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# Planning a health promotion program: Mobile app gamification as a tool to engage adolescents

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**Abstract**

Over the past decade, the World Health Organization (WHO) has been alerting about the existing overweight prevailing among the adolescents' group. This group is considered a nutritional risk group mainly because of less correct eating patterns and misbehaviors towards physical activity. To prevent obesity within this risk group, we are working on a mobile application involving gamification techniques. This article presents the preliminary results of a design study for this app, and explores possible design guidelines and processes based on results achieved in preliminary user interface and experience tests.


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## 1. Introduction and scope

Estimating and quantifying the impact of overweight and obesity, as well as the prevalent chronic diseases associated to it is difficult [1]. According to Bussiek et al. [2], a study revealed that about 110 million children and young adults, under the twenties, were estimated to be obese. According to the Childhood Obesity Surveillance Initiative - COSI Portugal 2016 [3] Portugal is one of the European countries with the highest prevalence of overweigh/obesity. This study conducted in 2016 with 6745 children from 230 schools revealed a worrying scenario. In fact, the number of children traveling by car to school is increasing, as well as an increase on the use of computer for electronic games, revealing that Portuguese adolescents continue to have numerous sedentary behaviors. The results of this study reinforce the need to surveil the nutritional status of the school population, to train families for healthier eating habits, to inspect food supply in schools and to promote adolescents' physical activity. The long-term effects of bad eating patterns can result in overweight, as well as an increase of micronutrient deficiencies, with the appearance of chronic diseases left untreated leaving consequences into adulthood [4]. 92% of the American adolescents between thirteen and seventeen years old indicated going online at least once a day. Furthermore, 88% mentioned having daily access to a mobile phone, a desktop or laptop computer. Therefore, the use of technological resources is growing, especially in adolescents.

The TeenPower project [5] aims essentially at helping overweight teenagers to address lifestyle surveillance, self-monitoring and social support through the use of a digital platform. This platform includes a mobile app in which teenagers are engaged in changing their lifestyle through gamification.

This paper presents a group of preliminary studies towards the development of the TeenPower mobile app: first, in order to assess the adolescents needs regarding the use of ICT for health promotion, we characterize and evaluate the type of mobile apps more frequently used by adolescents, as well as the features which can greatly engage them. From here, the results will guide us on experience design strategies to follow when creating the high-fidelity interface layouts and developing the TeenPower mobile app.

This document is organized as follows: Section 2 describes a literature review about the use of gamification in mobile application for health (especially obesity prevention), and for healthy lifestyles. Section 3 describes the results of a study around the use of ICT regarding health promotion in adolescents. It also includes the user journey, a paper-based prototype and its evaluation. Section 4 discusses the main findings, states the limitations of the study and outlines the implications for the next phases of the project. Conclusions and future work are presented in section 5.

## 2. Related work and methodology

Developing e-health applications and systems is hard since it involves not only domain-specific knowledge on Healthcare, but also advanced Design and ICT skills [6]. m-Health applications are able to engage adolescents through game experiences, using specific techniques that contribute for changing habits, improving motivation for doing physical activity, and supporting for eating healthy food. A recent systematic review from 2017 [7] showed that there is a fast-growing adoption on gamification practices and on serious games for health self-monitoring and management. This review suggests that m-Health offers advantages over traditional face-to-face methods for delivering behavioral interventions, especially in adolescents. It includes real-time data collection, feedback and low-cost dissemination.

Working the Design process in health interventions serves both game designers and health experts [8]. Nevertheless, this study shows limitations regarding interdisciplinary participants and in the understanding of the game's elements inside a health context. Another interesting point is how game design and health concepts match in order to correspond to specific Universal Principles of Design [9]. The framework for health games of Sawyer and Smith's [10] categorizes games by their domain: personal, professional practice, research/academia, or public health, and focuses on health activity like prevention, therapy, assessment, education, or informatics. Nonetheless, there are other potential frameworks [11] which consider only health-giving based on three topics: player, game, and therapy. In this insight, the user behavior can be influenced by both approaches, design and evaluation of serious games, in particularly those applications which are focused on health promotion and illness management.

Sebastian Deterding provided a hands-on course in CHI PLAY'17 [12] introducing a research-based method for designing gamified applications. The author argued that there is still inconsistent guidance about how to design these applications and revealed the existing gap in understanding crucial aspects of the Design process. In this program, the author followed the reference of Design Lenses [13] to ideate the improvement of motivation and engagement, as well as to identify shortcomings from Design. As it exists practice in working the Design process in e-Health projects related with chronic diseases [14], we decided to follow the same strategy: apply corresponding Universal Principles of Design [9] to game environments, for the development of the TeenPower mobile app.

## 3. Preliminary studies on the design of the mobile app

The TeenPower collaboration between the Design, Healthcare and Technology fields started in the first semester of 2017/2018, when the research team presented the project to 26 multimedia design students. The main goal was to create a mobile app user experience focused on a health intervention program related to obesity in adolescents. After receiving the highlights about previous studies, the work inside the class started. The students were requested to explore, individually, the obesity theme with the purpose of: 1) list how many related mobile apps already exist in commercial online stores; 2) which of them consider self-monitoring; 3) if they use or not any gamification techniques to engage users, and 4) to identify what kind of mini-games do they present. After an initial period for background knowledge, the class was divided into five groups, with three students each, to work on the design process. This process was divided into three phases: 1) user journey, 2) paper-based prototype development, and 3) prototype evaluation.

### *3.1. ICT for adolescents engagement with overweight*

Regarding the assessment of adolescents needs concerning the use of ICTs for health promotion, we focused on characterizing and understanding what type of mobile apps are more frequently used by adolescents, as well as to identify which m-Health features should be present to be more appealing to adolescents and to create a greater experience of engagement. To understand this scenario, 165 adolescents (between 12 and 18 years old) recruited from the central region of Portugal were inquired: 95.2% answered that they are smartphone holders. Regarding the most used features, social networks present the higher value, 97%. 69.7% of participants referred to the use mobile entertainment applications like video, music, and others. 58.2% play mobile games. This report also aimed to identify the adolescents' usage facilitators and barriers to use a m-Health application. They were asked if they have already tried a m-Health app. 62,6% said they never attempted but considered as essential features food suggestions and physical activity recommendations.

### *3.2. User Journey*

The User Journey method helps designers and other professionals in understanding how to address the user's needs [15,16]. Figure 1 presents the experience through storytelling created by the students, involving elements such as the character (which is supposed to be the adolescent's alter-ego behind the story), and the user interactivity, which helps to understand the sequence of the events. For designers, this is an instrument of information which engages the audience about how to experience all the events [9].

The engagement of a user of the TeenPower app occurs from the moment that s/he has the opportunity to customize her/his character, uploading/synchronizing clinical data from a backoffice web app, and starting to play after a character status appeared. This information, related to eating, drinking and resting, will be placed in preset locations for users to earn or buy, involving small challenges, according to healthcare professionals which are tracking the adolescent's behavior through the backoffice web app and making decisions accordingly. Another existing area is the map where the adolescents will be able to maintain their health condition through physical activities, providing them, simultaneously, knowledge to lead a healthy lifestyle. The game also offers tips and informational videos that adolescents may use, specifically selected by healthcare professionals. The strategy defined encourages the user to

move towards the desired health, to learning with the game, acquiring knowledge on healthier behaviors with different challenges. For instance, by incorporating step-by-step elements for keeping fit or through mini games well known outside of the digital world, according to the performance.

### *3.3. Paper prototype evaluation with usability tests*

After the conclusion of the User Journey, the three students' groups started the sketch phase, which consisted in a hand drawing practice using paper prototype [17]. The groups illustrated the scenarios where they felt more doubts in respect to create a game experience that could embody healthier behavior in different levels, with challenges such as mini games. Figure 1 (a) presents the three mobile screens from the most voted paper prototype, where it is possible to see the character representation, how adolescents choose food from the food wheel, and where they are able to attend activities using a map. After the development of the paper prototype, usability tests with end users were conducted. Figure 1 (b) shows the students preparing the sequences of screens according to the tasks defined before. The evaluation involved 5 participants from the Afonso Lopes Vieira high school in Leiria, Portugal, following the recommendations of Jakob Nielsen [18]. The high school teens group was formed by two girls, with 17 and 14 years old, and three boys, one with 16, and the other two with 14 years old.

a b c


Fig. 1. (a) Paper prototype; (b) ESAD.IPL students simulating the paper prototype sequence. (C) Usability test "First Click" – Adolescent.

The primary goal of this evaluation was to analyse a set of predefined tasks, three per each adolescent. Table 1 presents the goals, the task evaluation, and a summary of the results, with the information about how many users completed them successfully, and a few observations. Table 2 shows the user feedback collected by the research team, after the students finished their tests.

Table 1 – Task evaluation

| Task – Mobile app | | Goals | Results summary | |
|---|---|---|---|---|
| | | | Task successfully completed | Other user's observations |
| 1 | Create a character | Comprehend if users recognise the diversity of customization options for the features, after proceeding with a log in. | 4 | • Difficulty in registration – 1 |
| 2 | Complete a mission | Understand if users have no difficulties in interpret the game map, and the mission they have to accomplish. | 1 | • In the map, it took a while to realize environment – 3<br>• Difficulty in getting along with the gym list – 1 |
| 3 | Feed the character | Observe whether if it is obvious for the users that they have to feed the character. | 2 | • In the dashboard, did not understand that exist a window chat – 1<br>• In the dashboard, did not understand how to feed the character – 2 |

Table 2 – User feedback

| User | Suggestions to improve | Positive aspects |
|---|---|---|
| Adolescents | "More suitable for younger children".<br>"I think a game is not what is needed".<br>"Create a daily mission that offers a bonus reward the encouragement of young people in use the application every day. Weekly/ monthly events that award prizes to those who are more assiduous". | "I think the person could have fun with the application while doing healthy activities." |

## 4. Discussion

The preliminary study from section 3.1 helped us to comprehend issues about adolescents behaviors related with the use of technology, providing us a relevant indicator: 62,6% of participants said to never attempted m-Health systems but considered that essential features are suggestions of food and physical activities. This preliminary study also reflects that they play games but, in the context of promoting their health, fail to understand the real benefits. This issue was considered in the design process of the TeenPower app, and a game experience was created following the storytelling technique. We gathered teen common daily habits, simple game elements such as challenges, and behind it artifacts for health promotion with a visual support focused on their age group.

As seen from the User Journey in section 3.2, user engagement is based on entertainment with educational topics. The user perceives the overcome of small challenges and achieves rewards for it. The usability tests from section 3.3 helped us to recognize that participants did not know what does it mean to play a game and simultaneously to contribute to their health. 4 participants from the 5 felt different difficulties, as Table 1 shows. In the third question "feed the character", participants also felt problems mainly because of some graphic elements not well defined. The feedback collected at the end (Table 2) also pointed out that most of the adolescents suggestions were based on contributions to improve the game, not on the existing relationship of doing healthy activities when they are having fun.

## 5. Conclusion and future work

Gamification techniques applied to game experience without an efficient support from the Design field may compromise the user understanding of serious games' real benefits. This paper argues that it is mandatory to involve all different stakeholders in the design process when working in this field, as a real contribution to promote healthy habits in adolescents, behind entertainment and therapy.

The TeenPower platform (backoffice and mobile app) is now being developed with the direct support of an interdisciplinary team. The backoffice web app will be managed by health professionals and school teachers, being designed to allow the monitoring and interaction with adolescents and editing/managing the mobile app contents. The mobile app requirements and resources will be based on the results presented in this paper. A wide trans-territorial pilot study will be implemented to test the platform during the school year of 2018-2019. Further data collection with end users will be done in the pilot phase, to determine if the design process influences or not the creativity of those who were involved in the creating of TeenPower game experience.

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