Examining Enjoyment in Gamifying Physical Exercise and a Healthy Diet

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Abstract. This paper examines the role of gamification for enjoyment in physical exercise and a healthy diet. The lack of motivation for these health-related behaviors is associated with the rising incidence of cardiovascular diseases, diabetes, hypertension, and obesity. Gamification involves leveraging on enjoyment derived from game mechanics that could galvanize individuals to exercise and consume healthier meals. Literature has also noted that enjoyment is associated with competing activities, personal investments, valuable opportunities, social constraints, and social support. This work introduces Zest!, a gamified application designed to enhance enjoyment to exercise and diet. Zest! aims to enhance enjoyment by entwining exercising and dieting activities with game mechanics. An evaluation was conducted to understand users' perception of enjoyment associated with exercising and dieting as a result of using Zest!. It validates the game mechanics in enhancing the enjoyment to the activities. A total of 70 participants took part in the study and used it for two days. During the study, the participants were given tasks to utilize the available features. A questionnaire was administered at the end of the study to elicit their perceptions. Regression analyses were performed on the data collected. The results indicate that gamified applications has to potential to enhance enjoyment for physical exercise and a healthy diet. The implications from this study are presented.

Keywords: Gamification · Physical exercise · Healthy diet · Game mechanics · Enjoyment

1 Introduction

The rising incidence of cardiovascular diseases, diabetes, hypertension, and obesity calls for an examination of the lack of motivation to exercise and maintain a healthy diet. Regular exercise combined with consuming healthy food has been noted to be more beneficial than doing the individual activities alone [1] and long term engagement have resulted in sustained and maintenance of body weight [2]. Gamifying exercising and dieting has been proposed to galvanize individuals to take appropriate action [3]. Employing game mechanics, which are features found in games, with health-related activities is argued to invoke enjoyment that could motivate people to continue

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exercising [4] and consume healthier meals [5] despite experiencing setbacks [6]. Even though enjoyment is perceived to be important for health-related behaviors [7], it has not been extensively investigated in previous studies [8].

Enjoyment is associated with competing activities, restraining barriers, and social support [9, 10]. Competing activities that are perceived to be less attractive than exercising and dieting have a negative relationship with enjoyment. In contrast, restraining factors that reduces the individual's intent to terminate engaging in these activities have a positive association with enjoyment. Three types of restraining barriers have been identified. First, personal investments are time, effort, and financial resources put into the activity. Second, social constraints are the expectations and norms that create feelings of obligation to continue with the activity. Third, valuable opportunities are the prized prospects that only available through participation. Additionally, social support is also expected to have a positive relationship with enjoyment [10]. Although antecedents to the enjoyment of health activities have been identified, there is a lack of examination of the related game mechanics [8].

Given the research gap, this study aims to examine: *What are the game mechanics that could enhance enjoyment of physical exercise and a healthy diet?* The contribution of this work is two-fold. First, it introduces Zest!, a gamified application designed to enhance enjoyment of exercising and dieting. Second, it presents the implications from a user study that elicited users' perception of enjoyment from game mechanics.

The following section delves deeper into the discussion on the gamification and enjoyment of physical exercise and a healthy diet. It also provides an overview of the studies of gamified applications. The section that follows introduces Zest!, a gamified application that enhances the enjoyment of physical exercise and a healthy diet. The methodology section describes the process to answer the research question through a user evaluation. The results section presents the outcome of the evaluation while the discussion section reflects on the findings. The concluding section provides the implications together with the limitations of this work.

2 Related Work

2.1 Gamification

The increasing interest surrounding gamification the academia and industry signals the need to examine it in greater depth. Gamification entwines daily activities with game-like mechanics to motivate and sustain users' interest [3]. The mechanics found in video games are utilized in non-game situations to provide an enjoyable environment for users [3]. The commonly adopted mechanics are points, levels, and leaderboards [11]. Game mechanics are used in various domains that include health [12, 13], language learning [14], and personal tasks and habits [15].

Gamification differs from other genres in the following ways. These applications are set apart from video games through their purpose. The latter are played for purely hedonic reasons, while the former are used for hedonic and utilitarian purposes [16]. With respect to serious games, these are full-fledged games that are typically used for simulations in training and education. These games rely on the graphical and

interactive nature of games to bring the full experience of the simulation to the user. In contrast, gamified applications adopts the relevant game mechanics to motivate users regardless of the context of use [17].

Game mechanics are utilized in gamified applications for physical exercise and healthy diet to bring enjoyment. Previous studies have underscored the relevance of these mechanics to motivate individuals in health-related behaviors [18]. These mechanics are intertwined with physical exercise activities and have yielded positive results [19, 20]. Similarly, game mechanics are used in encouraging healthy dieting and studies have highlighted the association with enjoyment [5, 21]. Furthermore, studies have examined the effects of gamifying both exercising and dieting [22–24].

To date, only three studies have utilized game mechanics with physical exercise and dieting. Vivospace [24] combines gamification for physical exercise and healthy diet. This application enables users to log the exercise they did and meals they had. Users could make their goals such as to run 5 km in 25 min or lose 5 kg in 2 weeks. Furthermore, they could share their logs with other users and provide encouragement to these individuals. Meanwhile, in SpaPlay [23], users are given the mission to maintain the condition of a health spa by exercising and consuming healthy food. Upon completion, users are awarded points and currency that could be used to maintain the upkeep of the spa. These studies showed that gamification could increase exercise activities and improve diet but the duration of exercise and healthy food consumed remained below the recommended amount [22]. Furthermore, the studies did not measure the participants' perception of enjoyment [8].

2.2 Enjoyment

The extent of work surrounding gamified applications for health-related activities indicates the importance of enjoyable experiences. Enjoyment is the positive affective state in reaction to a stimulus that galvanizes individuals into action [25]. As enjoyment is a powerful emotion that could drive an individual to overcome adversity [6], it has been adopted as a psychological construct to understand the factors that galvanize individuals to take action. Due to this, it has been adopted for activities involving health-related behavior change [26].

The importance of enjoyment for physical exercise has been noted in population and empirical studies. Respondents in population surveys shared that enjoyment was relevant for them to exercise [27]. Among the correlates to physical exercise, enjoyment was found to be a strong predictor [28]. Although enjoyment is noted to be important, it seems to be elusive to individuals as highlighted by the lack of motivation to engage in physical exercise [7].

Enjoyment of a healthy diet refers to the preference for healthy food [29], which is consumed to meet the recommended daily amount of energy and nutrition [30]. Empirical studies have noted enjoyment to be a strong predictor of a healthy diet when compared with other correlates [31]. It is also associated with meeting the recommended amount of fruit and vegetable intake [32]. Despite the relevance of enjoyment to improve individuals' diet, many do not hold it in high regard as healthy food is perceived to be unappetizing [33] and the portion size would not satiate hunger [34].

From the perspective of gamification, enjoyment is a fundamental aspect as it motivates individuals to engage in the task [35]. It is defined as the sense of fun experienced by the individual while using the gamified application [36]. As features from games are adopted, it is expected that gamified applications would be able to bring an enjoyable experience for the user, leading them to use the application and engage in health-related activities [35]. However, related studies on gamification have used concepts like intrinsic motivation [37] and flow [38] interchangeably with enjoyment, making it difficult to pinpoint the precise nature of enjoyment [8].

2.3 Antecedents to Enjoyment

Literature has identified five antecedents to enjoyment, namely competing activities, personal investments, social constraints, valuable opportunities, and social support. Competing activities describe the appeal of other activities that might derail engagement [9]. These alternative activities are those that are more appealing than health-related activities and would make them less enjoyable. Studies have indicated that physical exercise to be enjoyable when other activities are not appealing [39]. Similarly, when individuals are presented with healthy and less healthy food, they would be more likely to enjoy the healthier option [40]. Related studies on gamified applications have argued for the importance of applications to increase the appeal of engaging these activities [21].

Personal investments refer to the time, effort, and financial means needed for the activity and cannot be recovered [9]. When an individual engages in physical exercise, they might need to purchase equipment and/or club memberships, set aside time, and put in an effort. Similarly, healthy dieting would involve putting in time for shopping, preparation, and cooking [34]. Investing into health-related activities has been found to be associated with enjoyment of physical activities [41] and dieting [42].

Social constraints reflect the expectations and social norms that bring the feelings of obligation for the individual to continue with the activity [9]. It is the perceived sense of obligation from others that pressures the individual to persist. For physical exercise, social constraints improve the individual's sense of enjoyment [10]. Similarly, a healthy diet is related to the norms and expectations of their family and friends [43].

Valuable opportunities are the prized prospects only available through continued involvement in the activity [9]. These anticipated opportunities are related to the physical, psychological or sociological benefits of health-related activities [41]. Exercising provides the opportunity to improve one's competency and the chance to be with friends [44]. For a healthy diet, this is characterized by the perceived competence in preparing healthy food [34].

Social support refers to the support available from other individuals that could help in the engagement of health-related activities [45]. It describes how the support provided by others who are considered significant leads to persistence in the individual. It has been noted that individuals engaging in physical exercise could receive support from others [46]. Social support is also found to be associated with fruit and vegetable consumption [47]. The relationship between social support and enjoyment has been empirically validated in related studies [39, 48].

In sum, previous studies have established that game mechanics could help users to engage in physical exercise and a healthy diet. The outcome from the studies also noted that the duration exercised and amount of healthy food consumed were below the recommended amount. Although the adoption of gamification mechanics hints that enjoyment is relevant, the concept of enjoyment has yet to be examined. Furthermore, the antecedents introduced have not been applied in the context of gamification.

3 Zest!

Zest! is a gamified application that aims to motivate users by making exercising and dieting activities enjoyable through gamification. Users' are challenged to balance the calories burned through exercising with the calories consumed from meals [49]. The definition of the antecedents to enjoyment were used to guide the choice of features available in Zest!. In total, there are six functions in Zest!. The main screen provides an overview and navigation links to other functionalities in the application. The remaining five functions, namely 'Move,' 'Eat,' 'Learn,' 'Connect,' and 'Ranking,' have separate screens. Zest! was implemented on the Android platform as part of a multi-tier architecture that is comprised of the mobile client, Web service, and database. It was developed for Android 2.3.5. The Web service was developed using PHP. The database which stores the data is a MySQL database.

The main navigation screen (Fig. 1) is presented to the user after logging into Zest!. It provides an overview of relevant information related to health behavior to the user, and access to the different features in Zest!. The tailored message, which is the greeting on top of the screen, embody the concept of competing activities. It is system-generated addressed to individuals [50]. The messages increase the appeal of engaging in these health-related activities by highlight the importance of these behaviors [51] and is personalized with the user's name to make it relevant for him/her. At the same time, the messages are tailored to either galvanize them when they had not earned any points in the current day or to praise them when they had logged exercises and meals.

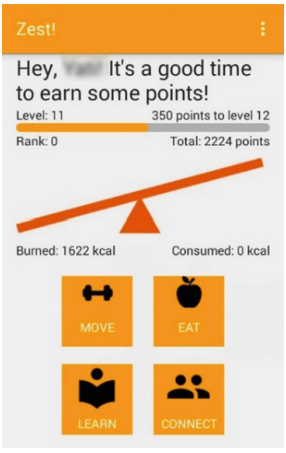
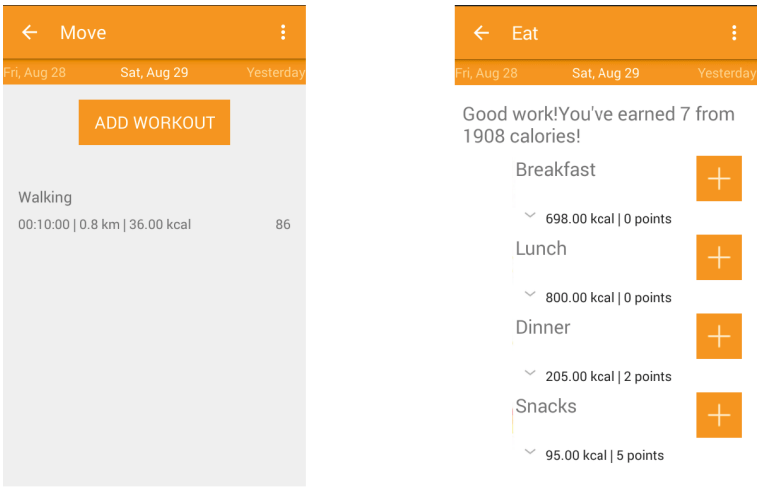


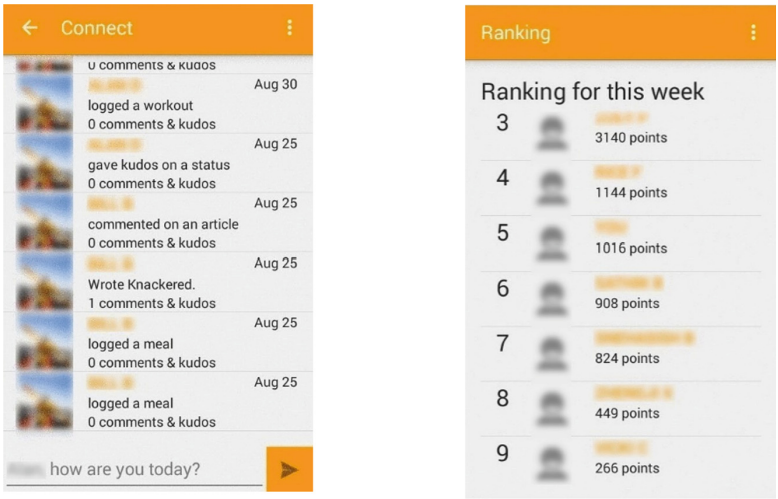
Fig. 1. Zest! main navigation screen

Figure 2 presents the main screen for 'Move' and 'Eat.' In 'Move,' the user logs a physical exercise that had been undertaken. The workouts that have been done on a particular day are listed with the details of the activity, calories burned and points earned. In 'Eat,' the user logs the meals consumed for breakfast, lunch, dinner, and snacks. The meals consumed are listed with the caloric intake from the food and the points earned. The points earned, which are associated with personal investments, are awarded to reflect the effort put in by the user [11].



(a) (b)

Fig. 2. (a) 'Move' screen, and (b) 'Eat' screen



(a) (b)

Fig. 3. (a) 'Connect' screen, and (b) 'Ranking' screen

Figure 3a presents the 'Connect' screen with a list of feeds showing the users' activities. It also presents the users' statuses and kudos (appraisals from others). The appraisals reflect the community expectations to restraint the individual in continuing to exercise and dieting [52]. Social support is provided through the comments feature, and this enables users to interact with others [53].

Linked with valuable opportunities is the leaderboard that ranks the users by the points earned. It is an indicator of their effort with others in the community [11]. The leaderboard in Zest! (Fig. 3b) ranks the users based on their weekly performance.

4 Methodology

A user evaluation was conducted to understand users' perception of enjoyment associated with exercising and dieting as a result of using Zest!. The outcome of the users' perception is a validation of the game mechanics, namely tailored messages, points, levels, kudos, leaderboards, and comments, role in enjoyment of the activities. A total of 70 participants took part in the study and used Zest! for two days. During the study, the participants were given tasks to utilize the available features such as exercise and meal logs, comments, kudos, and leaderboard. A questionnaire was administered at the end of the study to elicit their perceptions. This procedure had been reviewed and approved by the University's Institution Review Board committee with serial number IRB-2015-03-020. Each participant was given a small sum of $10 as a form of gratitude for their contribution and effort.

The items used in the questionnaire were adapted from past studies related to sports commitment [9]. These items were adapted to the context Zest! for enjoyment of physical exercise and a healthy diet. Table 1 presents the mean, standard deviation and Cronbach's alpha for each variable.

Table 1. Mean, standard deviation, and Cronbach's alpha of the variables

Variables	Physical exercise			Healthy diet		
	M	SD	α	M	SD	α
Competing activities	3.22	0.65	0.91	3.23	0.65	0.91
Valuable opportunities	3.48	0.76	0.86	3.52	0.76	0.88
Social constraints	2.58	0.82	0.85	2.40	0.89	0.92
Personal investments	3.85	0.85	0.95	3.64	0.81	0.89
Social support	3.48	0.66	0.85	3.42	0.66	0.91
Enjoyment	3.64	0.73	0.91	3.64	0.75	0.91

Competing activities measures the appeal of engaging in the alternative activity that conflicts with enjoyment for physical exercise [39] and dieting [40] brought by the tailored messages in Zest!. The competing activities for physical exercise and dieting variables are made up of five items that inquired the participants' feelings about engaging in the activities each. Personal investments measures the user's perception of

the resources that have been invested into physical exercise [10, 39] and a healthy diet [54] through the game mechanics of points and levels available in Zest!. The variables that measured personal investments for exercising and dieting were made up of three items each. Social constraints measures the feeling of obligation to continue exercising [10] and dieting [43] from the community in Zest! through kudos. Each of the variables for social constraints in physical exercise and a healthy diet were measured by four items. Valuable opportunities measures the participants' perception of the possibilities that are only available through using Zest! to engage in physical exercise [39] and a healthy diet that is embodied in the leaderboard. Four items made up the variables for valuable opportunities in exercising and dieting respectively. Social support measures the participants' feelings of encouragement and support that others provide through the comments for engaging in physical exercise [10] and dieting [47]. Three items queried the social support they received in Zest! to motivate exercising and dieting each.

There are two dependent variables. One dependent variable is participants' perception of enjoyment in physical exercise and is made up of four items. Another dependent variable was the participants' perception of enjoyment of a healthy diet and it was made up of three items.

The 70 participants were between 21 years old and 49 years old ($M = 27.22$, $SD = 7.06$). Male participants made up the majority (62.86%). In terms of education background, the majority of the participants were from Computer Science/IT (48.57%, $N = 34$), Engineering ($22.86\%, N = 16$), and Arts, Humanities, and Social Sciences ($20.00\%, N = 14$) disciplines. A small segment of the participants used mobile fitness applications. They used these applications to log their exercise ($27.14\%, N = 19$) and meals ($10\%, N = 7$) at least once a month. They also used these applications to search for health-related information on a monthly basis ($17.14\%, N = 12$). Additionally, they also indicated that they play games on social networking applications on their mobile phones ($37.14\%, N = 26$).

5 Results

From the data collected, regression analyses were conducted to examine the relationships of competing activities, personal investments, social constraints, valuable opportunities, and social support with enjoyment.

5.1 Regression Analyses Results for Physical Exercise

Table 2 presents the outcome of regression analysis for physical exercise. The model was found to be statistically significant (Adjusted $R^2 = 0.48$, $F(64, 5) = 13.79$, $p < 0.001$) and accounted for 48% of the variance. The results showed that the competing activities variable has a negative association with enjoyment to physical exercise ($\beta = -0.27, p < 0.01$). This outcome indicates that the tailored messages in Zest! were able to reduce the attractiveness of other activities and in turn making exercising more enjoyable.

Table 2. Linear regression analysis for enjoyment of physical exercise (N = 70)

Independent variables	Standardized beta	t-values
Competing activities	−0.27	−2.70**
Personal investments	0.13	1.19
Social constraints	0.02	0.22
Valuable opportunities	0.49	4.33***
Social support	−0.07	−0.63
Adjusted R^2	0.48***	

Note: a. dependent variable is "Enjoyment of physical exercise"
b. **p < 0.01, ***p < 0.001

Additionally, the results indicated that the valuable opportunities variable is positively associated with enjoyment of physical exercise ($\beta = 0.49, p < 0.001$). The results highlight that the gamification features in Zest!, which were able to show the opportunities that were only available in the application, made physical exercise enjoyable for the participants. The leaderboard embodies opportunities for physical exercise.

However, there were no significant associations between the variables of personal investments ($\beta = 0.13, p = 0.24$), social constraints ($\beta = 0.02, p = 0.83$), and social support ($\beta = -0.07, p = 0.53$) with enjoyment of physical exercise. The outcome suggests that the points, levels, kudos, and comments might not be able to make exercising enjoyable.

5.2 Regression Analyses Results for a Healthy Diet

The results for the regression analysis for a healthy diet is presented in Table 3. The model was found to be statistically significant (Adjusted $R^2 = 0.44$, $F(64, 5) = 11.78$, $p < 0.001$) and it contributed to 44% of the variance. The results showed competing activities have a negative relationship with the enjoyment of a healthy diet ($\beta = -0.29$, $p < 0.01$). It suggests that the tailored messages in Zest!, which reduces the likelihood of the participant in engaging in alternative activities and enhance the feeling of enjoyment towards a healthy diet.

Table 3. Linear regression analysis for a healthy diet (N = 70)

Independent variables	Standardized beta	t-values
Competing activities	−0.29	−2.70**
Personal investments	0.32	3.16**
Social constraints	−0.11	−1.08
Valuable opportunities	0.26	2.35*
Social support	0.19	1.89
Adjusted R^2	0.44 ***	

Note: a. dependent variable is "Enjoyment of a healthy diet"
b. *p < 0.05, **p < 0.01, ***p < 0.001

As expected, the results demonstrated a significant positive association between personal investments and the enjoyment of a healthy diet ($\beta = 0.32, p < 0.01$). This highlighted that points and levels in Zest! reflected the resources put in for dieting and in turn made it more enjoyable.

The result indicated that valuable opportunities have a significant positive association with the enjoyment of a healthy dieting ($\beta = 0.26, p < 0.05$). The outcome indicates that the leaderboard could enhance the feeling of enjoyment for a healthy diet.

However, there were no significant associations between social constraints ($\beta = -0.11, p = 0.28$) and social support ($\beta = 0.19, p = 0.06$) with enjoyment. Compared to other features, the related features, namely kudos and comments, need users to interact with one another.

6 Discussion

The results of our work yielded the following findings. First, there are significant relationship for competing activities and valuable opportunities with enjoyment of physical exercise. The findings suggests that reducing the appeal of competing activities is associated with enjoyment. Presenting personally relevant messages that highlight the value of engaging physical exercise reduces the users' focus on other activities as individuals are more likely to be receptive to messages that are personally relevant to them [50]. For instance, addressing the users by their name captures their attention and offering suggestions is a call to action. Additionally, providing valuable opportunities are associated with enjoyment. The anticipation of such opportunities helps to enhance the users' enjoyment of physical exercise [28]. One such opportunity in Zest! is the recognition of user's abilities through leaderboards [55]. The leaderboard compares the user's effort with respect to others.

Second, there were non-significant relationships for personal investments, social constraints, and social support on enjoyment of physical exercise. For personal investments, the finding may contradict prior studies that argued for the importance of personal investments [11]. The outcome could be attributed to the lack of clarity highlighting the users' effort to their physical exercise. The features that embody personal investments in gamified applications has to reflect the users' effort in a meaningful way that could be understood easily [55]. The lack of significant association for social constraints suggests that the participants did not feel part of the community as they used the application for two days. They were not familiar with the expectations and norms in the community. For such behavior to be established, both time and a substantial community size are required [56]. Third, there is no significant association with social support. For such support to be formed, a substantial size is required and attaining this would require time. Like before, the participants used Zest! for two days indicating that they might not be familiar with other users and this may have limited the support available [53].

Third, there are significant relationship for competing activities, personal investments, and valuable opportunities with enjoyment of a healthy diet. It is found that competing activities have a negative association with the enjoyment of a healthy diet. It corroborates with prior studies that have examined using messages in gamified

applications to stress the value of healthy diet to the user [21] The messages that were tailored to the user were able to encourage users to consume healthier meals. Additionally, personal investments are related to enjoyment. The features, points, and levels, translate the effort put in by the user through the awarding of points [28] and attainment of levels [55]. Put together, indicating the effort put in by users through these features led them to a more enjoyable experience in healthy dieting. Also, valuable opportunities have a positive relationship with enjoyment. The outcome highlights the importance of providing novel opportunities for the individual to maintain their diet as advocated in previous studies [22]. The leaderboard in Zest that highlights the effort put in by the user for dieting is a recognition of their effort.

Fourth, there was no significant relationships for social constraints and social support with enjoyment of a healthy diet. The nascent user community might not have been established long enough to form social norms. The two days that the participants took part in the study could be considered too short for them to be acquainted with one another and they were more focused on their activity [57]. For social support, the participants might not be familiar with others to give the necessary encouragement that they might need to make dieting more enjoyable. This finding could also be attributed to the duration of the study as the participants might need time to be familiar with others [58].

7 Conclusion

Three design implications could be derived from the findings. First, game mechanics that are representation of personal investments into these activities is essential to enjoyment. Gamification designers could consider integrating game mechanics that emphasize effort put in by the user for improving their health. This could be done by tying the desired behaviors to the relevant mechanics. For instance, points are linked to the calories expended during exercising and the consumption of healthy food. Similarly, levels reflects users' progress and raises awareness of their status.

The second implication is associated with the valuable opportunities that are only found in gamified applications. It is envisaged that game mechanics could endorse users health-related behaviors only by using the application. Leaderboards could provide the much needed recognition of users' competence. However, there are users who might be deterred by the competitive aspect of leaderboard as they have different abilities and focus from other users [37]. Instead of integrating a global leaderboard that ranks all users, leaderboards could be used to compare groups of users who shares similar abilities or interest.

Finally, the appeal of competing activities could be reduced by enhancing the value of using the gamified applications. As a recommendation, gamified applications with tailored messages could appeal to the user's value in maintaining a healthy lifestyle. Based on the context, the application provides appropriate messages to galvanize the users to nudge users into action.

This study has also examined the concept of enjoyment for gamification of health-related activities. It has presented the antecedents to enjoyment. The study has provided empirical evidence that game mechanics could enhance enjoyment of

physical exercise and a healthy diet. It is further substantiated in Zest!, where the game mechanics associated with the antecedents are put together. Thus, gamified applications is a promising intervention for motivating users to engage in physical exercise and a healthy diet.

There are caveats to this study. First, the variables measured were psychological variables and there were no measures of actual behavior. Although enjoyment is argued to be an important aspect for motivation, empirical studies have indicated the mediating role of enjoyment to actual behavior [10, 44]. Second, the user evaluation of Zest! was conducted over two days. However, previous studies have examined the long-term usage of applications with to understand the behavioral outcome [22, 23]. Therefore, it is pertinent to conduct a longitudinal study to affirm the relevance of the game mechanics. Third, the small sample size of the participants who took part in this study is another limitation. The number of participant might limit the generalizability of this study.

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