A Responsive Web Application for the Improvement of Healthy Habits in the Child Population

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Abstract: The World Health Organization declared childhood obesity as a global epidemic, stressing the need for urgent action in order to face this serious public-health problem. This paper presents a pilot program based on a technological solution to improve the nutrition and physical activity habits in children. The solution is a multiplatform application that can be accessed both from computers and mobile devices. A study of current, similar solutions was carried out and a web application was designed and built, combining information on healthy nutrition and physical activity habits with the functionalities of an online social network. This application was used to carry out a pilot intervention with children from the first and second years of Compulsory Secondary Education (CSE) at a school in Spain. After the pilot program, feedback was received from the users, obtaining valuable information for introducing a number of improvements that will be incorporated into a future program.

1 INTRODUCTION

In 2000, the World Health Organization (WHO) classified obesity as an epidemic. Its study has been approached from the different branches of Health Sciences, through Psychology, and even Economics. Within the context of governance, bodies such as Ministries, Regional Councils, City Councils, Healthcare Management, schools, etc., have also shown their concern and interest in the fight against obesity in the face of truly alarming and rising figures (Arias, 2017). In this sense, the experts point out that such a multicausal disease cannot be tackled from the most traditional solutions, forgetting the relational

and contextual aspects. Valente et al speak of relational inheritance when they explain the transmission of diseases through peer influence. From this perspective, programs against or to prevent obesity should be approached in light of such relational environments and peer influence (Valente, 2012). However, programs for the prevention of obesity are not being considered, and there is some disappointment with the results of current strategies, which is why this research team considers the implementation of this project relevant.

The WHO is working on different lines of action aimed at obesity and infant/youth malnutrition. It presents important experiences as follows: (i) the

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Shape up Project (2006) which is based on a collaborative approach between the individual, the school, the community, the family, municipalities and the whole social environment (Simovska, 2008), (ii) School for Health in Europe (SHE), the network of Schools for Health in Europe, which supports organisations and professionals to develop and support school health promotion in each country by providing the European platform for school health promotion (Europe Network Foundation, 2019), (iii) the Childhood Obesity Surveillance Initiative (COSI), which aims to measure trends in overweight and obesity in children aged 6-9 to monitor progress and reverse the epidemic and allow comparisons to be made between countries in the European Region (Wijnhoven et al., 2015), and (iv) Building resilience: a key pillar of Health 2020 and the Sustainable Development Goals Examples from the WHO Small Countries Initiative (2017), a document that sets out Health 2020's defence of resilience as a key factor in the prevention and promotion of the health and well-being of the individual and the community (World Health Organization, 2017).

Recently, reports from the European Commission (Wijnhoven et al., 2015; World Health Organization, 2017), have reflected some alarming data regarding the indicators of obesity and overweight in Spain. In 2001, 12.6% of the adult population suffered from obesity, rising to 16.2% in 2014, an upward trend in both overweight and obesity. In the adolescent stage, the prevalence of overweight and obesity at age 15 increased from 16% in 2001-2002 to 20% in 2013-2014, while in the rest of the EU they remained at 18%. The prevalence was higher for boys than for girls, at 24% and 15% respectively. These figures, which will lead to an increase in the number of obese adults, will give rise to different systemic effects of all kinds, including cardiovascular, respiratory and traumatological pathologies, as well as an increase in suffering from different types of cancer in adult life (Ortega et al, 2016; C. Yang et al., 2019). The increase in the prevalence of overweight and obesity in adolescents could potentially put at greater risk the sustainability of the Spanish public health system, which has made a major effort in prevention and health promotion that has not come up with the expected results. In fact, in 2011, the Spanish Government (European Observatory on Health Systems and Policies, 2017), aware of these figures, adopted several legal reforms specifically to reduce excess weight among children. For example, the objective of the Law on Food Safety and Nutrition has been to limit, among other things, the intakes of saturated fats, salt and sugars in school canteens.

Doing a review of the literature in relation to the effectiveness of the applications against the prevention of obesity, there are different programs in which using web or mobile applications, have managed to reduce the percentage of fat in different patients as well as sustaining this weight loss over time (Coughlin et al., 2015; Mangieri, Johnson, Sweeney, Choi, & Wood, 2019; H. J. Yang et al., 2017). There are also studies that have been able to verify the relationship between the use of social networks and the effect that this has on physical activity in the population (Godino et al., 2016; Pinkerton, Tobin, Querfurth, Pena, & Wilson, 2017; Zhang, Brackbill, Yang, & Centola, 2015), together with the influence that friendships can have on greater physical activity (Salway, Sebire, Solomon-Moore, Thompson, & Jago, 2018).

This study presents a tool to assist in the prevention of juvenile obesity. This tool consists of a web application made with a responsive design. Thanks to this responsive design, it is possible to visualize it correctly on computers, mobile devices and tablets. Through this application, the individual will be able to create a profile with his or her data, on the basis of which he/she will obtain a series of recommendations and advice related to the improvement of totally individualized nutritional and sports habits, thanks to the use of artificial intelligence algorithms and semantic technologies. To achieve this, it is essential that the person shows motivation and adherence to these recommendations. The user will be able to contact people who have a very similar profile, creating a relationship of mutual support between both individuals. It will also have a section for direct contact with health professionals and researchers if necessary, as well as forums and open communities that encourage self-monitoring and self-motivation among the users of the application.

2 METHODS

The tool to be developed had to be well visualized in computers and mobile devices to involve the participation of students of 1st and 2nd year of Compulsory Secondary Education (CSE), between 12 and 15 years old. For this reason, it was decided to create a web application with a responsive design. In this way, users could make use of it in computers and mobile devices such as tablets or mobile phones.

This web application has a social network part in which are shown a series of tips on nutrition and physical activity to encourage and educate users in a

fun way. This application should have a reward system to help promote the use of the application among students. This web application has been named SanoYFeliz (Happy and Healthy).

As a web application, the problem was addressed using the perspective recommended by the software engineering. In this sense, it was necessary to consider the work as a software development project and to organize the processes and tasks according to the different phases of its life cycle. Once the general objectives of the project had been established, it was time for studies and analyses prior to its implementation, subsequent decision-making regarding the methodology and the technologies to be used, project planning and documentation of the system requirements.

2.1 Domain of Study

The first step carried out was an in-depth analysis of the domain, i.e. the field of application, as well as the context of the project. This knowledge is fundamental for: an optimal refinement of the requirements; a correct understanding in the communication with the client (in this case, the research group); a correct use of the terminology; the extraction of implicit functionalities inherent to that domain; and finally, to simplify the logic of the application under development.

The nature of the project and the end user to whom this application is addressed were decisive aspects. Among the interests of the research project is the collection of data for analysis. In addition, the research group has numerous experts in nutrition, biomedical and health sciences, etc. whose involvement in the development process has been very useful.

The users for whom the web application is intended are secondary school students, which must be taken into account when designing the interface and the limitations and risks that this could entail due to their age or personal circumstances: restriction on image uploads, prevention of the use of bad words and control over the content sent by users so that it does not contain adult content..

Some studying in the field of health was necessary to understand the interest of the data that would be handled in the application. An investigation of the most popular social network platforms was also carried out in search of similarities with the objectives pursued in this project. In this way, useful aspects and ideas regarding design or functionality were found that could be adapted and incorporated according to one's own needs.

The social network most analyzed for its closeness to the subject matter discussed is FatSecret[7], a platform that allows the user to keep a comprehensive record of their diet and physical activity day by day, in addition to social interaction through community functions. The latter is the most interesting part, as the FatSecret health section is specifically geared towards counting calories, being more useful, for example, for a professional audience in the world of sport than for an average user looking to improve their habits and lose weight.

Facebook [8] is another case study of special interest, both for its social structure and for its event function that serves as inspiration for event management in this project.

As indicated in some lines of research, there are multiple applications that make nutritional recommendations to athletes or people who need to eat a very specific and careful diet (Charles, Stanley, & Agbaeze, 2013; Donciu, Ioniţă, Dascălu, & Trăuşan-Matu, 2012). However, no app has been created that pursues the improvement in health and the prevention of obesity in the juvenile public.

The aforementioned applications do not exploit the relationships between users through the creation of communities (Jane, Hagger, Foster, Ho, & Pal, 2018). Friends and peers have a great social impact on the development of certain health habits (Salvy, de la Haye, Bowker, & Hermans, 2012), especially in this age group. Furthermore, there may be a positive contagion effect. This means that if a person has friends with good habits, they can improve their own (Salathé, Vu, Khandelwal, & Hunter, 2013). Therefore, taking advantage of the social environment to achieve a better adherence to healthy habits is one of the strategies to follow in this project.

What users value most about an application to monitor their physical activity is that it makes it entertaining and rewarding, giving them the motivation to achieve their goals (Dharia et al., 2016). The current applications have generic routines without considering the preferences and the fitness status of the adolescent, which can be counterproductive (Dennison, Morrison, Conway, & Yardley, 2013). The focus of this project is based on the positive coaching method (Jones, Woods, & Guillaume, 2016) to encourage the involvement of the adolescent in the management of their own

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[7] https://www.fatsecret.com/

[8] https://www.facebook.com/

healthy habits making them aware of their health and enhancing their capacity for self-evaluation and resilience.

2.2 Technologies Selected

The web technologies used to meet the objectives were mainly HTML5, CSS and javascript for the visual part and PHP and MySQL for the application functionality.

It was necessary to design and implement the application in a solid framework. PHP language was used to make this application and, in particular, the Laravel framework due to the positive references it had, as well as its architecture based on the Model-View-Controller (MVC) pattern, as explained in detail in the corresponding section of this document.

On the other hand, the Bootstrap design library was incorporated to simplify the graphic section of the web, at the same time facilitating the coherence between the pages, the requirement of the adaptability of the design and the adhesion to the principles of web usability.

2.3 Architecture

The web application was developed making use of a Model-View-Controller (MVC) software architecture pattern. The traditional functioning of the MVC architecture is described in the following figure and each of the three parts into which it divides the application is explained below. Laravel is a PHP framework based on MVC that facilitates the development of applications in this language through multiple features (Saunier, 2014).

2.4 Database Design

This project uses a relational database for data persistence, managed with MySQL. This has been designed based on the aforementioned specified requirements and the study of the domain through iterative increments throughout the development process.

Figure 1 details the schema of the database structure, followed by a brief explanation of each table and field. Two fields present in most of the tables have been omitted: the timestamps created_at and updated_at that record, respectively, the time of creation and the time of the last modification of each entry in the table.
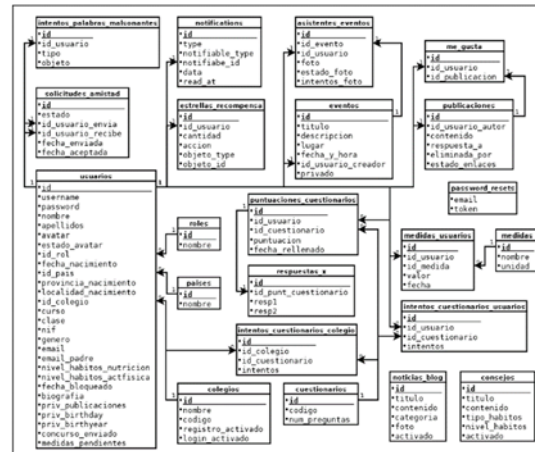

Figure 1: Database structure schema of application SanoYFeliz.

2.5 User Interface Design

In order to comply with the user interface requirements, some styles have been defined to follow in the development of the application's visuals. The Bootstrap library was used to make the interface visually appealing to the user and the responsive design. Furthermore, it was decided to use web usability principles (W3C, 2009) as follows.

- Give special importance to the composition of visual elements and the use of color.
- Always look for a simple and intuitive interface.
- Focus the design on user interaction and take into account the profile of those who will use the application (teenagers).

2.6 Functionalities

This application has a public part, accessible to everyone, and a private part, the social network.

In the public part, there is a home page, a section indicating the information of the project, a section of advice on healthy habits in the field of nutrition and in the field of physical activity and a news section, blog, with articles on healthy habits.

In reference to the social network part, users should be able to: add comments on their wall, add friends, comment on their friends' walls, reply comments, give "like" to posts, as well as create events and attend them. They also had to be able to send photos and videos to administrators to access a contest.
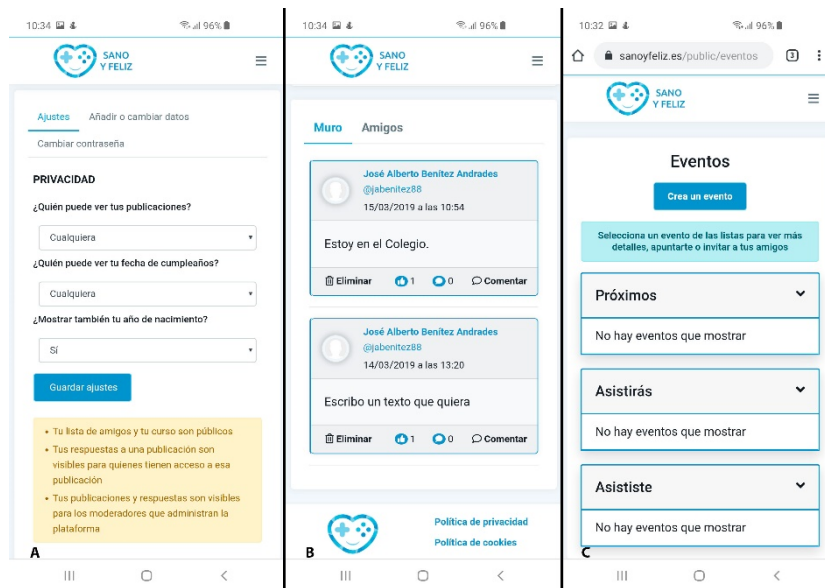
Figure 2: Screenshot of three different sections of application with responsive design.

As high school students, an automatic bad word detection system was created that removed comments and alerted administrators that a user had made an inappropriate comment.

On the other hand, the application had to have an administrator role. This role allowed the following actions: create new schools in the application, add new nutrition and physical activity tips, add new news to the blog, monitor events, and review and moderate user comments.

2.7 Specification of the Reward System

The aim of this rewards system is to recognize users when they carry out positive activities on the platform, both from a social and a health perspective. In this way they are more motivated to continue progressing at the same time as having fun.

The reward mechanisms are designed to be attractive to teenage students, based on a system of healthy points. The healthy points are called "BieneSTARS" (in English it could be called Well-beingSTARS), a simple word game that combines with its graphic representation as a star icon. Each user has a counter that accumulates BieneSTARS, and depending on the total amount is assigned a level to be more stimulating. The following image, figure 3, shows how the user is informed of his progress so far, including a bar that is completed as they approach the next level.

The users start from level 0 and when they get 10 points they reach level 1. The BieneSTARS necessary
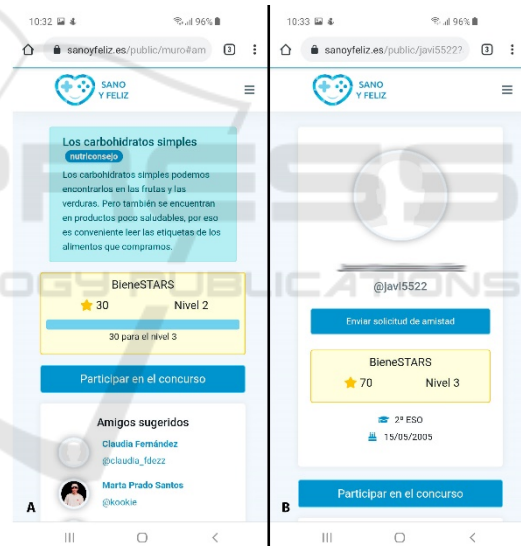

Figure 3: Screenshot of application showing BieneSTARS wall section (A) an in an user profile (B).

to raise the level are increased by 10 at each level. In order to reach level 4, a total of 100 will have to be accumulated. No limit has yet been set for the level that can be reached, although it is difficult to reach high figures taking into account the BieneSTARS/level curve represented in the following graph, figure 4.

This reward system takes into account the following actions: making friends, attending an event, creating a new event, participating in the contest, reading a blog post, updating body measurements.
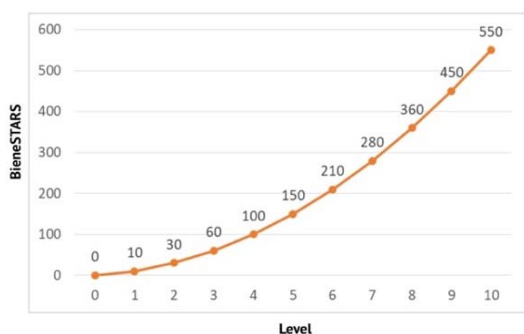
Figure 4: Ratio of points (BieneSTARS)/level in the reward system.

3 RESULTS

The SanoYFeliz platform (https://www.sanoyfeliz.es) is operational and includes all the functionalities described in this document.

The following sections review the main problems encountered during the development of the application, document the pilot experience of testing the application with real users and list various improvements and additions that are planned to be added to the web application from now on.

3.1 Experience with Real Users

In March 2019 a pilot project was launched to test the platform with students from the Diocesan School San Ignacio de Ponferrada, León. The research group, in charge of the contacts with the educational centre and the almost 90 participating students, wanted to check the acceptance of the web application by these users, as well as finding out possible errors, changes and improvements. The study sample consisted in students from two courses, not only overweight or obese ones were selected.

The students were first guided through the registration process and invited to fill in their body measurements and healthy habits questionnaires, giving them the freedom to use the social functions of applications from then on. Everything went satisfactorily and the small errors detected were corrected quickly and without prejudice to users or the system.

During the first days, the client became aware of the need to include new administration functions for greater control and supervision of the students, in the face of possible behaviours that had not been foreseen. Modifications such as the inclusion of private events were also proposed. All of this was gradually incorporated into the platform (as detailed in the section on planning) without the need to introduce periods of inactivity for maintenance, as there was a replica of the system on which to implement the changes and carry out the corresponding tests.

New questionnaires were added later, important data sources for customer investigations. At the beginning of May, the students were asked to fill in a final "satisfaction questionnaire" to collect their impressions and assessments of the web application.
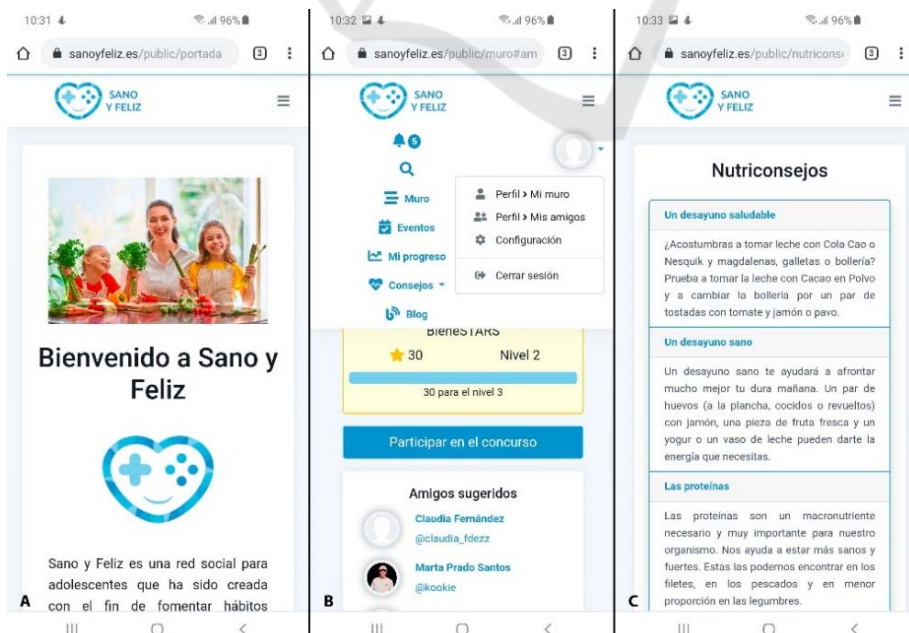

Figure 5: Screenshot of SanoYFeliz showing the public interface and the menu.

The response was generally positive and useful suggestions were extracted for further expansion of the system, as discussed in the following section.

This pilot experience was also very satisfactory for the client, who obtained numerous data of interest for their analysis. It is planned to extend the use of the application to several schools in the province of León in the near future.

3.2 Extensions for Further Development

Based on the recent pilot experience, new needs arose that are translated into functionalities to be added to the web application before its implementation in new educational centres. Thus, the development of the product will continue with the launch of new finished versions.

Among the possible new tasks are the following:

- Implement a system of private messages between users.
- Improve the reward system with a weekly ranking with the users who have obtained more BieneSTARS (healthy points).
- Automatic sending of emails to inactive users for a certain period of time, encouraging them to use the application.
- In the moderation of publications, add filters to facilitate the work of the administrator.
- Allow the user to configure the notifications they receive.
- In publications, implement mentions to users.
- Add to the news blog a system of tags that allows the administrator to tag the news and the users to navigate through them.
- Give more visibility to the "I like" by including in the user profile a tab with the publications he liked and allowing each publication to say which users belong to the "I like" he has received.

Furthermore, certain future lines of expansion, within the framework of this research project, are contemplated, such as the improvement of artificial intelligence techniques to the individualized recommendations of the system through semantic web technologies, developing a knowledge model with OWL ontologies and a reasoning module.

4 CONCLUSIONS

This final section presents the conclusions after the completion of the project tasks and discusses the degree of success of the work carried out, using as acceptance criteria the achievement of the objectives, compliance with software requirements and customer satisfaction. Based on this, the following conclusions can be highlighted:

- The web application developed may be useful for its purposes: support and motivation to the adolescent student for the acquisition of healthy routines, and exploitation of the data obtained for the research project.
- All the components and functionalities required and with the expected behaviour have been implemented.
- The specified functional and non-functional requirements are implemented in a verifiable manner.
- The agile methodology adopted has allowed the planning to be carried out successfully.
- The pilot experience of testing the application with real users has been satisfactory both for the client and for the users themselves.
- It has been possible to obtain a final product according to the expectations and needs of the client

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