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Mobile Healthcare Applications and Gamification for Sustained Health Maintenance

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Abstract: This paper examines how gamification affects user intention to use mobile healthcare applications (mHealth) and how the effect of gamification works differently according to health status, age, and gender. We use data from a mobile survey conducted by a Korean representative survey agency. We estimate the effect of gamification on user intention to use mobile healthcare applications based on a structural equation model and examine the moderating effects of self-reported health status, age, and gender. We find that gamification is effective in increasing user intention to use mHealth, especially in the healthy and younger groups. These findings suggest that mHealth, with the gamification factor, would encourage healthy (but lack exercise) people as well as unhealthy people to maintain their health status, and thus the mHealth developers need to consider the gamification factor when they develop mHealth services for healthy people.

Keywords: mobile App healthcare; gamification; sustained health maintenance; structural equation model

1. Introduction

A mobile healthcare application (mHealth hereafter) offers its users medical information (e.g., diagnosis and treatment) and guidance for managing their health. These applications, with the help of various sensors in a smart watch or smart phone, help users check and control their health conditions. For instance, dietary intake monitoring application (DIMA) enables dialysis patients to self-monitor their food intake by providing real-time feedbacks [1]. That is, this is a form of personalized healthcare based on individual needs and control [2]. Moreover, this application is useful for all types of users, regardless of their health status. According to a study from the IMS institute for healthcare informatics, more than 165,000 health-oriented applications had been published by 2015, and ten percent of the applications made use of various sensors to collect a user's physiological function data to provide bio-feedback [3].

However, unlike unhealthy people who need to closely monitor their health conditions, healthy or young people are not very interested in using the healthcare applications [4]. Sustainable healthcare is achieved by motivating people to care for themselves continuously through appropriate exercise before their health status worsens. In urban environments specifically, urbanites suffer from a lack of time and place to exercise. Therefore it is desirable to design mHealth to be able to induce not only unhealthy people but also healthy people to use it.

Gamification of mHealth is one way of motivating healthy people to use the application, as the gaming factor could motivate people who are not in bad condition or are healthy to engage in healthy behavior [5]. Gamification is a process of using 'gaming' elements to motivate and engage people in non-gaming contexts [6]. For example, with the *Nike + Fuelband* and *Runkeeper* applications, users experience running as if they were playing a game. Gamification has been applied in diverse fields to motivate target users to change their behaviors, specifically in the education [7], medical [8,9], and psychology fields [10]. In terms of mHealth, a mobile phone can be a platform for personalized healthcare because it is an effective tool for behavior change [11,12]. The recent rising mobile game *Pokémon Go* is also a good example of gamification that uses augmented reality, demonstrating how gamification can motivate healthy users to walk around and work out unintentionally, in order to reach goals within the game.

Most previous studies in this area have focused on the effectiveness of mHealth, especially by considering specific target audiences [13] such as those with cardiovascular disease [14], those who suffer from obesity and need to lose weight [15,16], and even those who simply need to increase their physical activity [17]. On the other hand, several studies have been conducted to determine the motivational factors for adopting mobile healthcare applications. Previous studies have found that the user's health conditions [18], social factors [19], and mass media exposure [20] are important motivational factors for using mHealth with continuous exercise.

However, little is known regarding how gamification contributes to making healthy people adopt a mobile health care application. Souza-Júnior, et al. [21] explored which gamification techniques are useful in mHealth applications and how these techniques are implemented through a case study. However, they did not determine how this contributes to making healthy people adopt such applications.

This paper aims to find the role of gamification regarding the intention to use mobile healthcare applications. Data were collected from 310 nationally representative South Korean consumers and analyzed using the structural equation model. The rest of this paper is organized as follows. In Section 2, we explain the concept of gamification in terms of mobile healthcare applications, how it motivates users to change their behavior and the possible factors that make users adopt such mobile healthcare applications. Section 3 describes the survey data and the methods used for our study. The results of our study are presented in Section 4. Last, we summarize our results and their implications in Section 5.

2. Gamification and Mobile Healthcare Application

2.1. The Concept of Gamification and Motivation

Gamification is the utilization of game-design elements and principles in non-game contexts [22]. It is a way of enhancing motivational affordance in any type of service, in order to invoke behavioral outcomes [23,24]; this is accomplished through the use of 'gaming' elements to motivate and engage people, especially in traditionally non-gaming contexts [6]. Gamification uses intrinsic and extrinsic rewards to motivate users to change their behavior [25]. While achieving various goals and receiving different rewards such as points and badges, users may feel a sense of accomplishment and keep performing the action that they normally would not do without the gamification factor. Moreover, it gives users a sense of control, making the tight relationship between their actions and the outcomes of the game more prominent [2]. These elements motivate users to do something they are not used to doing by providing conditional rewards or making them lose game scores or items. From the view of behavioral economics, people behave irrationally when encountering situations in which they need to make a decision [26]. Gamification tends to make people choose irrational decisions. People usually do not want to lose what they already have obtained [27], hence they are motivated to change their behavior to avoid such losses, including losses in various scores, items, or reputation that they have earned through gaming [28].

2.2. Factors to Adopt for the Mobile Healthcare Application

mHealth provides health-related services through mobile devices using Information and Communications Technology (ICT). The development of sensors and wearable technologies allows personal medical information to be easily collected and data to be analyzed in real time. This could be a simple application such as *Fitocracy*, *QUENIQ*, *Zamzee*, *Lose it*, or *7 minutes*, which encourage users to exercise more effectively. Alternatively, there are also applications that require a variety of wearable devices for measuring the amount of exercise (e.g., calorie consumption, distance, and the number of steps) as well as information from the body (e.g., heart rate, weight, and body heat) to improve the quality of exercise; such applications include *Nike + Fuelband*, *Runkeeper*, and *GoGoYu*. Users wear the diverse forms of wearable devices, and the devices help users to count steps, track moving distance, and monitor their daily fitness conditions such as sleep and diet [29]. Mobile healthcare applications help users to record and analyze the data collected by the wearable devices and share the information with friends. mHealth also provides a service to change health-risk behaviors such as smoking. In this case, engagement and rewarding abstinence can be offered as a form of gamification to help users to change their risky behaviors [30].

Scholars have mainly studied the determinants of adopting mHealth or healthcare IT from the viewpoint of healthcare professionals such as clinicians [31–34], whereas little research has been conducted from the viewpoint of users. According to Wu, Wang and Lin [32] and Wu, Li and Fu [33], we have found that perceived usefulness is one of the most important factors when a user adopts a new mobile health application.

Further, gamification is an important factor for users adopting mHealth [21]. Souza-Júnior et al. [19] found that various gamification techniques are used in some mobile health wellness apps, and this gamification inspired users to use mHealth. This could help people with exercising, which they typically would not do, by utilizing their psychological tendency of not wanting to lose what they have already obtained [27].

Hypothesis 1. *Gamification (Enjoyment) is an important factor for increasing both user intention to use mHealth as well as perceived usefulness (PU).*

Based on self-determination theory (SDT) applied to the motivation to play games, Ryan, et al. [35] proposed that the "Player Experience of Need Satisfaction" (PENS) model can estimate the effects of autonomy, competence, and relatedness on both enjoyment and future game play by assuming that such desires are satisfied through playing games. Autonomy is a desire that is satisfied through activity to achieve interest or individual value, and playing a game provides a feeling of autonomy [36]. Competence is related to the skill or ability to solve challenges, thus making the controls of the game intuitive or easily mastered would provide a feeling of high competence [36]. Relatedness is a psychological need in SDT to enhance motivation by having a feeling of connection with others [36]. According to Edwards, et al. [37], top-rated healthcare applications are identified to apply individual behavior change techniques and the combinations of the techniques, which are based on the PENS model. Therefore, we propose one hypothesis that includes the effects of these three factors on enjoyment.

Hypothesis 2. *Competence, autonomy, and relatedness will have a positive effect on the gamification (enjoyment) of mHealth.*

There are three factors known for affecting perceived usefulness of a new technology. The first is relative advantage. The relative advantage factor has been regarded as one of the most important determinants of user intention to adopt a new technology (see, Moore [38], Sultan and Chan [39], Hong, et al. [40], and Venkatesh and Davis [41]). mHealth could be defined as a new business sector that converges between ICT and the traditional healthcare sector; at the same time, it is hard to say that mHealth is a totally new service in terms of its function, as it only adds functions, including connecting to the Internet, based on existing healthcare services. Users cannot avoid comparing quality, function, and convenience with previous services that do not connect to the Internet when they are in need of a healthcare service.

Second, compatibility with previous services is also an important factor for adopting mHealth due to reasons similar to those above [42–44]. According to Yang, et al. [45], compatibility has a significant effect on user intention to use new technologies such as wearable devices. Rogers [46] defined compatibility as the degree to which a new technology meets the value of the existing system, experience, and users' hidden needs. Along the same line, compatibility of mHealth could be defined as the degree of harmony between mHealth and the related existing healthcare industries.

The third factor is accessibility. Accessibility measures how users are able to access to the specific information system by internal and external telecommunication networks, which are used to receive any required information [47]. Lin and Lu [48] and Lederer, et al. [49] found a positive effect of accessibility on user intention to use a web site. Moore and Benbasat [47] also emphasized the importance of accessibility in IT innovation. mHealth is a form of service that adds Internet accessibility to existing services. Moreover, the convergence with wireless Internet allows users to access this new service at any time and location. Hence, we assume that users will value mHealth highly only if the relative advantage, compatibility, and accessibility of the new service is higher than those of the existing services.

Hypothesis 3. *Relative advantage, compatibility, and accessibility will have a positive effect on the perceived usefulness (PU) of mHealth.*

Healthy people, compared to unhealthy people, are likely to use mHealth as a complement to maintaining their health [18], similar to using personal trainers or obtaining health related advice. In other words, healthy people use mHealth because they value the enjoyment factor higher more than unhealthy people do. Enjoyment is also valued highly by the younger generation. For the younger generation, one aspect of the enjoyment factor could be related to connecting with social media [20], as they are fluent with online communication through the use of various social network services. Since mHealth largely incorporates functions that allow users to communicate with other users through the application, the younger generation would easily adopt mHealth when their close friends started using it, and would likely continue to use this application to exercise [19].

Hypothesis 4. *For a healthier and younger user, gamification (enjoyment) is a more important factor for adopting mHealth than the perceived usefulness (PU).*

3. Methods

3.1. Data and Analysis

To prove the proposed research model and hypotheses, we used data from a mobile survey conducted by a Korean representative survey agency for two weeks. The data includes 310 respondents who have ever used any mobile healthcare service. The questionnaire rates each item on a five-point Likert scale, where one indicates that the respondent strongly disagrees with the item and five indicates that the respondent strongly agrees. Table 1 shows the descriptive statistics of the 310 respondents, where 49.4% of the respondents were male and the other 50.6% were female. The portion of teenagers, and those in their twenties, thirties, forties, and fifties and over were 21%, 21%, 18%, 20%, and 20% respectively, which is similar to the real age distribution of South Korea.

Table 1. Descriptive statistics of the subjects (N = 310).

Variables	Percentage (%)
Sex	
Male/Female	49.4/50.6
Age	
10–19/20–29/30–39/40–49/50 or above	21/21/18/20/20
Educational attainment	
Below high school/High school/College or above	17/29/54
Marital status	
Married/Single	44/56
Household income (Monthly, $)	
0–2000/2000–2999/3000–4999/5000 or above	10/14/34/42
Self-reported health status	
Healthy/Unhealthy	72/18

3.2. Research Design

We use the structural equation model (SEM) to analyze the user intention to use the mHealth service. SEM has been applied in many studies to measure the loyalty and intention to use of end users for various information and communication technologies. We calculated Cronbach's alpha to measure the reliability of the survey instruments by using *IBM SPSS Statistics 23* (IBM Corp., Armonk, USA), and we checked that all the scores were above the acceptable level of 0.700; that is, all the observed variables are statistically reliable. Table 2 shows the results of Cronbach's alpha reliability and the regression weights of the observed variables.

Table 2. Cronbach's alpha reliability and regression weights of the observed variables.

Component	Cronbach's α	Unstandardized Regression Weight	Standardized Regression Weight	S.E.	C.R.	p
Relatedness						
1	0.887	1.000	0.773			
2		0.993	0.757	0.059	16.770	<0.001
3		1.094	0.789	0.078	14.105	<0.001
4		1.211	0.885	0.078	15.559	<0.001
Competence						
1	0.828	1.000	0.687			
2		1.205	0.709	0.112	10.756	<0.001
3		0.926	0.615	0.114	8.145	<0.001
4		0.995	0.656	0.099	10.060	<0.001
Autonomy						
1	0.813	1.000	0.781			
2		0.850	0.699	0.084	10.170	<0.001
3		0.870	0.672	0.089	9.801	<0.001
Relative Advantage						
1	0.830	1.000	0.689			
2		0.932	0.612	0.095	9.793	<0.001
3		1.040	0.727	0.091	11.462	<0.001
4		1.203	0.751	0.102	11.799	<0.001
5		1.023	0.715	0.091	11.298	<0.001
Accessibility						
1	0.844	1.000	0.705			
2		0.938	0.653	0.084	11.121	<0.001
3		1.079	0.748	0.103	10.452	<0.001
4		1.016	0.738	0.098	10.401	<0.001

Table 2. *Cont.*

Component	Cronbach's α	Unstandardized Regression Weight	Standardized Regression Weight	S.E.	C.R.	*p*
Compatibility						
1	0.806	1.000	0.625			
2		1.105	0.651	0.124	8.937	<0.001
3		1.106	0.624	0.128	8.664	<0.001
4		1.324	0.703	0.141	9.415	<0.001
5		1.364	0.762	0.138	9.857	<0.001
Enjoyment						
1	0.833	1.000	0.793			
2		1.037	0.788	0.071	14.545	<0.001
3		0.866	0.657	0.074	11.745	<0.001
Perceived Usefulness (PU)						
1	0.846	1.000	0.736			
2		0.907	0.653	0.084	10.776	<0.001
3		0.898	0.667	0.082	11.011	<0.001
4		1.007	0.743	0.082	12.249	<0.001
Attitude						
1	0.875	1.000	0.733			
2		0.960	0.715	0.067	14.342	<0.001
3		0.989	0.698	0.082	12.051	<0.001
4		0.998	0.745	0.077	12.909	<0.001
Intention to Use (IU)						
1	0.855	1.000	0.690			
2		1.020	0.708	0.091	11.226	<0.001
3		1.040	0.700	0.094	11.112	<0.001
4		0.949	0.672	0.088	10.743	<0.001

4. Results and Discussion

4.1. Feasibility of the Model

To estimate the measurement model fit, we used four common model-fit measures; Root mean square error of approximation (RMSEA), incremental fit index (IFI), comparative fit index (CFI), and chi-square/degree of freedom (χ^2/df). All the model-fit indices satisfy the acceptance criteria suggested in the previous literature, as shown in Table 3.

Table 3. Model fitting indices.

	RMESA	IFI	CFI	Chi-Square/df
Level	0.056	0.902	0.901	2.325
Acceptance level	<0.06	>0.09	>0.09	<3.0
Reference	[50]	[51]	[51]	[50]

4.2. Structural Paths and Hypotheses Tests

We tested the structural relationships by estimating the hypothesized paths. As a result, all the hypotheses were supported at the 90% significance level. As shown in Table 4, relatedness, competence, and autonomy have a significant effect on enjoyment, and the standardized regression weights are 0.403, 0.250, and 0.363, respectively. All the hypotheses about the effects of accessibility, relative advantage, and compatibility on perceived usefulness were supported, but the regression weights were different. Users perceived more usefulness when the service was functionally superior to the previous services (β = 0.579, C.R. = 6.181) and when it was compatible with the previous services (β = 0.501, C.R. = 8.299), but the regression weight of accessibility was relatively low (β = 0.150, C.R. = 1.768). Both the enjoyment and perceived usefulness have significant effects on attitude, and perceived usefulness (β = 0.587, C.R. = 10.163) and had greater effect than enjoyment (β = 0.462, C.R. = 10.811). Table 4 shows the estimation results.

Table 4. Estimation Results.

	Unstandardized Regression Weight	Standardized Regression Weight	S.E.	C.R.	*p*-Value
Enjoyment ← Related	0.417	0.403	0.059	7.050	<0.001
Enjoyment ← Competence	0.304	0.250	0.183	1.659	0.097
Enjoyment ← Autonomy	0.395	0.363	0.155	2.554	0.011
PU ← Relative Advantage	0.569	0.579	0.092	6.181	<0.001
PU ← Accessibility	0.142	0.150	0.080	1.768	0.077
PU ← Compatibility	0.479	0.501	0.058	8.299	<0.001
Attitude ← PU	0.597	0.587	0.059	10.163	<0.001
Attitude ← Enjoyment	0.450	0.462	0.042	10.811	<0.001
IU ← Attitude	0.987	0.952	0.084	11.687	<0.001

Note: PU is perceived usefulness, and IU is intention to use.

4.3. Moderating Effects

In addition, this paper divides the entire sample into junior/senior, male/female, and healthy/unhealthy groups based on age, sex, and health condition of the respondents, and estimates whether the effects of gamification on the intention to use the mHealth service changes according to age, sex, or health conditions of the users.

The most important hypothesis of this paper is that mobile healthcare applications will encourage healthy people to participate in healthcare services by introducing gamification. It is because existing healthcare-related services have not given much attention to healthy people [1]. To prove this hypothesis, the entire sample was divided into two groups; those who thought they were healthy and those who did not. Table 5 shows the results.

The results showed that perceived usefulness and enjoyment affect attitude at the 99% significance level, as well as the overall group measurement. However, the healthy group showed that the effect of enjoyment on attitude was 0.725, which was 0.325 larger than the value of 0.400 for the unhealthy group, and this difference was statistically significant at the 95% level. On the other hand, the effect of perceived usefulness on attitude was statistically significantly lower by 0.274 in the healthy group (0.369) than in the unhealthy group (0.643). In other words, people in the unhealthy group, even though the healthcare app provides enjoyment while exercising, provides a better attitude when the app is useful, that is, health can be improved through the app. In the healthy group, on the contrary, the effect was greater when the enjoyment was larger than the perceived usefulness. In other words, it is important for healthy people to be provided with enjoyment in order to maintain exercise through the mobile healthcare app, and relatedness (0.567) and autonomy (0.513) have more influence on enjoyment than competence (0.270). Accordingly, the mobile healthcare app can motivate healthy people by satisfying their desire to achieve interest or individual value and by making relations with other people.

In this section, the entire sample is categorized into 186 juniors and 124 seniors based on age. Forty years of age was used as the cut-off to categorize the groups, based on Serenko, et al. [52]. As a result, the effect of enjoyment on attitude in the junior group (0.498) was significantly higher than in the senior group (0.366). In the case of the senior group, perceived usefulness (0.702) had a greater effect on attitude than enjoyment (0.366). Therefore, as in the healthy group, the junior group showed that providing enjoyment through the mobile healthcare app is important for sustainable healthcare, and relatedness (0.326) has a significant effect on the junior group to feel enjoyment. Given that young generation tends to adopt applications to connect with their friends, these results may indicate that the junior group in Korea may be more interested in mHealth if it can be linked with social network services. In the case of competence and autonomy, regression weights for those were greater than that for relatedness, but both were insignificant. In the case of the senior group, perceived usefulness was more important than enjoyment, as mentioned above. In addition, the relative advantage (0.575) had a greater effect than accessibility (0.222) on perceived usefulness in the senior group. That is, although one of the advantages of the mobile healthcare app is its accessibility, the senior group felt that the mobile healthcare app was more useful when it was better than other healthcare services in terms of functionality. These results are shown in Table 6.

As a result of analyzing the moderating effect by dividing the sample into male and female groups according to gender, there were no statistically significant differences between perceived usefulness and enjoyment on attitude, unlike the previous healthy/unhealthy and junior/senior groups. On the other hand, factors affecting enjoyment differed between males and females. In males, competence and autonomy were not statistically significant, and the influence of relatedness on enjoyment was statistically more significant than that for females. In Korea, men tend to enjoy team sports such as basketball and soccer, which is presumed to reflect this tendency. In the case of perceived usefulness, the male group considered relative advantage to be the most important factor affecting usefulness, but for female group, on the other hand, compatibility was the most important. The results are described in Table 7.

Table 5. Moderating effects of healthiness.

	Unhealthy Group (N = 56)					**Healthy Group (N = 254)**					**Difference btw Groups**
	URW	**SRW**	**S.E.**	**C.R.**	***p*-Value**	**URW**	**SRW**	**S.E.**	**C.R.**	***p*-Value**	
Enjoyment ← Related	0.383	0.388	0.064	6.014	<0.001	0.567	0.435	0.179	3.172	0.002	0.966
Enjoyment ← Competence	0.426	0.357	0.221	1.928	0.054	0.270	0.207	0.256	1.057	0.290	−0.461
Enjoyment ← Autonomy	0.276	0.251	0.186	1.482	0.138	0.513	0.499	0.213	2.408	0.016	0.837
PU ← Relative Advantage	0.555	0.546	0.100	5.560	<0.001	0.653	0.736	0.210	3.115	0.002	0.421
PU ← Accessibility	0.158	0.177	0.080	1.974	0.048	0.074	0.056	0.264	0.281	0.779	−0.303
PU ← Compatibility	0.483	0.513	0.062	7.847	<0.001	0.433	0.419	0.148	2.920	0.003	−0.317
Attitude ← PU	0.643	0.642	0.067	9.633	<0.001	0.369	0.330	0.107	3.437	<0.001	−2.164 **
Attitude ← Enjoyment	0.400	0.505	0.043	9.222	<0.001	0.725	0.817	0.123	5.914	<0.001	2.497 **
IU ← Attitude	0.969	0.940	0.092	10.509	<0.001	1.026	1.005	0.190	5.390	<0.001	0.270

Note: URW is the unstandardized regression weight, SRW is the standardized regression weight, PU is the perceived usefulness, and IU is the intention to use. ** $p < 0.05$.

Table 6. Moderating effects of age

	Junior Group (N = 186)					**Senior Group (N = 124)**					**Difference btw Groups**
	URW	**SRW**	**S.E.**	**C.R.**	***p*-Value**	**URW**	**SRW**	**S.E.**	**C.R.**	***p*-Value**	
Enjoyment ← Related	0.326	0.333	0.069	4.753	<0.001	0.589	0.509	0.113	5.191	<0.001	1.980 **
Enjoyment ← Competence	0.408	0.364	0.254	1.606	0.108	0.013	0.010	0.271	0.050	0.960	−1.063
Enjoyment ← Autonomy	0.349	0.337	0.223	1.567	0.117	0.511	0.446	0.218	2.339	0.019	0.518
PU ← Relative Advantage	0.574	0.652	0.100	5.740	<0.001	0.575	0.470	0.195	2.945	0.003	0.007
PU ← Accessibility	0.141	0.137	0.103	1.365	0.172	0.222	0.264	0.125	1.776	0.076	0.503
PU ← Compatibility	0.435	0.475	0.069	6.315	<0.001	0.448	0.436	0.092	4.886	<0.001	0.115
Attitude ← PU	0.566	0.548	0.076	7.474	<0.001	0.702	0.710	0.092	7.665	<0.001	1.145
Attitude ← Enjoyment	0.498	0.590	0.060	8.352	<0.001	0.366	0.490	0.052	7.069	<0.001	−1.666 *
IU ← Attitude	0.952	0.989	0.109	8.762	<0.001	1.016	0.887	0.129	7.882	<0.001	0.380

Note: URW is the unstandardized regression weight, SRW is the standardized regression weight, PU is the perceived usefulness, and IU is the intention to use. ** $p < 0.05$, * $p < 0.1$.

Table 7. Moderating effects of sex.

	Male Group (N = 153)					Female Group (N = 157)					Difference btw Groups
	URW	SRW	S.E.	C.R.	p-Value	URW	SRW	S.E.	C.R.	p-Value	
Enjoyment ← Related	0.548	0.495	0.108	5.062	<0.001	0.306	0.315	0.067	4.549	<0.001	−1.899 *
Enjoyment ← Competence	0.230	0.194	0.358	0.645	0.519	0.420	0.336	0.208	2.017	0.044	0.457
Enjoyment ← Autonomy	0.414	0.362	0.322	1.285	0.199	0.375	0.369	0.161	2.327	0.020	−0.108
PU ← Relative Advantage	0.834	0.751	0.199	4.189	<0.001	0.351	0.396	0.091	3.858	<0.001	−2.208 **
PU ← Accessibility	0.109	0.107	0.164	0.663	0.507	0.105	0.117	0.088	1.190	0.234	−0.023
PU ← Compatibility	0.314	0.324	0.067	4.719	<0.001	0.702	0.703	0.105	6.680	<0.001	3.12 ***
Attitude ← PU	0.530	0.595	0.072	7.334	<0.001	0.629	0.549	0.094	6.666	<0.001	0.834
Attitude ← Enjoyment	0.440	0.607	0.059	7.467	<0.001	0.492	0.537	0.065	7.569	<0.001	0.588
IU ← Attitude	1.070	0.952	0.138	7.747	<0.001	0.925	0.963	0.101	9.127	<0.001	−0.843

Note: URW is the unstandardized regression weight, SRW is the standardized regression weight, PU is the perceived usefulness, and IU is the intention to use. *** p < 0 01, ** p < 0.05, * p < 0.1.

5. Conclusions

As the development of mobile technologies enables to provide various healthcare services through smartphones [53], mobile healthcare applications and their use have been increasing [54,55]. In addition, recent study in healthcare has emphasized the importance of preventive care (i.e., Care [56] emphasized the preventive care as an effective tool for overweight and obesity in children, and Dietz, et al. [57] suggested patients in overweight use innovative technology to prevent severe obesity). Yet, it is difficult to motivate young or healthy people to manage their health before they have a health problem.

Recently, various IT technologies have been combined with healthcare technologies and in some related services, the gamification element emerged as a way to motivate people to exercise more. For instance, 'Smart Rope' of *Tangram Factory* is a rope which shows the number of times a user crosses the line like a virtual reality using a hand-held sensor and 23 LED bulbs. It allows users to play games while recording and managing their workouts, and then sharing their workouts with friends. In this study, we analyzed via SEM the influence of gamification on user intention to use mHealth, and the moderating effect of individual health status, age, and gender were used to examine how gamification influences the user intention differently according to each moderating factor.

The results showed that enjoyment had a greater effect on attitude for healthy people than for unhealthy people, which means that the gamification factor of mHealth played an important role in increasing the probability in user healthcare participation. Notably, we found that gamification is an important factor in motivating healthy people to be interested in healthcare by satisfying their desire to achieve interest or individual value, as well as by making relationships with other people. This result was confirmed when we compared the effect of gamification on attitude by age group.

In the case of the junior group, the enjoyment had a greater effect on the attitude than for the senior group. This conclusion was the same as for the comparison between the health and the unhealthy groups. However, in the junior group, competence and autonomy did not have a significant effect on enjoyment, unlike in the healthy group, and by increasing the relatedness, it was possible to increase the enjoyment for the junior group, which may be positively associated with the intention to use mobile healthcare applications.

The results imply that developers should consider gamification when developing mHealth services if their target users are healthy people. If they target the younger generation, they need to have a strategy that maximizes the enjoyment factor by using not only gamification but also social interaction.

This paper has several limitations. First, the healthy/unhealthy group is classified solely by a user's own judgment. Second, it considered 310 Korean respondents, and therefore, the sample size of the unhealthy group was relatively small. Moreover, it used data collected from a self-report survey; what people say and what they do are often not consistent. Third, there is no consideration of price and cost of the mHealth service. Lastly, in order to focus on the effect of gamification on user intention to use, some of the factors are omitted in the model such as app stickiness and social identification. Despite its limitations, the research has practical implications. This paper is notable in that it empirically showed that the enjoyment factor is important for adopting mHealth, as well as for improving the perceived usefulness, which has been emphasized but not empirically supported in previous literature [36,58]. In addition, it provides managerial implications for practitioners when they develop mHealth services or establish target market strategies by showing that the effects of gamification differ according to healthiness, age, and gender. Considering the actual behavior changes and health status after using mHealth or including more factors such as app stickiness and social identification can be our future studies.

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