

# PROVITAO: a research program based on active games for help the ambulatory treatment of childhood obesity

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**Abstract**— Childhood obesity is the most prevalent chronic disease in developed and developing countries. Recent studies showed that the Canary Islands are the Spanish region with the highest rate of childhood obesity. However, this disease is easy to prevent, educating children from healthy habits, and, the ICT in general and videogames in particular, represent an opportunity to work towards change. Therefore, this paper presents the design of an educational intervention program to help the ambulatory treatment of childhood obesity. This program is intended for children 8 to 12 years of age with obesity and who come for the first time to the Pediatric Service of the University Hospital of Canarias, and is currently being validated. The partial results show that the satisfaction of the minors with the program is high, emphasizing the focus in games.

**Keywords**—Gamification, Active Games, Childhood obesity, Healthy Habits Education.

## I. INTRODUCTION

In the present society, surrounded by technology and with high levels of sedentary lifestyle, active videogames are presented as a new tool that can help society not only in its entertainment environment but also can provide public health benefits (ALVES, 2013) [1]. Some recent studies highlight the role that video games play in promoting healthy behaviors as well as the possibilities they offer to deal with childhood obesity, and refer to the potential of active video games as a tool to promote physical activity (BARANOWSKI) [2].

Keeping in mind this reality, it is necessary to find new ways to motivate children in the practice of physical activity. Active video games can be useful in designing personalized exercise programs and in increasing physical activity among

overweight children and adolescents. Currently, virtual scenarios have been shown to reduce the child's sense of effort as well as increasing motivation. This makes active video games as a new alternative for the maintenance of an active lifestyle (LÓPEZ et al, 2015 [3]; ZURANO CONCES, 2011) [4]. Therefore, it becomes clear that active video games can become the new tool to understand the relationship between video games and the health of the child-juvenile population.

The term “exergaming” derives from the combination of the words exercise and gaming, putting together the virtual game and the exercise (CUBEROS et al, 2015) [5]. Although, this definition has been used for a long time to refer to active video games, currently there are several categories in the area of exercise and gaming and that this term refers only to one type of active games. Therefore, it is possible classify videogames in three types: exergames, sports games and learning games, as can be seen in Table I (GONZALEZ GONZALEZ; NAVARRO ADELANTADO, 2015) [6].

Table I. Types of Active Video Games

Categories	Examples
Exergames	Dance Dance Revolution, Wii Fit, GZ Endurance Cycle, Sony Eye Toy
Sport games	BrainBreaks, Sportwall XerTrainer, Makoto, LightSpace Wall
Learning games	FootPOWR, GZ Kids-Sport, NeuroActive BrainBike

Source. Own elaboration

There are certain video games and devices, some of them widely marketed, where the playing can be a healthy exercise and exercising can be fun. Some devices are oriented to repetitive rehab exercises and others simply to improve physical fitness, such as Wii Fit. Some commercial devices, such as Wii or Kinect, are being used by medicine for use in occupational therapy or rehabilitation (CLARK et al, 2010) [7]. On the other hand, we find different types of health-oriented software, such as video games for the prevention and promotion of health, others for health improvement and, finally, video games for the training of health personnel (SERRANO, 2010 ) [8].

Physical activity not only has physiological effects in physical health, but also has a positive impact on the psychological well-being of the obese child, increasing self-esteem, life satisfaction, and social adaptation (i.e. being part of clubs or team favors establishing oneself bonds of friendship). Research has shown that obese children generally have low perceived self-efficacy and body dissatisfaction, and for this reason tend to lead a more sedentary life (SOUTHALL, OKELY STEELE, 2004) [9]. The first difficulty that pediatricians find in applying the prescription of sports in obese children who are being treated is lack of motivation. It is necessary, therefore, to establish physical activity programs adapted to the conditions of each child, adapting the goals and the level of subjective effort, in order to avoid being unmotivated and abandoning the practice (GUIXERES et al., 2011) [10]. However, there are few studies in the literature that

evaluate the actual efficacy of these games as a means of promoting physical activity among children and adolescents. Very few studies focus on using videogames as part of treatment in obese children. Even so, intervention programs focused on increasing physical activity are an effective way of investing public money to prevent obesity (MOYA MARTÍNEZ, 2011) [11].

In relation to the world of video games and their use as an application to promote healthy living habits, some systems or platforms stand out due to their impact and innovation. Some examples are described following.

Let's Move! (To move!) is a comprehensive program created by Michael Obama in 2010 to prevent and treat childhood obesity, which included a contest to award the best application for children's health. The winner was the smash your food game, where literally the boy or girl pretends to crush food with a compressor to see the salt, sugar and fat content of different foods.

A similar application of Medtronic, the world leader in medical technology, is "Counting Carbs with Lenny," a Lion that teaches children with diabetes to learn the carbohydrate content of foods.

Leap Frog is one of the companies that manufactures digital toys more known worldwide, this American company manufactures LeapBand, a band where the children can interact with a virtual mascot, this forces them to stay in movements through a series of activities and challenges, and thus promote a healthier lifestyle.

The non-profit Hopelab company, aimed at enhancing technology to improve children's health, created Zamzee, which has now become part of WellTok. Zamzee is a program to promote physical activity among teenagers, for it rewards the amount of exercise performed with "Pointz" or Points (running, jumping, walking). This physical activity is recorded with a device (accelerometer) that must always carry over, and when connected to the computer calculates the number of points you have generated and then can be redeemed by products of participating companies, from customizations Zamzee to iPod devices or donations. The results applaud the effectiveness of the product that in 6 months has seen as the activity of the children has increased in 59% with respect to its other companions.

Another very similar system is the one created by the company GeoPalz, iBitz is aimed at encouraging physical activity for children, and measures the number of steps that children take by using a pedometer. With it children can see the steps they have taken and introduce them to the web. The steps become points redeemable for gifts in different portals that the parents have previously selected and those who have put a price in points. In addition, the number of points collected during the day will buy a few minutes of play, when they expire, the game is closed until the child moves a little more. GeoPalz has partnered with game developers so that the child's points can be used to achieve secrets and achievements in certain games.

In the Canary Islands, a platform for the creation of active games was developed based on the Kinect sensor of Microsoft

(c) called TANGO: H (Tangible Goals: Health) (GONZALEZ et al, 2013) [12]. The power of TANGO: H lies in its capacity of generation of exercises, that is to say, it is not a static platform in which the exercises or games are fully defined and integrated, but allows the implementation of these through a configurator that makes this simple homework. The program is able to interpret and execute the exercises previously created by a physiotherapist or education specialist in the Tango:H Designer (Tangible Goals: Health Designer) editor. The user performs the exercises previously created in the form of a video game, interacting with the system through body movements and gestures. The combination of the editor and the game modules allows the creation of a variety of exercises, customized and adapted to the characteristics of the users. The application has a simple interface that guides the user in the selection and execution of available exercises. PROVITAO use this platform as one of the main tool to teach and learn health habits. Following, we describe the design of the educational program named PROVITAO.

## II. PROVITAO: RESEARCH PROGRAM BASED ON ACTIVE GAMES TO HELP AMBULATORY TREATMENT OF CHILDHOOD OBESITY

PROVITAO is an educational program based active video games and motor games to support the outpatient treatment of childhood obesity, which aims to improve adherence and therapeutic compliance and the acquisition of healthy habits in children and their family environment. It is a project developed between the Research Group of Interaction, Technologies and Education (ITED) of the University of La Laguna, and the collaboration of the Canary Health Service of the University Hospital of the Canary Islands (HUC) and the Institute of Technologies and Renewable Energy (ITER).

The main objective of the project is to validate the effectiveness of the intervention model based on motor games and active games in the change of attitudes and healthy habits in obese children. In addition, PROVITAO aims to serving as a tool for the prevention and promotion of healthy lifestyles. This model is the one that arises in this work, together with a program of exercises, motor games and video games, commercial and developed by the research group, such as TANGO: H, both for the patients and for the parents.

The educational intervention presented below aims to be an effective tool that favors the acquisition of healthy habits in the children and their families, and that has repercussions in the improvement of the quality of life, present and future, of the children who suffer obesity. In this way, the objectives pursued are the following:

- Promoting the acquisition and permanence of healthy living habits in overweight / obese children through health education.
- To evaluate the influence of the educational intervention program on overweight / obese children.
- Promoting social awareness of the importance of developing childhood obesity (health problems, long-term complications, health and social costs) and prevention in this area.

The methodology of the study is quasi-experimental, with a longitudinal and prospective cut of 3 years (from March 2014 to June 2017). It consists of two phases, and in each phase a control group and an experimental group are available. The program is carried out at the University Hospital of the Canary Islands (HUC), located in the province of Santa Cruz de Tenerife, Autonomous Community of the Canary Islands, Spain. In order to carry out the field work and data collection, the HUC Ethical Research Committee has been asked for permission.

The implementation of this work has followed ethical guidelines and principles for medical research in human beings, as reflected in the Declaration of Helsinki adopted at the Assembly of the World Medical Association (WMA) in 1964 and in the last update of 2004. The knowledge and approval of the Ethical Committee of the University Hospital of the Canary Islands as responsible entity, as well as the responsible parents or guardians of the students, is therefore ensured. It also guarantees the anonymity of the participants as well as the confidentiality of the information, and these collected data are used only for scientific purposes. Differentiated informed consent has been made for the parents or legal guardians and for the participation of the children. Participation is voluntary, however, acceptance of participation implies the commitment of collaboration of parents and children. The information sheet specifies the type of intervention and number of visits to be made, as well as the place where they will have to go and the number of hours that will be dedicated to the intervention and what parameters will be evaluated. It also explains that the study period coincides with the school year, the existence of different groups, the need to be videotaped for data analysis and compliance with data protection law. The target population is children diagnosed with obesity / type II diabetes (Table II).

Table II. Inclusion and exclusion criteria

Criteria	
Inclusion	<ul style="list-style-type: none"> <li>- Children between 8 and 12 years old with obesity using as criterion a BMI higher than Pc 97 for the first phase of the project.</li> <li>- Children between 8 and 12 years old with obesity using as criterion a BMI higher than Pc 97 and Diabetes type II for the second phase of the project.</li> <li>- Patients who attend the HUC Pediatrics service.</li> </ul>
Exclusion	<ul style="list-style-type: none"> <li>- Children and girls who do not have basic network technologies at home (computer and internet) and television. The project will be responsible for providing the other technological tools required for home intervention (Kinect sensor, Wii console and Wii balance board) and in group sessions.</li> <li>- Children whose parents do not wish to participate in the project.</li> <li>- Children and children with cognitive impairment that prevents participation in the project.</li> </ul>

	-Participation during the last 12 months in a clinical trial.
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Source. Own elaboration

The variables and measuring instruments used in the project are divided according to the area of analysis, which are described in Table III.

Table III - Measures, instruments and moments of the intervention by area

Area	Measures	Instruments
Medical	-Weight -Height -Leather skin - Bone Bones -Muscular and corporal measures -Body composition and body mass index -Physiological measures -Perceived effort	-Weight -Altimeter -Plicometer -Compass -Measuring tape -Formula (according to tetra-compartmental method and somatotype) -Pulsimeter and accelerometer -Scale of perceived effort
Ludic-emotional	-Emotional state in motor play and video game	Emodiana (GONZÁLEZ; NAVARRO-ADELANTADO; CAIROS, 2013) [12]
Interactivity	-Player Profile -Use of video game TANGO-H -User experience TANGO-H -Actitude towards video games	-Gamer Profile Interview -Graduation of videos - TANGO-H Records User Experience Questionnaire -Adaptation of the Questionnaire on use and attitudes towards video games (ALFAGEME, SÁNCHEZ, 2003) [13]
Psychology-Pedagogy	-Interpersonal relationships, relationships with parents, self-esteem, self-confidence -Knowledge about healthy habits, habits and attitudes towards physical activity and food (children)	-BASC (Child and Adolescent Behavior Assessment System)  - Own questionnaire

Area	Measures	Instruments
	-Knowledge about healthy habits, habits and attitudes towards Physical Activity and feeding (children) -Quality index of the Mediterranean diet (parents) -Satisfaction with parent training	- Own questionnaire  - KidMed  - Own questionnaire

The educational intervention is developed in three distinct phases, which are described below:

1st Phase: Pre-intervention evaluation. In this initial stage, the application for permits and the preparation of fieldwork are carried out. Taking into account the type of study, population, sample, variables and instruments, and methods of collection and analysis of information relevant to the study. A cross-sectional descriptive study of the sample is carried out, following the following objectives:

- Assessing the environment, risk factors, protective factors, unhealthy habits, and the level of knowledge that children and their families have;
- Know the prevalence of obesity and overweight in the sample.

2<sup>nd</sup> Phase: Development of the intervention. In this phase a longitudinal observational analytical study is carried out. This phase is organized in the quarters of the school year and repeated for 2 years. During this phase of the study an educational and promotional intervention is carried out on healthy habits and lifestyles for the participating minors and their families. The objectives to achieve in this phase are:

- Provide information on the importance and need for adequate food during the early stages of life to prevent the occurrence of obesity.
- Know the importance both socially and healthily of being obese.
- Encourage healthy habits and lifestyles, promoting a permanent change of behavior.
- Develop individual self-esteem, encourage communication and relationships among peers and their families, create a family environment that reinforces good habits to improve the quality of life of obese patients.

Social and active play is used as a strategy for motivating and fostering attitudes, abilities and self-knowledge, as well as helping children to develop healthy activities based on their own interests through a vocational program.

The intervention during the first quarter of the school year is organized as follows:

1. Holding group sessions for children. During the 12 weeks (3 months) of the group intervention with motor play, participants should attend group sessions of 2 hours duration once a week, in which they do a training activity of healthy habits and health education about obesity / diabetes (60 minutes), practice traditional motor games and perform in pairs activities of an active video game with content in healthy habits (60 minutes);

2. Holding home sessions for boys and girls. In addition, they must carry out other weekly activities scheduled for the home, where they will practice 30 minutes of commercial video game with content of physical activity (Wii Fit Plus);

3. Performing training activities for fathers and mothers.

For the participating children, an educational program is developed, where different workshops or training sessions of 60 minutes duration are established, which are given once a week. The subjects that are taught are:

- Food and nutrients. Energy content of different food groups. Food pyramid;
- Child and adolescent eating patterns. Common difficulties with feeding at these ages;
- Eating disorders in children and adolescents. Risk factor's;
- Assessment of nutritional status, and perception of body image;
- Eliminate myths about food and diets;
- Characteristics of a healthy and balanced diet. Mediterranean diet;
- Tips for choosing how to prepare and cook;
- The shopping cart;
- Emotional intake;
- Physical activity as a healthy lifestyle habit. Benefits for life;
- Video game. Myths and beliefs.

For the different activities that we carried out with the children, expository and participative methods are used through the dynamics of groups, debates and role play.

For parents, a single 90-minute educational session is established, addressing three issues: healthy living habits, obesity as a disease, and false beliefs about video games.

The intervention during the second quarter of the school year is organized as follows:

1. Holding home sessions for boys and girls. During the next 12 weeks (3 months), the intervention will be individual and home, supported by ICT. As ICT tools will be used videoconference and a commercial video game (Wii Fit Plus);

2. Creation of a vocational project. It works in the creation by the minors themselves of a vocational project in relation to

the discovery of healthy activities that they may like and their environment. This activity is tutored by a member of the research team through a videoconference session. Also, the program of activities with the Wii Fit Plus in the home is followed;

3. Contact with municipalities and associations of the zone of the minors to know the resources and healthy activities available;

4. Conduct an orientation activity for parents. This quarter includes an orientation activity for parents on the vocational orientation of their children.

Finally, the intervention during the third quarter of the school year is carried out as follows:

1. Realization of the vocational project. During the last 12 weeks (3 months), the intervention will be individual and domicile, supported by ICT. TIC tools use videoconferencing. The objective of this quarterly intervention is to support minors in the development of their own vocational project in relation to healthy activities. This activity is tutored by a member of the research team through a weekly videoconference session;

2. Performing an advisory activity for parents. This quarter includes an advisory activity for parents on the support to the development of the vocational project of their sons / daughters.

This intervention is carried out in a space of an educational center, equipped with the necessary infrastructures, and in the afternoon, so as not to interfere with the school life of the participants.

#### 3<sup>rd</sup> Phase: Evaluation

This phase aims to evaluate the influence of the educational intervention program on children with obesity and to validate the effectiveness of the technological tools developed as support to the treatment. So, every 6 months according to medical consultation, and during the following year, anthropometric assessments of the children of both groups (both experimental and control) are performed.

### III. CONCLUSIONS

This article has presented an analysis on the problem of childhood obesity and its possible prevention and treatment using active video games. We have also analyzed some relevant programs and studies that share the approach of the PROVITAO project, that is, using active video games as the central axis of the educational intervention.

As a main contribution, the design of the educational intervention program based on motor games and active video games of the PROVITAO project has been presented. It consists of several stages of intervention, each of which has a series of steps, instruments, measures and variables that have been carefully selected and developed by the research team itself. This project has an interdisciplinary approach, so that the design and taking of the measures and variables used are performed by each particular area, as well as the analysis of the results.

At present, the data of the courses in which the intervention is being performed are being analyzed to measure the effectiveness of the program in all areas (medical, psychological, interactive, etc.). However, we can already measure the degree of satisfaction with the games of the program participants through the satisfaction questionnaire that we used with the experimental group of the 2014-2015 course, who have already completed the intervention. Some responses of the 12 boys and girls in the experimental group to the questions asked about the intervention program, focused on motor games, active video games and the use of the Wii in the home shows positive responses of children. The response of the children has been positive to the proposal and development of the program. We can observe that 83.3% of the children were encouraged to the weekly sessions and had fun in them (100%). No doubt, in the children's responses, it is observed that what they valued most in the group sessions is the game in all its forms, in the games of formation (100%), the games of the field (82.7%) and TANGO:H (83.4%). However, they do not feel very comfortable in assessing and expressing their emotions. With regard to home sessions and use of WII, although they consider that they have had a lot of fun (83.3%), they get bored (66.7%), in general, because they use the same game (50%) or because they play alone (37.5%). 100% of the children believe that they have learned through the educational intervention program, and that both physical activity (91.7%) and healthy eating (90.9%) have changed their lifestyle.

Finally, we consider that it is necessary to consider introducing healthy habits into the educational curriculum of minors, to ensure long-term acquisition of healthy behaviors and prevention of noncommunicable diseases related to poor habits. This will impact on an improvement in health for the whole society.

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