	○	○	pleasant	16
secure	○	○	○	○	○	○	○	not secure	17
motivating	○	○	○	○	○	○	○	demotivating	18
meets expectations	○	○	○	○	○	○	○	does not meet expectations	19
inefficient	○	○	○	○	○	○	○	efficient	20
clear	○	○	○	○	○	○	○	confusing	21
impractical	○	○	○	○	○	○	○	practical	22
organized	○	○	○	○	○	○	○	cluttered	23
attractive	○	○	○	○	○	○	○	unattractive	24
friendly	○	○	○	○	○	○	○	unfriendly	25
conservative	○	○	○	○	○	○	○	innovative	26

APPENDIX C5: POST-TESTING QUESTIONNAIRE IN USER TESTING

All-Youth

POST-TESTING QUESTIONNAIRE

General impression

How do you rate the Version B in general?
Terrible [ ]1 [ ]2 [ ]3 [ ]4 [ ]5 [ ]6 [ ]7 Excellent

How likely would you like to use Version B in the future?
Not at all [ ]1 [ ]2 [ ]3 [ ]4 [ ]5 [ ]6 [ ]7 Extremely

Please indicate how motivating you would find each reason for using Version B?

Indicate each statement with 1-7 degree of agreement.

[ ] I would like to contribute in city environment improvement.

[ ] Using the service is fun and pleasurable.

[ ] I can get positive feedback with virtual rewards.

[ ] The points I got give me a sense of competence.

[ ] I feel satisfied when I earn the badges.

[ ] I like to the challenge from missions/quests/tasks.

[ ] I feel connected to peer in my community.

[ ] I like to explore others' ideas and find the people with similar thoughts.

[ ] I need social interaction with others for communicating and supporting.

[ ] I like to choose the avatars and characters based on my preference.

[ ] I enjoy virtual world.

[ ] It is fun to purchase virtual goods with virtual currency.

[ ] I like to feeding virtual pets or planting.

Evaluator fills in:

Participant ID: _____