Computers in Human Behavior 55 (2016) 529–551

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Learning healthy lifestyles through active videogames, motor games and the gamification of educational activities

Carina S. González [a, *], Nazaret Gómez [b], Vicente Navarro [c], Mariana Cairós [d], Carmela Quirce [b], Pedro Toledo [a], Norberto Marrero-Gordillo [e]

[a] School of Engineering and Technology, University of La Laguna, Spain
[b] School of Nursing and Physiotherapy, University of La Laguna, Spain
[c] Faculty of Education, University of La Laguna, Spain
[d] Faculty of Psychology, University of La Laguna, Spain
[e] School of Medicine, University of La Laguna, Spain

ARTICLE INFO

Article history:
Received 5 April 2015
Received in revised form
15 July 2015
Accepted 30 August 2015
Available online 9 October 2015

Keywords:
Informal learning
Healthy lifestyles
Active videogames
Motor play
Gamification in education
Obesity and overweight

ABSTRACT

The World Health Organization (WHO) has declared obesity as a 21st-century epidemic after reaching global proportions. In Spain, this disease is suffered by 62% of the population, leading to the emergence of new health problems. Increasing childhood obesity in the world is a direct result of changes in the lifestyles of the population. Therefore, in this paper we present a gamification training program to prevent childhood obesity based on motor games, and active videogames developed for overweight children ages 8–12. The design of the program consisted of: group sessions in a school setting, individual sessions at home for the children, and developing healthy habits to help families. The motivation and the effectiveness of the gamification training program were studied. The results involving biometric variables, learning healthy habits and experience in the intervention were highly satisfactory.

1. Introduction

In 2004, the WHO declared obesity as a 21st-century epidemic as it reached global proportions, although as early as 1998, the WHO had already spoken about obesity as an emergent health problem in its global report (World Gastroenterology Organization (WGO), 2011; World Health Organization (WHO), 2004). This epidemic mainly affects developed and developing countries, although it is no longer exclusive to high-income countries as it begins to be present in poor countries, in all age ranges from childhood to adulthood. In Spain, 62% of the population suffers from this disease, according to the Study of Nutrition and Cardiovascular Risk in Spain, ENRICA (2009–2011) (Spanish Society for the Study of Obesity (SEEDO), 2013).

The importance of this disease lies in the serious health problems associated with overweight and obesity. It is the fifth leading risk factor for death in the world, causing nearly three million deaths a year. It is responsible for nearly 58% of diabetes and 21% of ischemic heart disease cases, and between 8% and 42% of some cancers, and these risks grow in proportion to the increase in body weight (Spanish Agency for Food Safety, 2005; WGO, 2011; WHO, 2014).

Obesity has been increasing steadily over recent decades, and obesity in the pediatric population has become one of the most serious public health problems. It is estimated that about 42 million children under five were overweight or obese in 2010, 35 million of whom live in developing countries (Ezzati & Riboli, 2013; Spanish Agency for Food Safety, 2005; WHO, 2014.)

Obesity is defined as “abnormal or excessive fat accumulation in the body that harms health”.

Childhood obesity has a complex and multifactorial etiology that stems from multiple genetic factors and the environment (WHO, 2003). And although there is some genetic predisposition, obese is mainly the result of an imbalance between energy

* Corresponding author.
E-mail addresses: cjgonza@ull.edu.es (C.S. González), nazaretg.90@gmail.com (N. Gómez), vnavarro@ull.edu.es (V. Navarro), mariana.cairos@gmail.com (M. Cairós), cquirce@ull.edu.es (C. Quirce), petode@ull.edu.es (P. Toledo), nmarrero@ull.edu.es (N. Marrero-Gordillo).

http://dx.doi.org/10.1016/j.chb.2015.08.052
0747-5632/

consumption and expenditure over a sustained period of time. This is confirmed by the low proportion of patients diagnosed with obesity because of genetic or hormonal disorders. Risk factors that have been shown to influence the development and maintenance of obesity, such as parental obesity, low education and socioeconomic status of parents, insufficient sleep, high birth weight, or exclusive artificial breastfeeding also play an important role (González Jiménez et al., 2012; Klünder-Klünder, Cruz, Medina-Bravo, & Flores-Huerta, 2011).

This increase in the amount of childhood obesity around the world is a direct consequence of lifestyle changes and of the social and labor development that most populations have endured. Traditional foods like fruits, vegetables, legumes and fish have been replaced with foods richer in calories, fats, and sugars, as part of a diet that is now based on pastries (food industry), snacks and salt. Little or no physical activity is carried out due to a higher level of urbanization and mechanization, the development of transport systems, changes in social and health policies, urban planning schemes that leave little room for green zones and the long time spent by schoolchildren engaging in sedentary leisure activities at the computer or TV (Cussó Segura & Garrabou Segura, 2007; Spanish Agency for Food Safety and Nutrition, 2008).

In Spain, changes in lifestyle and the development of the National Health System, among other factors, led to the emergence of new health problems; thus, non-communicable diseases such as obesity replaced infectious diseases. In the Canary Islands this phenomenon is due to the economic development that occurred with tourism and migration from the countryside to the big cities, which ultimately led to a change in eating habits, and to the replacement of traditional foods with those rich in fat (SEEDO, 2013).

The easiest way to calculate excess body fat is through the body mass index (BMI), a simple indicator of the relationship between weight and height that is used to identify overweight and obesity in adults using the following formula: weight (in kilograms) divided by the square of the height of the individual (in meters). It is easy to use, inexpensive, and noninvasive. Thus, the WHO and the International Obesity Task Force (IOTF), which is based on Western lifestyles, establish a cutoff point in adults of 25 kg/m^2 to define overweight and 30 kg/m^2 for obesity. This measure is intended for international use (Martínez Costa & Pedrón Giner, 2002; WHO, 2014).

And although in the case of adults this is a good way to diagnose overweight, the normal amount of fat in the pediatric population varies by sex and stage of growth. To address this problem, certain graphs are used to show how a child should grow in optimal conditions. In Spain the most widespread graphs are the 1998 and 2004 growth curves and tables from the Faustino Orbegozo Foundation's Research Institute for Growth and Development, which establish overweight in P90 and childhood obesity in P97. Also used are the tables from a more recent study by Carrascosa et al., as these have been designed specifically for our child population (Martínez Costa & Pedrón Giner, 2002; Working Group of the CPG for Prevention and Treatment of Childhood and Adolescent Obesity, 2009).

The Spanish Society for the Study of Obesity (SEEDO) confirms that 44.5% of Spanish children are overweight. This means that almost one in two children is overweight relative to the growth patterns established by the WHO. In Europe, only Italy and Cyprus exceed these numbers according to the IDEFICS study (Identification and Prevention of Dietary and Lifestyle-Induced Health Effects In Children and infants), which aimed to assess the risks of overweight and obesity in children and its long-term consequences throughout the European Union.

A comparison of the results of recent epidemiological studies in Spain (the Paidos stydy (1984), the EnKid study (1998–2000), the 2006 and 2011–2012 National Health Surveys and the Aladino study (2011)) highlight the increasing BMI of children, and therefore the increasing prevalence of childhood obesity in Spain since the 80s, especially in the autonomous community of the Canary Islands, the region with the highest percentage of childhood obesity in the country. However, there is some good news, as the results of the 2013 Aladino study show a slight decrease in the rates of childhood overweight and obesity. While two years ago this percentage stood at 45.3% for children between 7 and 8 years, it currently affects just 43%, a decrease of 2.3 points. This is likely due to the efforts of health agencies to craft policies promoting healthy living habits, especially for school children (Canary Islands Government, 2014; Serra Majem et al., 2003; Spanish Ministry of Health, 2014).

Another concern is the large influence of the media on the consumption and behavior habits of young people, as the messages they convey can be either beneficial or harmful to health (Menendez García & Francisco Diez, 2009). Advertising aims to stimulate the desire and the need to consume, with children and adolescents being a significant percentage of its market share. It creates stereotypes whereby consuming a product becomes a need. However, this type of advertising often tends to focus on the consumption of high-calorie foods (Jiménez, 2006; Muñoz, 2000).

A study in Cuba found that adolescents acquire knowledge on vegetable consumption through television (95%), followed by school (79%), radio (62%) and family (52%). Similar findings were obtained by two studies in Mexico and Cuba showing that the media, especially television, has an important effect on people's behaviors and beliefs, and provides a means that can be used to promote learning that is even more effective than school or family. A study in Spain found that 35.2% of students do not recognize the influence of television on their eating habits; however, 71.8% consume products announced on television. Finally, a study in Peru found that the most influential medium among groups of adolescents was television, with no significant differences between students studying in schools promoting sustainable development and those that do not. However, for both groups the family environment had an important role as an educator on the consumption of healthy foods (Roman & Quintana, 2010).

Therefore, and due to the significant influence of the media on the acquisition of lifestyle habits, many educational initiatives by governments and institutions have focused on controlling advertising and on exploiting the positive aspect of the media as a mass communication channel to transmit messages that promote healthy lifestyles. A good example in Spain is the PAOS code, an agreement signed between the Ministry of Health and the Spanish Federation of Food and Beverage Industries to self-regulate food advertising aimed at children (WHO, 2011).

The educational program we describe in this paper's main objective aims to improve the quality of life of overweight and obese children by educating them in healthy lifestyles. The main objective of the training in healthy habits program is to promote behavioral changes in the short, medium and long term. We thus used gamification (Hsin-Yuan Huang & Soman, 2013) as a tool to increase their motivation. Also, as this training was not regulated by the school, an informal education program was designed, although it was validated in a school outside school hours, as well as at children's homes.

Computers have been criticized for enticing children into more sedentary lifestyles that hinder healthy behaviors. This work thus focuses on the design and use of technologies that promote active lifestyles. Indoor and outdoor physical activities can be enhanced

by technology, including videogames. A better understanding of the interaction between children and technology is needed in order to promote better user experiences and to motivate children to participate in physical activities. To this end, gamification and game-based physical activities provide a tool to achieve this goal.

We established two hypotheses:

H1 *Increased motivation through gamification of the intervention program.*

H2 *Improved healthy lifestyle habits through a program that combines training and motor and active games, both at home and in school.*

To validate these hypotheses a complete educational program was created from an interdisciplinary point of view (medicine, psychology, computer science, education). Instruments (questionnaires, interviews, etc.), tools (videogames, sensors, etc.) and educational activities and games were selected, created and, when so required, validated by the research group. The active games were selected and designed by the medical team, the physical education staff and teachers of specific didactics. Tango:h has an editor where professionals can design the activities, games and exercises. The psychologists in our research group supervised the gamification program and educational activities. The computer science engineers were responsible for designing the tools that allow professionals to create, monitor and evaluate the game-based digital activities. The complete educational program will be described in Section 4.

This paper is organized as follows. First, we conduct a review of the literature on educational programs conducted in different parts of the world to treat obesity. Second, we present the objectives and methodology of our program. Finally, we describe the case study and offer our results, discussion and conclusions.

2. Background

Research and programs focus obesity management on modifying unhealthy behavior habits by providing health education on nutrition and healthy lifestyles (Mediterranean diet, physical activity, more sleep), and through prevention programs (prevent overweight/obesity) and intervention programs (reduce the incidence of overweight/obesity).

Some of these programs are discussed by area of study:

- Studies focusing on nutritional reeducation.
- Studies focusing on the influence of the family environment.
- Studies focusing on physical activity and energy expenditure.
- Studies on the development of technologies to promote healthy habits

2.1. Studies focusing on nutritional reeducation

In Singapore and the United Kingdom, obesity among schoolchildren has been lowered through nutrition education programs that promote healthy foods and drinks and restrict the consumption of sweets and soft drinks. Another example of this type of intervention is provided by Ciudad Real, Spain, where nutrition education and the use of the Mediterranean diet for a year has achieved a significant decrease in BMI (Calatayud Sáez, Calatayud Moscoso del Prado, & Gallego Fernández-Pacheco, 2011).

Similar efforts in Chile and Mexico have proven very positive. By focusing on nutritional education and increased physical activity, they have managed to lower the prevalence rates of overweight (Bacardí-Gascon, Pérez-Morales, & Jiménez-Cruz, 2012; Kain et al., 2008). In Granada, Spain, an evaluation of an educational program on diet and exercise has shown a significant reduction in BMI values in both sexes, even more significant among girls (Aguilar Cordero at al, 2011). Another interesting study based on the same program but with two years of intervention and two of evaluation was effective in reducing the prevalence of obesity in school (Llargués et al., 2012).

These studies also consider it essential to convince educational authorities of the need to implement and evaluate programs that are effective in preventing obesity (Llargués et al., 2009, 2012).

The results obtained in the OBEMAT program for adolescents with obesity, which focused on the use of emotional therapy, were found interesting as it yielded improved anthropometric and biochemical parameters. It also determined that the teenagers' emotional response explained the success or failure of the intervention (Feliu Rovira et al. 2013).

An important theme when considering an educational program is the role of schools as education centers where children spend many hours a day. There is consensus among education specialists that the teacher is the main driver of change in schools. Their participation is thus essential to making schoolchildren learn healthy habits (Salinas, González, Fretes, Montenegro, & Vio, 2014).

2.2. Studies focusing on the influence of family environment

Children learn from their parents, and during the first years of life the parents are responsible for their nutrition. The influence of the parents' nutritional and socioeconomic status on the acquisition of overweight or obesity in their children has been known for several years. All this is taken into account by some programs that have focused their efforts on the family and whose effectiveness in acquiring healthy habits has been proven (Berlanga, 2013; Klünder-Klünder, Cruz , Medina-Bravo , & Flores-Huerta , 2011; Roset Salla, Ramón Cabot, Salabarnada Torras, Ferrer Romà ABernal de Barbara, & Jiménez Pascua, 2011). However, there is a significant percentage of parents who do not perceive overweight or obesity in their children when they themselves suffer from it (Amigo, Busto, Pena, & Fernández, 2013; Rodríguez Martín, Novalbos Ruiz, Villagran Pérez, Martínez Nieto, & Lechuga Campoy, 2012). Therefore, family involvement is considered essential to a program's success by raising awareness of obesity as a disease, and by improving the family's knowledge of, participation in and responsibility for establishing the healthy habits needed to combat obesity (González Jiménez et al., 2012; González Cabriles, 2013).

As other studies have shown, an intervention program on healthy habits should incorporate children, parents and the school community as a whole in order to make significant and lasting changes.

2.3. Studies focusing on physical activity and energy expenditure

These educational intervention programs focus on promoting physical activity both at school and in the children's leisure time.

Programs that increase and improve physical education in schools have managed not only to improve the fitness of students, but also to motivate children and adolescents to continue performing physical exercise (Ardoy et al., 2011; Sánchez López et al., 2011). In other cases, although the prevalence of obesity was significantly improved, this could not be attributed to the sessions, although the level of physical activity did increase (Planas Juan et al., 2012). Two other studies involving a 4-month program featuring 40 min of aerobic exercise 5 days a week showed a significant decrease in the BMI of obese children (Molina Puche & García Sola, 2011).

It is important to realize that not all physical activity is able to

positively effect a reduction in body weight (frequency, duration and intensity) (Tan, Aziz, Chua, & Teh, 2002). For example, when the energy consumed in a dancing game was measured, it was found that the cardiorespiratory response was similar to that of an aerobic dance of medium to high intensity, but, as it lasted only 8 min, it failed to meet the recommended daily exercise in children (60 min per day) (Cantallops Ramón, Ponseti Verdaguer, Vidal Conti, Borràs Rotger, & Palou Sampol, 2012).

Another factor to consider when planning a physical activity is motivation. Studies and intervention programs involving physical activity show that it is necessary to encourage and motivate children with an appealing activity, in addition to encouraging them to participate in team rather than individual sports (Borràs Rotger, Vidal Conti, & Ponseti Verdaguer, 2008).

As part of a study involving a group of overweight children and adolescents using the dance platform Dance Dance Revolution (DDR) as a routine physical activity (5 days/week and 30 min/day), telephone follow-ups were conducted that, in addition to collecting data on time use and level of motivation, reinforced their participation. However, the results indicated that the participation rate was low as the game was not motivating enough, plus its use could not be related to BMI. Proposals to increase participation were made, such as encouraging cooperative play, increasing the musical variety and including a competitive component in these activities (Madsen et al., 2007).

In the same vein, the effect of a weekly session of group play in motivating children 9–12 years old to play a dancing video game in their homes was evaluated. The findings revealed that group play sessions increased the motivation and level of participation of children (Chin et al., 2008).

Finally, there is ample research on the energy expenditure of sedentary activities, traditional games and gaming assets that seeks to subvert the false beliefs that exist around videogames. This research has focused on the application of videogames to promote health based on the good results that have demonstrated the use of active videogames to maintain an active lifestyle.

One study analyzed the energy expenditure (EE) required by a sedentary game and two active videogames (one involving movements of the upper body, and a dancing game). They found that the conventional game increased the basal EE 22%, while active ones increased basal EE 108% (movements of the torso) and 172% (dancing). They also noted that obese children had higher EE when playing the dancing video game than non-obese children (Lanningham-Foster et al., 2006).

A later study found that the EE of an active game was significantly higher than that derived from other activities such as remaining at rest, standing, watching television seated and sitting while playing a conventional videogame (Lanningham-Foster et al., 2009).

Similar results were obtained in another study that analyzed the EE in a sample of children ages 6–12 participating in a conventional video game and two active games for the XaviX Port console. One was a bowling simulator and other game involved fighting and avoiding obstacles. The results indicated that the EE required by active videogames was higher than resting and conventional videogames (Mellecker & McManus, 2008).

Another study reported similar results when evaluating energy consumption in children playing active and non-active videogames. Its findings showed an increase over the base line of between 120% and 140% in the EE and the energy consumed when participants were playing active games, values that were similar to other types of activities such as a light walk, jogging and swimming (Maddison et al., 2007).

A study at the University of Oklahoma with a group of children ages 10 to 13 measured the calories consumed at rest, while watching television and while walking. The data were then compared with the calories burned when playing videogames (Wii Sports and DDR). The results showed that children burned the same amount of calories when they walked moderately and three times more than while resting (Wetzsleon, Swanson, & Pickett, 2008).

Although some studies have shown positive results involving the energy costs of playing these kinds of games, said energy cost rises when these same virtual activities are executed in reality, indicating that this type of activity cannot replace actual activities and sports. Only a small number of active videogames, or "exergaming", manage to have children perform physical activity of moderate intensity. Moreover, very few studies so far have attempted to study the various effects of active videogames on obese children. There is also very little research related to the application of active videogames in rehabilitation. Therefore, more studies and more scientific evidence are needed to evaluate the effectiveness and sustainability of this type of active videogame and its potential interest as a clinical tool.

2.4. Studies on technologies to promote healthy habits

The use of information and technology in general has been criticized for leading to more sedentary children. As a result, many researchers have responded by working on technologies that endorse active lifestyles (Hourcade, 2015). In this regard, gaming platforms such as Nintendo Wii, Microsoft Kinect and others, include body movement as an interactive element to promote physical activity. These technologies will continue to advance unabated in coming decades, thus making it necessary to study their metabolic efficiency and how they can be effectively applied in clinical intervention programs to treat obesity and promote physical activity (Exergame Fitness, 2014).

Outdoor physical activities are also supported by technology through augmented reality, sensors, mobile devices and so on. In this area Lund, Klitbo, and Jessen (2005) were pioneers in designing the Playware technology that uses sensors, actuators, hardware and software building blocks for playgrounds. This work led other researchers to consider how this type of playground could be designed. For example, Sturm, Bekker, Groenendaal, Wesselink, and Eggen (2008) focused on objectives such as social interaction, simplicity, challenge, goals, and feedback. Seitinger (2009) was concerned with how these playgrounds could be used to develop spatial competition, including taking multiple perspectives, zooming in and out, estimating distances, experiencing movement, finding visual cues, advocating ubiquitous interfaces that could support aspects of spatial cognitive development. Another approach to promoting outdoor physical activity is digitally enhancement through the use of mobile devices (Avontuur et al., 2014; Magielse & Markopoulos, 2009).

Collaboration and social aspects must be considered in the design of educational videogames. Padilla, Collazos, Gutierrez, and Medina (2012) propose a set of theoretical issues for educational videogames and for game-based learning. Collazos, González, and Gutierrez (2014) present a set of patterns for monitoring and evaluating educational videogames. Gonzalez and Navarro (2015a,b) present a structural framework based on the fundamentals of motor play to guide the design and evaluation of active videogames.

Therefore, this study will specifically analyze the effectiveness of commercial programs like the Wii and of an exergaming program called TANGO:H, developed by our research group ((Gonzalez et al., 2013a,b). TANGO:H was designed in keeping with the principles of educational, collaborative and active videogames (Collazos et al., 2014; González & Navarro, 2015a).

3. Methodology

This project's goals are to aid in treating obesity in young people, in improving the health status of children and in preventing diseases in adults. It relies on an educational intervention model designed to promote healthy habits, with an exercise program, motor games and commercial videogames. It also features games designed by the research group, such as TANGO:H and Pirate's Island (González-González, Toledo, Collazos, & González, 2014). Children and parents were involved in alternating sessions in school and at home framed in a context of non-formal education. The program is "gamified" in order to motivate the children to engage in the activities.

This project lasted one year. The first six months were devoted to diagnosis and to designing the study (sample, instruments, logistics), and the final three months to collecting and analyzing the results, conclusions and final reports and featured three months of intervention, from September to December.

3.1. Objectives

The project's general objectives were as follows:

- To promote the acquisition and retention of healthy lifestyles in overweight/obese children through health education.
- To evaluate the influence of educational intervention programs in overweight/obese children.
- To promote social awareness of the importance of preventing childhood obesity (short- and long-term complications and health and social costs).

As to the specific objectives of the study, these included:

- Assessing the prior habits and lifestyles (habits, customs and beliefs) of overweight children and their families.
- Providing accurate information on the habits of healthy behavior and dispelling myths.
- Analyzing the effectiveness of the intervention in promoting healthy habits.
- Measuring the children's motivation to engage in physical activity by playing motor games and videogames.

3.2. Design

The study was organized into three phases. In the first phase we designed the study, selected the sample, ascertained the anthropometric measurements of the sample before the intervention, took measurements and assessed the environment, the risk factors, the unhealthy habits, the protective factors, and the level of knowledge among children and their families through questionnaires. The second phase involved informing the participating children and their families of healthy habits and lifestyles and encouraging their adoption. During the first three months, from September to December, one-hour group sessions were held twice a week where they received training on healthy habits (30 min), played traditional motor games and performed activities in pairs on an active video game with content related to healthy habits. At home they played 30 min of a commercial game containing physical activity (Wii Fit Plus) twice a week.

For parents, a single educational session lasting 90 min was held where three topics were discussed: healthy lifestyle habits, obesity as a disease, and false beliefs about videogames.

In the 3rd phase the survey data was collected for later analysis. The quasi-experimental research was designed as a longitudinal, prospective study with a one-year duration. To achieve this, a control group and an experimental group were set up.

G1 Experimental Group (overweight children participating in the intervention program) comprising 10 to 15 children.
G2 Control Group (overweight children NOT participating in the intervention program) comprising 10 to 15 children.

3.3. Sample

The sample consisted of 24 children ages 8–12 with a BMI indicative of overweight. The pilot study focused on a school in an urban area of Santa Cruz de Tenerife. The participants were randomly selected, taking into account the following inclusion and exclusion criteria:

- Inclusion criteria:
  - Boys/girls between the ages of 8 and 12 who are overweight, with a BMI in excess of Cw 90, who are enrolled in the San Fernando Duggi School.
- Exclusion criteria:
  - Children who do not have basic networking technologies at home (computer and internet) or a television. The project provided the tools required for the intervention at home (Kinect sensor, Wii console and Wii balance board) and in group sessions.
  - Children whose parents do not wish to participate in the project.
  - Children with a cognitive impairment that prevents participation in the project.
  - Participation during the last 12 months in a clinical trial.

3.4. Variables and measurement instruments

Data were collected through a recording sheet (socio-demographic and anthropometric measurements) and the different questionnaires that were given to the children and both parents. The measurements and instruments are described in Table 1.

Given the complexity of the study that was carried out in different areas, only some of the results will be described in this paper. Since the aim of this paper is to present the intervention program with videogames, motor games and gamification, its main components will be described in Section 4, while the results involving the effectiveness of the proposed intervention program are given in Section 5.

4. Intervention program with motor games, videogames and gamification

As described in Section 3.2, the training program consists of 16 group sessions lasting 90 min each held twice a week in school, plus 16 home sessions lasting 45 min each (Fig. 1).

Fig. 1 shows the design of the training program for healthy habits, which comprises:

a) Group sessions for children in a school setting (90 min, twice a week): training (30 min), motor games (40 min) and TANGO:H active videogame (20 min) twice a week.
b) Individual sessions for children at home (45 min, twice a week): commercial active Wii Fit Plus videogame (30 min) and collaborative multiplayer online videogame (Pirate Island – 15 min).
c) Family training (90 min).

Table 1
Areas of study, instruments and measurements.

Areas	Measurements	Instrument	Moment
Medical	- Weight - Height - Skin folds - Bone diameters - Muscle and body perimeters - Body composition and body mass index - Physiological measurements - Perceived exertion	Balance Stadiometer Calipers Compass Tape measure Formula (somatotipe method for body composition using a tetracompartmental model) Heart rate sensor and accelerometer Scale of perceived exertion	Pre and post All sessions
Ludic – emotional	- Emotional State in the motor play and the videogame	Emodiana (Gonzalez et al., 2013a,b)	Sessions 11 to 16
Interactivity	- Player profile - Educational Playability (Ibrahim, Gutiérrez-Vela, González-Sánchez, & Padilla-Zea, 2012) (TANGO-H) - User experience (TANGO-H and Pirate's Island) - Attitude towards videogames	- Player profile interview - Video recordings - Records of TANGO-H (Gonzalez et al., 2013a,b) - User experience questionnaire - Adaptation of the questionnaire on use and attitudes toward videogames (Alfageme & Sanchez, 2003)	- Pre - All sessions - Post - Pre and post
Psychology and pedagogy	- Interpersonal relationships, relationships with parents, self-esteem, self-confidence (kids) - Knowledge of healthy lifestyles, habits and attitudes toward physical activity and nutrition (kids) - Knowledge of healthy lifestyles, habits and attitudes toward physical activity and nutrition (parents) - Quality index of the Mediterranean diet - Satisfaction with training of parents	- BASC (Behavior assessment system for children and adolescents) (González Marqués et al., 2004). - Dedicated Quiz - Dedicated Quiz - KIDMED (Serra-Majem et al., 2004) - Dedicated Quiz	- Pre and post

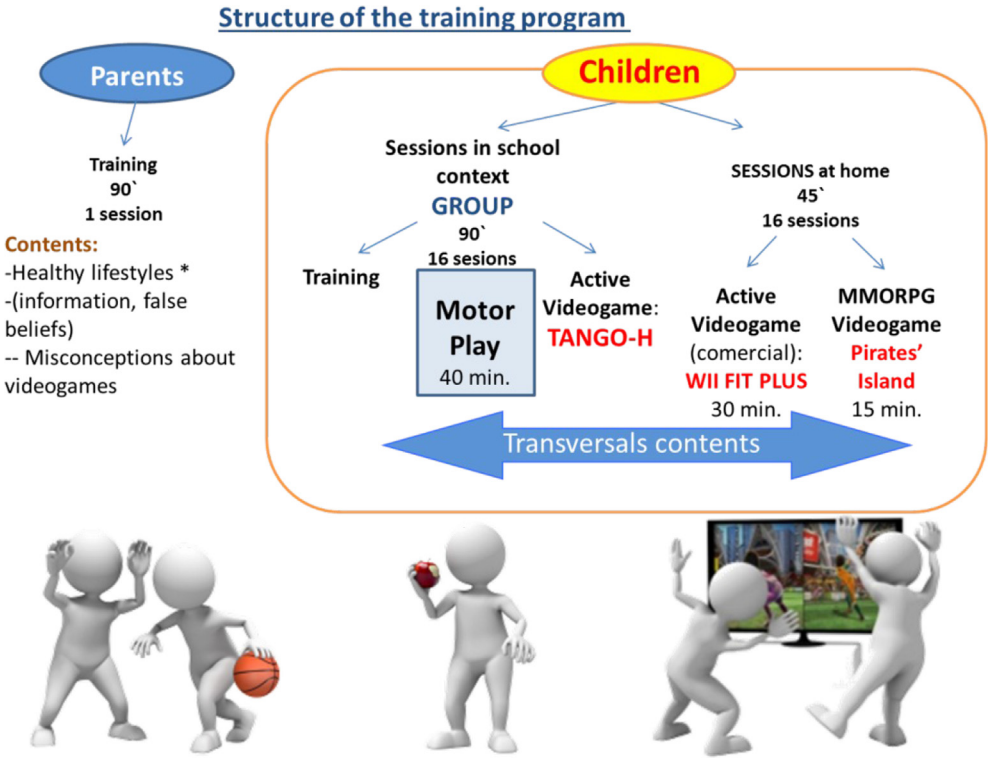


Fig. 1. Structure and contexts of the training program.

Fig. 2. Different moments of the intervention carried out in the school.

Moreover, the entire training program was gamified using different game mechanics to increase motivation and commitment to the completion of the planned home activities.

Next, we will describe the structure of the group and individual training sessions for the children and their families, as well as the gamification of the entire training program.

4.1. Group sessions in a school setting

Each session had a similar structure divided into moments (Fig. 2). Upon arrival, parents gave the home activities recording sheet to the psychologist. Then, the child was asked to respond to the "Emodiana" test. Their sensors (heart rate monitor and accelerometer) were then fitted and they proceeded with the rest of the group to the school's field to play a motor game with the instructors. Once the group was finished, the educators started their training. This training, lasting 30 min, consisted of an explanation by the teachers and the development of a game for children which reinforced the content covered. Then the group of children continued with active games prepared by the teachers for the remaining 60 min. While the motor games were being played on the field (40 min), two children were separated from the rest to perform the active game (TANGO:H) activity prepared for the session in the school library, which lasted 20 min per pair. After the session, the perceived exertion test was administered, the sensors were removed and the Emodiana test was given again.

All of the training sessions were designed from a recreational standpoint, reinforcing the content to be discussed at each meeting with different games and videogames. Table 2 shows the topics covered in the sessions and the objectives of each one.

4.1.1. Motor games

In the intervention with motor games, the games are differentiated by the motor interaction/structures they possess. Also, aspects that characterize the game or the intervention guidelines are also specified. Regarding the criterion derived from the motor interaction, the 'motor interaction' (Parlebas, 2001) is considered on four levels: without motor interaction (with a sublevel: without motor interaction while in a social relationship), opposition, cooperation, and cooperation-opposition. Some details on the original characteristics of the networks are also collected. The distribution of motor interaction data showed a greater number of social games, which was an intended condition in our study. The distribution following the criterion of motor interaction at different levels of this variable is also evident (Table 3).

4.1.2. Active videogame: TANGO:H

TANGO:H is an application designed to aid in the physical rehabilitation and cognitive training of sick children. It is also a tool for promoting health where, through social games and physical education, patients can learn, exercise and interact with others. It is also a tool for professionals (therapists, educators, and psychologists) to create exercises adapted to the particular needs of each patient or user group and to monitor their progress.

The power of TANGO:H lies in its capacity to generate exercises, i.e. it is not a static platform in which exercises or games are fully defined and integrated, though these can be implemented through an editor that makes this task simple. The program is capable of interpreting and executing exercises previously created by a professional in the TANGO:H Designer editor (Tangible Goals: Health Designer). The end–user interface is an active video game where the patient performs the previously created exercises as a game, interacting with the system through body movements and gestures. The combination between editor and game modules allows for the creation of a variety of personalized exercises that are adapted to the characteristic of the patients. To understand the composition and elements of the exercises, let us consider some of the concepts that define the interaction with the application, as described below (Table 4):

In order to consider a target as reached, the user will need to interact with it with any or all of the associated contact points for a target with OR logic or AND logic, respectively. Additionally, a special type of target can be assigned, a Dummy target, which does not have to be reached by the user. The exercises are displayed on the screen step-by step. Every target belonging to a step is shown on the game screen simultaneously. Once all step phases are successfully completed, the targets are replaced by the targets in the following step.

Using the established logic, the system classifies exercises into three different types: a) *physical, b) cognitive and c) free*. Each

Table 2
Group sessions carried out in the school setting.

Session goal	Training	Motor play	TANGO:H
1. Presentation	Introduction to the study and the participants	Different sets of presentations to introduce and develop team building behaviors to strengthen relationships among schoolchildren. Example: Catch the pirate or car workshop.	Introduction to the videogame platform.
2. Healthy lifestyles	Learn about different healthy lifestyles.	Capture the ball, Chop the eye, Pass the hoop or Shipwreck.	Selecting the images or statements that reflect good mealtime habits. Selecting healthy ways to go places.
3. Body mass index	Measuring the body mass index (BMI), standard values and their relationship to health.	The treasure hunter, Fishing Lake, excess weight (raises student awareness to the excess weight they often carry in their backpacks)	Selecting the items that are related to the BMI calculation. Sorting from highest to lowest according to the characters' BMI.
4. Importance of healthy lifestyles	The long-term consequences of poor diet and explaining the importance of good posture.	Food name games (this is how words are related to healthy food). In the Freezer (students toss foods to partners to simulate putting food in the freezer)	Selecting the images that reflect a situation that could occur if they do not have healthy lifestyle habits. Selecting those figures which apparently led a healthier life when they were children.
5. Water	Learning the importance of drinking water (quantity and frequency) and how healthy other drinks are.	Conductor. Race hats. Planting (team players must plant food in their gardens and avoid being robbed)	Selecting the images or elements that indicate how much we have to drink every day. Sorting drinks that appear in play area from best to worst.
6. The food pyramid	Foods in the Food Pyramid and frequency of consumption.	Attack the castle. Carbohydrate, fat, protein and vitamins (Each player is assigned a role and must catch the individuals of opposing teams.)	Matching the different foods that appear to the appropriate position in the food pyramid.
7. Carbohydrates (sugars)	What carbohydrates (sugars) are, which foods contain them, how often they should be consumed, simple and complex carbohydrates and how to differentiate them.	Four in a row, Robocop and Michael Jackson, Hunters (chasing game).	Selecting foods that contain higher amounts of carbohydrates
8. Proteins	What proteins are, what foods contain them and how often to consume them.	The supermarket (running game, where the narrator must name healthy foods and is replaced if he/she names an unhealthy food).	Selecting those elements that correspond to the origin of proteins. Selecting those that contain animal protein.
9. Vitamins, minerals and trace elements	What vitamins, minerals and trace elements are, which foods contain them and how often to consume them.	"The cookery" (there are three groups of cooks, and the grandmother suggests they make porridge. The grandmother stores all the food and has to catch anyone stealing food (if this happens the player must leave the food in the pantry). The team with the healthiest porridge wins. Game of truth or consequences (involving questions about food in which incorrect answers entail a motor task, such as walking around the court)	Selecting the statements corresponding to each vitamin. Selecting the set of foods that indicate how we can intake all the vitamins, minerals and trace elements needed by our body.
10. Lipids	What lipids (fats of animal and vegetable origin) are, what foods contain them and how often to consume them.	The anaconda, The bollicao (related to food), Undo the knot.	Selecting those elements that orrespond to the origin of the fat. Selecting foods that contain fats
11. Reinforcement of foreground	Reaffirm their knowledge of the food pyramid and the importance of drinking water.	The pirates and parrots, A steal the leg, roulette pump barrel. (involving Island videogame).	Selecting a healthy menu with food and dishes that appear in the play area.
12. Emotional intake	Learning to identify emotional states that could trigger an uncontrolled intake and ways to prevent it.	"Three states": every child is blindfolded to experience three different emotional states: tranquility (begin the journey), stress (hacked), relaxation (beach). To do this, a professional will speak to the children to tell them what is happening and what to do while listening to music and different sounds.	–
13. The pyramid of physical activity	Learning the Pyramid of physical activity, what caloric expenditure is, what the effects of exercise are, and an introduction to lesser-known sports.	Kabaddi, Ultimate, Frisbee	Matching the various activities shown to the corresponding position in the pyramid of physical activity.
14. Traditional Canarian sports	Learning about and practicing some traditional Canarian sports	"La Pina" and "La Billarda of Gran Canaria".	Selecting those images showing traditional Canarian games
15. Healthy lifestylles. reinforcement	Enhancing their knowledge and mastery through a review of healthy lifestyles	Brilé and "La Vareta".	–
16. Rule 5	Learning the "Rule of Fives" (5 meals a day, 5 fruits and vegetables daily, 5 g of salt each day, 5000 steps a day, 5 glasses of water daily) as a summary of a healthy lifestyle.	Great Game, consisting of 6 sets of motor and cognitive skills. No direct confrontation between teams. They have to solve a final riddle involving a word related to "every day, five times five ".	This activity was part of the Great Game: Form words from the syllables that appear in the playing area, which will be the clues for other players to continue the activity in the library.

exercise class is considered and evaluated differently at execution time. In the *physical exercises*, the professional desires the user to perform a series of specific movements, making him reach certain targets with one or more contact points. A large number of visual hints is required in order to communicate to the user the next movement to perform as intuitively as possible. The method chosen to indicate the next movement to the user was to match the target and the contact points by highlighting them in the same color. Furthermore, this exercise class requires a sequential structure that allows the therapist to orchestrate the exercise during the editing.

Table 3
Distribution of games based on motor interaction and levels.

Session	Motor interaction						Videogames link		
	Without interaction		Opposition	Cooperation	Coop/opposition	Original nets	TANGO:H	Pirates' island	Other
	Individual	In situation of coop./comp.							
1				1		1			1
2				1	1	1			
3		1		1	1				
4	1			1		2			1
5	1				1	1			
6		1			2	1	1		
7					1	2			
8	–	–	–	–	–	–	–	–	–
9	1	1		1	1		1		
10	1	1			1			3	
11			2		1				
12			1		1				
13					2				
14					2				
15		4					2		
16									
Total	**4**	**8**	**3**	**5**	**14**	**8**	**4**	**3**	**2**
	12								

Moreover, with *cognitive exercises*, the educator is interested in avoiding visual hints that can give away the next target to be reached. Thus, for this exercise class, a set of targets is presented that requires the user to engage in a cognitive task, such as relating the sound of a cat with its visual representation (matching). Through the use of sound cues, the user knows the next target without making it too obvious. Cognitive tasks do not require a pre-established order to reach the targets. In addition, a "free configuration" exercise type was added. This class allows the professional to create exercises on the editor ignoring any type of consideration established by the two previous types.

TANGO-H offers two game modes: a) single and b) multiplayer. In single mode the exercise is carried out by one player in the categories described above (physical, cognitive or free). In addition to the traditional way of playing with a single user, in the multiplayer game mode two people can play sequentially or simultaneously, either competitively or collaborative. This last mode is made possible by the functional detection of two human bodies concurrently.

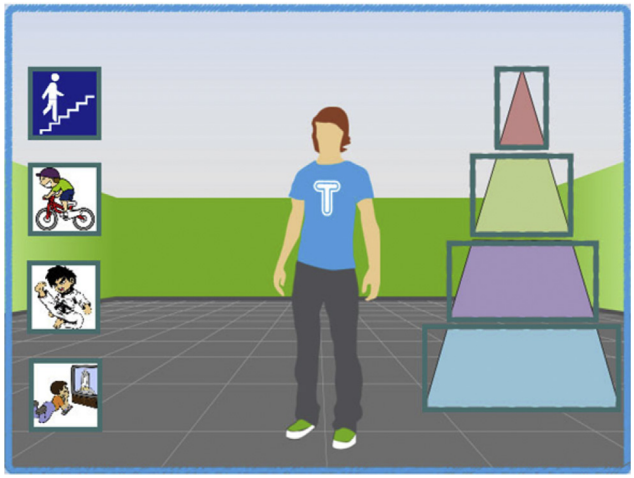
In the sequential multiplayer mode, after selecting the game, the two players perform the same exercise of equal complexity, one after the other. However, in the simultaneous multiplayer mode, players will face the selected exercise simultaneously, working together to both solve the exercise while competing to reach as many points as possible. The competitive mode shows the score for each player for the exercise performed, while in the collaborative multiplayer mode, users must work together to achieve the objectives, and the two users have the same score, time and bonuses.

Table 5 shows an example of the design of an exercise for a session with TANGO:H.

Table 4
Concepts and interaction elements in TANGO:H.

Element	Description
Contact point	Represents a point on the human body which allows the user to interact with a target. The system currently has a total of 13 contact points enabled.
Objective	This is the element that the user must touch with one or more contact points. A Target consists of an image, or a region of the screen, which holds a set of properties: - *Contact point.* Can have one or many. - *Sound*. Plays when a contact point reaches the target. - *Color*. Used in TANGO:H to represent the contact point that must touch the Target. A Target has one or more contact points associated with it. The interaction between them depends on one of the three following behaviors: - *All at once*. All contact points must simultaneously reach the Target. - *One*. At least one of the selected contact points must reach the Target. - *Dummy*. This is a target that, even if reached, does not change the dynamics of the exercise, so it is not necessary to define its Contact Points.
Stage	A Stage is a group of targets. To overcome a stage, you must achieve all the objectives that comprise it: - *Synchronously*. The user must reach all the targets in the stage simultaneously. - *Asynchronously*. The user must reach all the targets in the stage regardless of the order or the time instant in which it occurs.
Step	A Step is a grouping of stages. To complete a step, the user must complete the stages that compose it: - *Sequentially*. The user must complete the Stages in the order in which they were created. - *Randomly*. The user must complete the Stages in any order. A step can be repeated as often as necessary. The property that controls this is called iteration. A sound can also be assigned to play at the beginning of the step.
Exercise	An Exercise is a set of steps that are executed sequentially in the order in which they are defined. For the user to complete an exercise, he must complete: - All the sequential steps or every phase grouped in each of the steps (sequentially or randomly). - All the targets that are grouped in each of the stages (synchronously or asynchronously). The exercise is displayed on the screen in steps. That is, the targets that comprise a step will be shown simultaneously on the screen. Once all of the targets in each of the phases containing a step are reached, they will be deleted from the screen and the next Step will be shown.

Table 5
Example of physical exercise using TANGO:H.

Session 13. Pyramid of physical activity	
Exercise 1 The player must match the different activities that appear on the left with the appropriate position on the pyramid of physical activity.	Title: Match each activity to the correct site on the pyramid. Exercise type: Cognitive pairing Game mode: Collaborative Number of steps: 2 Total number of achievable goals: 16 Total number of distractors: 0 Maximum length for maximum score: 56 s Maximum points: 320 Minimum points: 16 Special rules: The pair of players is asked to hold arms so that they only have one hand and leg free to touch the game's objectives.
Step 1 *Number of stages: 4* *Number of achievable goals: 8* *Number of distractors: 0*	 

4.2. Individual home sessions for children

4.2.1. Wii Fit Plus exercises

The Wii Fit Plus is a game that allows exercise programs and records the players' progress. It consists of different physical activities that differ in the intensity and type of movements required, which sometimes are more analytical and more global. The unit used to measure energy expenditure is the MET, which refers to the power consumed by a person during his basal metabolism and is equivalent to 1 kcal/kg/hour. This game allows the player to interact via physical movements using different devices: the Wii controller (with an accelerometer that detects the movements carried out and which are shown on the screen), the nunchuck, Wii Balance and optical sensor board. The home training program planned consists of 16 sessions with the Wii Fit Plus and 2 sessions per week. The main objective was to ensure physical activity, independently and individually, at home through the Wii Fit Plus video game, the goal being to continue treatment beyond the classroom. Each session was specifically designed to work different body parts (Table 6). The materials needed to perform this exercise program at home were: Wii®, Wii Balance Board™, Wii Fit Plus and an exercise log.

4.2.2. Multiplayer online game: Pirate Island

The Pirate Island game was designed as a common place where students can interact with one another and conduct educational activities set in an island inhabited by different characters. This

Table 6
Wii Fit Plus sessions.

Session	Goals	Structure	Activities
1	Learn the operation of the console and the game. Coordinate hip and body movements.	Mount the Wii, create Mii, do the Wii Fit Plus physical test, note the weight and BMI (Body Mass Index) readings, establish objectives and play. Description: The first session was structured to familiarize the child with the Wii. Begin by creating a Mii character on the Wii and then start the physical test on the Wii Fit Plus. It should take note of your weight and BMI to then set a goal to achieve while the game is played. The team decided to give a common goal to all participants: 1 kg in two months. Then the child plays the game belonging to the area of Exercise Plus.	Get 10 points: Add numbers by touching them with the movement of the hips. Areas worked: hips and physical and mental coordination. MET: 2.5
2	Working aligning the pelvis. Working each body half separately, the lower and upper body. Balance training. Work the triceps. Work the legs and back.	Six games. Aerobics, plus exercise, balance, strength training and yoga: Six games from played.	- Hula Hoop®: classic game of hula hoop. Areas worked: alignment of the pelvis. MET: 4.0 - Walk Cycling: The player should move on the Wii Balance Board and move the motorcycle. Areas worked: the lower half of the body. MET: 2.5. - Land on the mark: The player must move like a bird, continue flying and land on the targets. Areas worked: Upper half of the body and balance. MET: 2.5. - The tight rope: The player must balance on a rope. Areas worked: balance. MET: 2.0 French Press: Exercise the triceps by placing the control behind the head. Areas worked: Triceps. MET: 1.5. - The Tree: Classic yoga exercise which involves placing one foot on the opposite knee and joining hands with the arms extended overhead, standing in that position for a few seconds and repeating with the opposite leg. Areas worked: legs and back. MET: 2.0.
3	Working balance. Work mind and body coordination. Burn fat. Working hips and legs. Improve metabolism. Working relaxation.	Six games practice. Description: aerobics, plus exercise, balance, strength training and yoga: Six games were played.	- Nods: The player must head incoming balls and avoid other objects that detract points. Areas worked: balance. MET: 2.0 - Boxing: The player must do punching combinations. Areas worked: Coordination and burn fat. MET: 3.5. - Get 10: Add numbers by touching them with the movement of the hips. Areas worked: hips and physical and mental coordination. MET: 2.5 - Ski Jumping: The player must simulate two ski jumps. MET: 2.0. - Front Stride: The player must place his hands behind his head and delaying foot double the measure. After reaching that position, bend the other knee 90°. Repeat exercise with the other leg. Areas worked: The thighs and hips. MET: 3.0. - Deep Breathing: The player must inhale deeply when the blue circle around the coach shrinks, and exhale when it expands, all while maintaining control over his center of gravity. Areas worked: improving metabolism. MET: 1.0.
4	Working balance and agility. Working sense of rhythm and coordination. Improve posture. Strengthen the back and thighs. Strengthen the ankles. Stretch the back.	Six games practice. Description: more exercise, balance, strength training and yoga: Six games were played.	- Segway Tour: The player must drive a Segway® over balloons and explode them. Areas worked: balance and agility. MET: 2.0. - Downstream: The player travels downriver in a bubble. Avoid touching objects or edges of the river because or the bubble bursts. Areas worked: balance. MET: 1.5. - Musical Parade: The player must walk on the Wii Balance Board while keeping pace with a whistle. At the same time he must move the knobs and feet to the right to gradually increase the pace of the band members. Areas worked: sense of rhythm and coordination. MET: 3.0. - Golf practice: practice your swing by hitting 20 balls. Areas worked: posture. MET: 3.0. The player must bend the knees while moving the arms to the side and back (the knees must never exceed the tips of toes). Areas worked: The back and thighs. MET: 3.5. - Palm: The player must lift the arms while breathing in and also lift the heels off the floor as if thrown upward from his body while stretching the hands up. The player must straighten the back while moving the arms slightly backwards. Areas worked: the ankles and back. MET: 2.0
5	Working balance. Working agility and coordination. Working sense of rhythm. Strengthen thighs, shoulders and hips.	Six games practice. Description: aerobics, plus exercise, balance, strength training and yoga: Six games were played.	Slalom Skiing: The player must tilt his body the left or right to switch between the blue and red pins. Areas worked: balance. MET: 2.0. Steeplechase: The player must run while dodging a series of obstacles. Areas worked: agility and coordination. MET: 3.0. Skateboard: The player must simulate skateboarding while doing a route that increases in complexity with different obstacles. Areas worked: agility and sense of balance. MET: 3.0. Step: The player must keep pace while stepping up and down on the Wii Balance Board. Areas worked: sense of rhythm. MET: 3.0.

(*continued on next page*)

Table 6 (*continued*)

Session	Goals	Structure	Activities
			Lateral extension: The player must extend in a crawling position with one arm and opposite leg aligned with the back. Then repeat the same exercise switching sides. Areas worked: strength shoulders and hips and sense of balance. MET: 3.0. Knee raised: The player must support his weight on one leg and lift the opposite leg raising the knee toward his chest. While in this position, breathe and concentrate on the posture by controlling the center of gravity keeping the buttocks and abdomen tight. Repeat several times and switch legs. Areas worked: strengthening thighs. MET: 2.0.
6	Working balance. Working aligning the pelvis. Working sense of rhythm. Burn fat. Toning the waist, side and shoulder muscles.	Six games practice. Description: aerobics, plus exercise, balance, strength training and yoga.	Fishing subzero: The player must balance on a large piece of ice while trying to eat different kinds of fish. Areas worked: balance. MET: 2.0. Super Hula Hoop ™: Basically like the Hula Hoop® only this time the game is divided into two parts in which the player must change the direction of rotation. Areas worked: alignment of the pelvis and burn fat. MET: 4.0 Downstream plus: The player travels downriver in a bubble. Avoid touching any object or the riverbanks because if so the bubble bursts. This is basically the same as the downstream activity with more obstacles. Areas worked: balance. MET: 2.0. Step dance: The players must keep pace with the step. Now the exercise is more complicated because they have to do more with their feet and clapping hands are added. Areas worked: sense of rhythm and burn fat. MET: 3.5. Side Pendulum: The players must support the weight of their body on the right leg, without bending. They should then lift the left leg sideways and raise their right arm while keeping the rest of the body motionless (no support on the ground raised leg). Switch sides. Areas worked: toning the lateral muscles and shoulder. MET: 2.5. Crescent: The players must try to keep the center of gravity within the circle of reference with the arms raised and palms together, leaning their body to either side keeping the spine straight. In addition, they must inhale when a blue circle shown on the screen shrinks and exhale when it expands. Areas worked: waist. MET: 1.5.
7	Working hand-eye coordination. Working balance. Working decisions. Working reaction time. Working sense of rhythm, coordination and attention Strengthen thighs. Align the pelvis and groin. Working concentration.	Six games practice. Description: more exercise, balance and yoga: six games of this type were played.	City fro: The players must get colored balls that fall from the top of the screen into cubes of the same color located at the bottom of the screen. To do this they control three platforms. The knob controls the upper platform and the two lower legs. Areas worked: hand − eye coordination. MET: 2.0. Platforms: The players must bend in any direction to get balls into holes. The difficulty level is Aumen-Tando, each level is different from before and involves more and more balls. Areas worked: balance. MET: 2.0. Snowballs: The players must throw snowballs at their opponents located in front of them and at the same time, they must hide to dodge incoming snowballs. Areas worked: decision making and reaction time. MET: 2.0. Rhythm Kung Fu: The players must look at the sequence of movements that Mii characters make, and then imitate the same rhythm for the best pose when their turn comes. The difficulty increases little by little. Areas worked: sense of rhythm, coordination and attention. MET: 3.0. Warrior: The players must place one foot on the Wii Balance Board and delay the other. Then turn their body 90° and flex the knee while remaining on the Wii Board and distributing their weight between the two legs. Then repeat the process changing the leg position. Areas worked: strengthening thighs and align the pelvis. MET: 2.0. Zazen: The players must sit on the Wii Balance Board with their back stretched and legs bent and remain motionless in that position to keep the candle lit. Areas worked: concentration. MET: 1.0.
8	Same as session 2		
9	Same as session 3		
10	Same as session 4		
11	Same as session 5		
12	Same as session 6		
13	Same as session 7		
14	Same as sessions 3 and 9		
15	Same as sessions 4 and 10		
16	Same as sessions 5 and 11		

collaborative video game created in Unity 3D has a simple player interface and tools that are common to other online multiplayer games, such as the minimap, chat, inventory or a newspaper that serves as the quest log. These elements are shown or hidden depending on the context, except the minimap, so that the amount of information presented to the user at any one time is minimized.

All players stay on the same map, where there are tasks, problems to solve and people to help. Each educational activity to be performed is represented on a mission, consisting of doing any number of things such collecting objects, convincing characters to do something, and so on. A session can have multiple missions. A player can start with a mission or acquire it during the game. Once accomplished, this mission will be completed for all the players who were present on the island at that time, i.e. the missions are assigned to the group. Some missions will be much easier if done in a group, and others will be simply impossible to complete without help, because the actual design has collaborative learning patterns.

When certain requirements have been met, the session will be terminated and proceed to the next. The sessions are planned so that they can last for two weeks on average, depending on how soon the players complete these objectives and on the decisions made by the island's administrators.

The activities are designed so that they can satisfy the objectives of training in healthy habits. Each session consists of a set of events grouped into missions, which must contain each of the following elements:

- Name
- Descriptive text for the user
- Begin and End conditions
- Related elements, if any:
  _ mission list
  _ characters list
  _ object list
  _ main line or lines of conversation
  _ consequences

A mission takes place in the context of a session, but does not have to begin and end in that session. For example, a mission may start in one session and end in another a week later. Therefore, we have designed different general missions for completion in the home over 8 weeks of intervention during the 16 planned sessions except mission 1, familiarization, with the game taking place in the school setting under the teachers' supervision (Table 7) (Fig. 3).

Moreover, along with Pirate Island, we have developed a series of tools that facilitate their development, which together with the tools provided by the developers of the engine Unity3D allow the implementation of a variety of teaching materials, adventures or content. Thus, professionals can design activities to do in the game using authoring tools.

4.2.3. Family training

The training program on healthy habits includes as a fundamental part the training of the family. Therefore, a training session of 90 min was included with the parents. The session was divided into two parts, the theoretical training is given first, followed by various training activities, including videogames. The theoretical explanation is divided into four main parts. In the first part the subject of diet and health is given by a physiotherapist and a doctor. The second part deals with the emotional intake and is delivered by a psychologist. In the third part the importance of physical activity is presented by a physical education professional. Finally, the benefits of videogames and false beliefs are exposed. The training contents were:

- General information on healthy lifestyles.
- Explaining the concept of BMI, including the formula, standard values and their relationship to health.
- Presentation on the amount and frequency of water intake.
- Explanation of the food pyramid, foods that compose it and frequency of consumption.
- The different components of food, what foods contain them and how often to eat them: carbohydrates (sugars), proteins, vitamins, minerals and trace elements, and lipids.
- Outlining groups of correct foods for every meal.
- Kilocalorie consumption and expenditure.
- Argumentation and identification of the influence of emotional states on food intake behavior and ways to avoid uncontrolled intake.
- Presentation of the pyramid of physical activity, and health benefits of physical activity.
- Presentation on the benefits of active videogames and clarification of misconceptions about them.
- Introduction to the “Rule of Fives” (5 meals a day, 5 servings of fruits and vegetables daily, 5 g of salt each day, 5000 steps a day, 5 glasses of water daily) as a summary of a healthy lifestyle.

Once the theory part is over, the parents are divided into different teams to carry out the following activities:

- Activity 1. “true and false sentences”: a sheet with different sentences on diet and lifestyle is given to the parents, and they must decide by groups, whether they were true or false.
- Activity 2. “TANGO-H”: Parents test the TANGO-H activity involving the food pyramid. In this activity the player must match the different foods that appear with their position in the food pyramid as appropriate.

4.3. Gamification of the training program

The mechanics that were used for gamification were: points, badges and leaderboards (PBL), time, challenges and positive feedback. The game modes used were: individual, competitive and collaborative. We did not consider users with different player types in the program, because all the children had to follow the program laid out by the professionals and do the same activities. Instead, we used the role playing and narrative inspired in Pirate Island. So, the pirate has several ranges and through gamification of activities, children can evolve weekly from the first level to the last. Thus, in the first week everyone will be “islanders” and then, as activities are carried out at school and at home, they advance levels, passing through different ranges: boy, pirate, officer, petty officer, captain, yonko and shichibukai. Every week the accumulated scores and statuses were updated.

The criteria for obtaining the points scored by the school in carrying out the activities were customized by the type of activity performed. As a general rule, points were assigned for successful completion of the activity, and these points were accumulated weekly. As for the motor games in each session, every child started with 10 points, with points subtracted if the rules were violated. Among the behaviors related to engine development games, two types can be distinguished: “not own or external” (disruptive or transgressive behaviors to the rule) and “own internal and play” (explicit contents of the rule).

Table 8 shows the different scores obtained by the participants and ranks, badges and feedback performed weekly for the gamification of the training program. We can see that every week there is

Table 7
Missions to carry out in the Pirates' Island videogame.

Mission	Goal	Specific missions	Description
1	Learn about the island, the characters and how to interact with them.	1.1. Talk to Captain Lena 1.1.1. Talk to Kira, the boy 1.1.2. Talk to Thiago, the pirate 1.2. Talk to the teacher 1.2.1. Collect eight apples	The player's avatar is created; learn to move around the island and what the missions are. The teacher will arrange a mission to teach the game mechanics, the mission is to gather eight apples. - List of items: - - Characters involved in the mission: Captain Lena, Kira, the cabin boy, Thiago the pirate and Professor Julia. Beach and village: -Scenarios where the meeting takes place - Location of the characters: Captain Lena and Thiago are located on the beach. Kira, the boy and the teacher Julia are located in the village near the school.
2	Learning the benefits of healthy lifestyles and choose a healthy menu.	2.1 Mayor 2.1.1. Speak 2.1.2. Getting food 2.1.3. Help Helladia 2.1.4. Delivering food	- The Mayor informs the player that his life is very busy and that their habits are unhealthy. The child must buy food from Helladia and give it to the Mayor. There will be two possibilities in the mission, which will be easier if the player chooses healthy food than if he buys the not so healthy food. - List of items: bricks, salad, fish, rice, apple, watermelon, glass of water, drumstick, sweet sugarcane. - Characters involved in the mission: Mr. Mayor, Helladia. Beach and village:-the scene where the mission takes place - Location of the characters: The Mayor is located in the town hall and Helladia on the beach near the boat I -Object needed to finish the mission: Reed (helps to fish). - Pirate ability associated with the needed object: Patience
3	Learn about the BMI, which standard value and how they are related to health.	3.1 Captain Lena 3.1.1. Speak 3.1.2. Talk with Kira, Thiago, Mr. Mayor and Sergeant Rodriguez 3.1.3. Tell the Captain what are the healthiest	In this session players have to implement the concept of BMI. For this Captain Lena seeks help the player to find the person or people healthier island to form your crew. The characters that appear are: Kira, the boy with a BMI of 20 (normal weight); Thiago, the pirate with a BMI of 27 (within the overweight range); Mr. Mayor with a BMI of 30 (inside the obese range) and Sergeant Rodriguez with a BMI of 24 (normal weight). In the mission the chance to talk with the teacher to clarify what is BMI and their values if the child does not remember or know should appear. Her professor should have this information. - List Of items: - - Characters Involved in the mission: Professor Julia, Captain Lena, Kira, Thiago, Sargeant Rodríguez and the Mayor. - Beach and village: Scenarios where the mission takes place - Location of the characters: Captain Lena is located on the beach near the entrance to the gorge, Kira is on the beach, Thiago is in town, the mayor at City Hall and Sergeant Rodriguez on the way to people.
4	Learning the consequences of bad habits.	4.1. Talk with the Mayor 4.1.1. Deliver the "Manual to a healthy diet" 4.2. Talk with Professor 4.2.1. Deliver water 4.3. Talk with Captain Lena 4.3.1. Deliver bed 4.4. Talk with Thiago 4.4.1. Deliver boots 4.5. Talk with Helladia 4.5.1. Release keys	The mayor asks the player for the opinion of Captain Lena on your BMI, he replies that it is within the range of obesity and asks the player to seek a solution. The player must collect every element in the "health kit" (bed rest, walking boots, water for hydration, healthy diet manual for a balanced-energy diet) to help the mayor. Character / Element needed / Element owned Mr. Mayor / Healthy Diet Manual / Keys Julia, the teacher / Water / Healthy Diet Manual Captain Lena / Bed / Boots Thiago / Boots / Bed - List Of items: key, bed, boots, water and book ("Manual to a healthy diet") - Characters involved in the mission: the Mayor, Professor Julia, Captain Lena, Thiago and Helladia. - Beach and village: Scenarios where the mission takes place - Location of the characters: The Mayor is at City Hall, Professor Julia at the school, Captain Lena is on the beach next to the entrance to the gorge (still closed), Thiago is in town in the shadow of a house and Eladia is on the beach near the boat. - Object needed to finish the mission: shovel (to dig) - Pirate ability pirate associated with item: Strength.
5	Learning the importance of drinking water and how much to drink.	5.1. Talk to Thiago 5.1.1. Deliver water to Thiago 5.2. Find water 5.2.1. Talk to Helena 5.2.2. Talk with Benjamin 5.2.3. Get the cube	The player finds that Thiago, the pirate is dehydrated and should go find water from the well but when he gets there, Helena, the archeologist, tells the player that she cannot draw water. The child must look around the island to see who might have water. This prompts you the player to change some bricks to build the future market. The player thus gets the bucket, goes to the well, gets water and takes it to Thiago. - List of items: 5 bricks. - Characters involved in the mission: Thiago, Benjamin, Helena the archeologist, Helladia - Beach, village and well: scenarios where the mission takes place - Location of the characters: Thiago is in the village sitting in the shade of a house, Benjamin is on the beach away from the boat, Helena is near the well and Eladia is on the beach near the boat.

6	Unlocked in the scene: Well Learning what the food pyramid is.	6.1. Talk with Helena, the archeologist 6.1.1. Talk with the Mayor 6.1.2. Talk with Helladia 6.1.3. Find parchment 6.2. Talk with Kira	In this mission the player must solve the mystery of the "golden" pyramid. To do this the player must get a scroll written in the ancient language used by the inhabitants of the island containing "NAGUN" information. - List of items: paper (parchment), Book - Characters involved in the mission: Helena, Kira, Eladia and the Mayor Beach, village, well: Scenarios where the mission takes place - Location of the characters: Helena is on the beach, Kira is on the road connecting the beach with the people, Eladia is on the beach next to the boat and the Mayor is in the City. - Item needed to finish the mission: Compass - Pirate ability pirate associated with the managed object: Orientation.

a new range, which can be achieved by those conducting activities following the rules established in the training program.

5. Results

This section describes some of the main results obtained in the study. Given the extent of the study, only those directly related to the effectiveness of the training program of healthy habits motor based games, videogames and gamification results are presented.

Therefore, we will see the results related to biometrics and perceived exertion (overweight/obesity), the KIDMED (learning), and the results related to Emodiana (experience). The results of the questionnaires were processed with the help of the SPSS statistical package. The main results of the intervention are described and organized according to the types of variables analyzed.

5.1. Biometric variables

Table 9 shows the biometric sample variables of the pre and post study.

No significant differences are observed because of the short duration of the intervention and the type of intervention in physical activity goes from mild to moderate intensity. This is reflected in the result of the effort perceived by the subjects, since the average and mean session participants were 2 (very soft) and on data collected by sensors (in the group) whose average values collected during 15 sessions were: 1: Distance: 0.65 km/h; 2: Mean HR: 107.17 bpm; 3: FC Max: 157.52 ppm and 4: Calories: 52.52 kcl. Figs. 4 and 5 illustrates the data collected by heart rate meter and accelerometer sensors.

5.2. Learning about healthy habits

Table 10 presents the KIDMED test item frequencies in the experimental (G1) and control (G2) groups at the start and end of the intervention.

Regarding the formation of healthy habits, we found significant differences between the experimental and control groups on the index value of "Quality of the Mediterranean diet (KIDMED)" ($t18 = 3.657$; $p \leq 0.05$) reported by parents in the pre (Table 11) and post test (Table 12).

As shown in the pretest, no significant mean differences between groups for the value for the "Quality of the Mediterranean diet (KIDMED)" were reported by the parents prior to the intervention. If we look at the average, both groups are in the range "Need to improve the dietary patterns to fit the Mediterranean model" of the questionnaire.

As shown in Table 12, there are significant differences between groups for the value "Quality of the Mediterranean diet (KIDMED)" ($t18 = 3.657$; $p \leq 0.05$) reported by the parents in our post-intervention measures. If we look at the average for each group, the score of the experimental group yielded an "optimal Mediterranean Diet" while the KIDMED score for the control group reveals "Need to improve dietary patterns to fit the Mediterranean model".

5.3. Experience

In order to analyze the experience in sessions with motor play and active videogames, a study of emotions expressed with Emodiana before and after training sessions was performed (Table 13). The set of emotions on this instrument has been selected by psychologists and experts on motor play based on the correspondence among emotions in videogames and motor play. This instrument was previously validated (Gonzalez et al., 2013a,b)). Moreover, verbal and non-verbal aspects were evaluated through

Fig. 3. Familiarization session with the Pirate Island videogame.

the analysis of recorded videos. Detailed information on the techniques used to validate this experiment can be found in González and Navarro (2015b).

This study was conducted based on the justifications made for these emotions. Where possible the reasons for the emotions expressed by the subjects were analyzed using a gauge of the agreement between the judges for each subjective item assessed in the sample. To this end, a table is constructed with 89 valid cases and a system of mutually exclusive categories was established. Items in subjective assessments or justifications given by the children were classified as internal or external to the intervention. The internal dimension includes explanations relating to the subject or person (P) and the structure related to the activity (E). The external dimension comprises the explanations relating to the context (C). Using this system of categories, each judge must identify categories that represent more accurately the assertion regarding the opinion of the justification of the emotion declared by each subject.

This led to seven possible categories (Table 14) being established (Fig. 6).

The interjudge agreement procedure was carried out in different phases, performing three iterations (iterative successive tests). This procedure was used to evaluate the intrinsic reliability of each item, and the reliability of the observers. If the interjudge agreement is significant, we can conclude the intrinsic objectivity of the items. Given the difficulty of the phenomenon of justification of emotions in children, requiring validation containing expert opinions related to different disciplines (psychology, motor play and videogame), we have chosen to calculate the reliability of the instrument's kappa Fleiss (Fleiss & Cohen, 1973). The value obtained for this reliability index k was 0.903, with the value 0 corresponding to the minimum possible match and 1 to the maximum.

On the Wii Fit, the degree of compliance with the physical activity scheduled for the household was recorded. To this end, the parents had to present a completed form detailing the degree of compliance with the weekly exercise schedule. Records showed high compliance with the sessions scheduled for the home (95.6%). Regarding the collaborative multiplayer online game “Pirate Island”, due to technical difficulties in different households, we decided not to consider conducting missions as an indicator of compliance with the tasks at home.

6. Discussion

The training program has shown to be effective in learning behaviors of healthy habits, as we can see significant differences in the rates of diet quality found in the healthy lifestyles KIDMED test between the control and experimental groups ($t18 = 3.657$; $p \leq 0.05$).

Although the results involving biometric measurements showed little difference at the beginning and end of our intervention, this may be due to the short period of intervention (8 weeks) and the design of physical activity low-medium stress levels (level 2 of perceived exertion). However, the main objective of this training program is not to achieve a decrease in BMI but to change unhealthy behaviors toward other healthy lifestyle patterns by including physical activity in daily activities. Therefore we think that performing physical activity through motor games and gaming assets is critical to the success of the training program, introducing physical activity naturally to the child.

Moreover, in assessing the experiment, the children's emotions were highly positive, both before and after each session (89.5% average before session, 95.1% average after session). This may be because the main motivation they have to attend the program is the game itself, which is not perceived as a complement to traditional training. We can also see the influence of playful structure formation by noting that 86% of the justifications of emotions shown by the children were due to personal reasons specific to the structure of the activity (P = 15% reasons; E = 21% PE = 50%).

Another factor to note is the high adhesion to the implementation of activities at home (95.6%) due to the integral gamification program, which included scores, levels, leaderboards, and allowed children to progress weekly based on compliance with rules and with the established schedule. The children awaited the weekly feedback and were eager to see their progress. This progress was especially designed for everyone to progress weekly on the “pirate” hierarchy, giving compensatory scores to those children that were left behind for reasons unrelated to the intervention, such as being sick for a week and not being able to attend the group session.

The results reveal that hypothesis H1, Increased motivation through gamification intervention program, can be checked by the results obtained on the emotions of the Emodiana, plus the results of the degree of compliance with the activities planned for the home.

As for hypothesis H2, Improved healthy lifestyle through a program that combines training, motor play and active videogames, both at home and at school, we can see that there was an improvement in the lifestyle of the children through our intervention program, as we see an improvement in the quality index of the Mediterranean diet (KIDMED) in the experimental group versus the control group.

7. Conclusions

In this paper we presented an integrated training program for the development of healthy lifestyles through a program of school

Table 8
Gamification elements of the training program updated weekly.

Week	PMax	PMax accumulated	Pmin	Pmin accumulated	Grades	Badges	Mechanics	Feedbacks
1	–	–	–	–	Islander		Level associated with status	Visual (to show the overall weekly standings)
2	185	185	30	30	Islander		Level associated with status	Visual (to show the overall weekly standings)
					Grummet			
3	740	925	58	88	Grummet		Level associated with status	Visual (to show the overall weekly standings)
					Pirate			
4	216	1141	23	111	Grummet		Level associated with status	Visual (to show the overall weekly standings)
					Pirate			
					Official			
5	361	1502	44	155	Official		Level associated with status	Visual (to show the overall weekly standings)
					Boatswain			
6	385	1887	18	173	Boatswain		Level associated with status	Visual (to show the overall weekly standings)
					Lieutenant			

(*continued on next page*)

Table 8 (*continued*)

Week	PMax	PMax accumulated	Pmin	Pmin accumulated	Grades	Badges	Mechanics	Feedbacks
7	350	2237	21	194	Lieutenant		Level associated with status	Visual (to show the overall weekly standings)
					Captain			
8	105	2342	25	219	Captain		Level associated with status	Visual (to show the overall weekly standings)
					Yonkos: Group of Winners			
					Shichibukai: First in the general classification			

and home activities. These activities were designed so that children can grasp the importance of eating habits and physical activity through a playful approach.

The study has a quasi-experimental design, with a control group and an experimental group. The sample was selected from a public school at random.

The training program developed achieved the overall project objective of promoting the acquisition and retention of healthy lifestyles in overweight/obese children through health education. Furthermore, the influence of the educational intervention program on overweight children has been evaluated.

Through training the family, we sought to increase awareness of the importance of preventing childhood obesity (short- and long-term complications, and health and social costs). We also evaluated the prior habits and lifestyles (habits, customs and beliefs) of overweight children and their families and tried to change these habits by providing accurate information on the habits of healthy behavior and dispelling myths.

Regarding the effectiveness of the training program for the promotion of healthy habits, various measures in different areas are registered: medical, psychological, educational, recreational and motor and interactive. The results support the effectiveness of the

Table 9
Biometric variables analyzed before and after the intervention.

	Group	N	Means	Deviation Typ.	d Cohen
Initial weight in kg	Exp	11	45,2636	7,65262	0,11 Negligible
	Control	9	48,1222	9,25065	
Initial height in cm	Exp	11	139,3636	6,65241	0,19 Small
	Control	9	144	9,79796	
Initial body mass index	Exp	11	23,2227	1,96905	0,01 Negligible
	Control	9	23,1694	1,59168	
Final weight in kg	Exp	11	45,85	7,61968	0,13 Negligible
	Control	9	49,1	8,88155	
Final weight in cm	Exp	11	140,7545	6,84374	0,17 Small
	Control	9	145,0111	10,25725	
Final body mass index	Exp	11	23,0836	2,11	0,04 Negligible
	Control	9	23,32	1,62862	

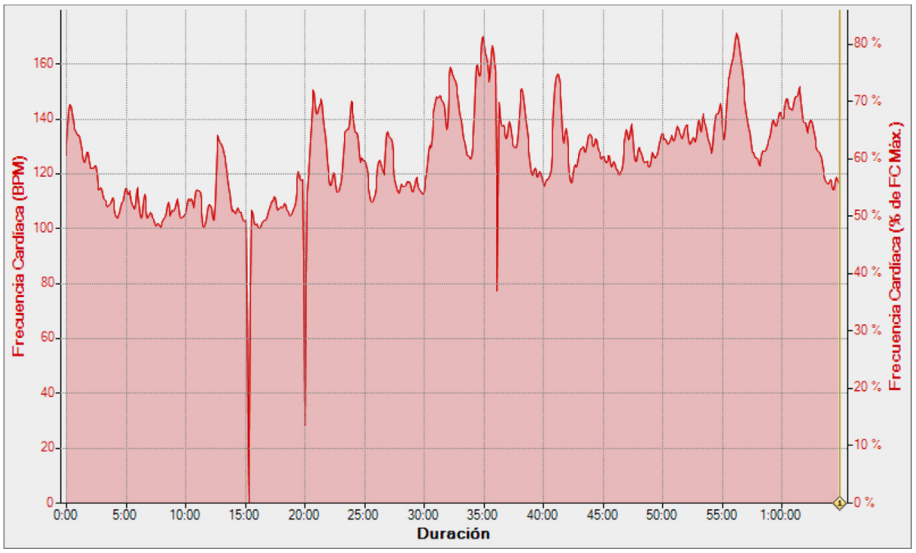


Fig. 4. Graphical example of the data registered by the heart rate meter.

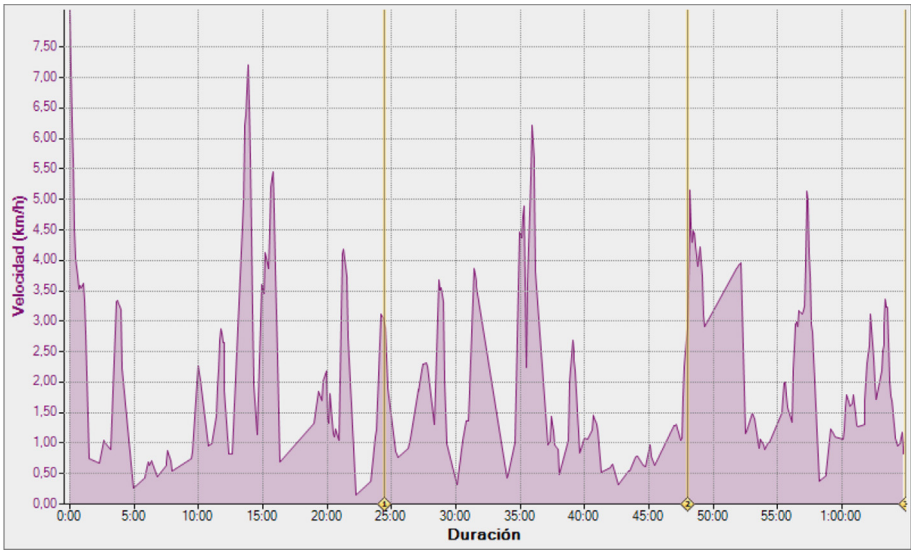


Fig. 5. Graphical example of the data registered by the accelerometer.

Table 10
KIDMED frequencies.

Test of quality of the Mediterranean diet (KIDMED)	Pretest						Post test					
G1. experimental group/G2. control group	G1			G2[a]			G1			G2		
Question/frequency (%)	No	Yes	NA	No	Yes	NA	No	Yes	NA	No	Yes	NA
1. Has fruit or fresh juice every day	18.2	72.7	9.1	11.1	66.7	11.1	9.1	90.9	0	55.6	44.4	0
2. Has a 2nd piece of fruit every day	63.6	27.3	9.1	66.7	11.1	11.1	54.5	45.5	0	77.8	22.2	0
3. Has fresh or cooked food regularly once a day	9.1	81.8	9.1	22.2	55.6	11.1	9.1	90.9	0	55.6	44.4	0
4. Has cooked or fresh vegetables regularly or more than once a day	72.7	18.2	9.1	77.8	11.1	88.9	36.4	63.6	0	66.7	33.3	0
5. Consumes fish regularly (at least 2 or 3 times a week)	27.3	63.6	9.1	22.2	55.6	11.1	18.2	81.8	0	33.3	66.7	0
6. Has fast food one or more times per week	90.9	0	9.1	66.7	11.1	11.1	100	0	0	77.8	22.2	0
7. Likes vegetables and drinks more than once a week	9.1	81.8	9.1	55.6	22.2	11.1	27.3	72.7	0	44.4	55.6	0
8. Has pasta or rice almost daily (5 days or more per week)	36.4	54.5	9.1	44.4	33.3	11.1	36.4	63.6	0	55.6	44.4	0
9. Has breakfast cereal or derivative	9.1	81.8	9.1	11.1	66.7	11.1	0	100	0	44.4	55.6	0
10. Has nuts regularly (at least 2 or 3 times a week)	63.6	27.3	9.1	77.8	0	11.1	63.6	36.4	0	66.7	33.3	0
11. Olive oil is used at home	0	90.9	9.1	22.2	55.6	11.1	0	100	0	22.2	77.8	0
12. No breakfast	81.8	9.1	9.1	77.8	11.1	88.9	90.9	9.1	0	100	0	0
13. Eats breakfast a dairy (yogurt, milk …)	9.1	81.8	9.1	11.1	66.7	11.1	0	100	0	0	100	0
14. Eats bakery products, cookies or cupcakes for breakfast	72.7	18.2	9.1	44.4	33.3	11.1	72.7	27.3	0	66.7	33.3	0
15. Has 2 yogurts and/or 40 g of cheese per day	36.4	54.5	9.1	33.3	44.4	11.1	72.7	27.3	0	44.4	55.6	0
16. Has snacks and/or sweets several times a day	90.9	0	9.1	77.8	11.1	88.9	100	0	0	88.9	11.1	0

[a] In the pretest of the G2, for all the questions some data were lost by the system (11.1%).

Table 11
T test for equality of means done in the pretest for G1 and G2.

Pretest

	GROUP	N	Means	Deviation typ.	Typ. average
KIDMED - Direct Score	Exp	10	7,80	1,619	,512
	Control	7	6,14	1,215	,459

Independent Samples Test

		Levene test for equality of variances		T test for equality of means						
									95% confidence interval for the difference	
		F	Sig.	t	gl	Sig. (bilateral)	Mean Difference	Typ. difference	Lower	Higher
KIDMED - Direct Score	Equal variances were assumed	1,598	,225	2,286	15	,037	1,657	,725	,112	3,202
	There have been not assumed equal variances			2,409	14,870	,029	1,657	,688	,190	3,124

Table 12
T test for equality of means done in the post test for G1 and G2.

Postest

	GROUP	N	Means	Deviation typ.	Typ. average
KIDMED – Direct score	Exp	11	8,73	1,489	,449
	Control	9	6,33	1,414	,471

Independent Samples Test

		Levene test for equality of variances		T test for equality of means						
									95% confidence interval for the difference	
		F	Sig.	t	gl	Sig. (bilateral)	Mean Difference	Typ. difference	Lower	Higher
KIDMED - Direct Score	Equal variances were assumed	,193	,666	3,657	18	,002	2,394	,655	1,019	3,769
	There have been not assumed equal variances			3,677	17,547	,002	2,394	,651	1,024	3,764

Table 13
Declarative perceived emotions in educational intervention sessions.

Emotion	Type	Before	After
		%	%
Happiness	Positive	80.33	81.97
Love	Positive	3.28	0.00
Satisfaction	Positive	4.92	13.11
Sadness	Negative	3.28	1.64
Fear	Negative	1.64	0.00
Nervousness	Negative	1.64	0.00
Seriousness	Neutral	1.64	0.00
Surprise	Neutral	1.64	3.28
Shame	Neutral	1.64	0.00
Total		100%	100%

intervention model designed and developed since we found significant differences between the control and experimental groups, showing an improvement in learning healthy habits. In addition, we evaluated the children's motivation to physical activity developed with active game play engine and observed highly positive emotions (87%) and a high degree of compliance activities at home (95.6%).

With respect to activities in the home, we encountered difficulties with the online multiplayer video game, since it required a broadband connection at home and a computer with a good graphics card, considerations not listed as causes of exclusion from the sample. We also found that difficulty in school because it was a public school that did not have a good Internet connection and powerful computers. No major difficulties were encountered with the Wii Fit Plus.

As for the group sessions conducted in the school context, we can state that they progressed satisfactorily in terms of complying with the training programs, the motor games and the active videogames. The motor games exhibited diverse behaviors and revealed how the leisure social structures generated emotions, as evidenced by the justifications provided by the children. The children's response was positive to the proposal and program development. The program has allowed us to check the anticipated structural characteristics of motor games and collaborate to record the emotions of each session. This set has provided us preliminary conclusions regarding an implementation and acceptance of games with a marked social character as well as a contribution of positive emotions focused on the joy and satisfaction issues related to games and more pronounced in children. Taken together, and considering the sample of selected children, we see that the

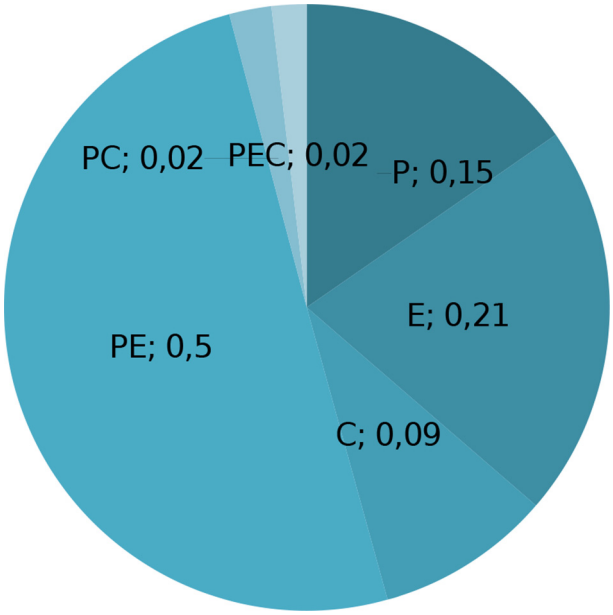


Fig. 6. Percentages of the categories assigned to the justifications of emotions.

intervention model designed is feasible for development in an extracurricular context.

We believe it would be interesting to integrate these programs into the education model schools, as they educate and motivate behavioral changes from an early age using the dynamics of the games, which are so close to children and girls.

We also believe that this type of training in healthy lifestyles can be introduced into the educational curriculum of minors. Having education in healthy habits be part of the curriculum can ensure the long-term acquisition of healthy behaviors and prevent non-transmissible diseases related to bad habits, resulting in improved health for society.

Another challenge is to ensure that technologies are designed that can make a difference for all children, regardless of their culture, socioeconomic status, or special needs. We need to conduct research on designing technologies in this area to try to offset the growing socioeconomic and digital gap among children of developed and developing countries, and for children with perceptual, motor, or cognitive impairments.

Table 14
Seven exclusive categories analyzed.

Category	Definition
1. Person (P)	When justification is done in first person, linking to the justification of emotion declared. For example: “because I laughed and had fun”, “because I fear misbehaving like last time”
2. Structure of activity (E)	When justification is performed on elements or agents of the specific intervention planned. For example, “because today I'm going to do new exercises and I will learn to play games”, “because the games were really fun.”
3. Context (C)	When justification is made on aspects of the child's environment and the scheduled activity. For example: “Because today is my father's birthday”, “because I have a long weekend and the holidays are coming”.
4. Person and structure of activity (PE)	When they combine the justifications of the P and E categories. For example, “because I feel good about doing the exercise I've done,” “because I really like games but I've misbehaved”.
5. Person and context (PC)	When they combine the justifications of the P and C categories. For example, “because today I had a good time in class, at home and here,” “because I am satisfied because I did a test.”
6. Structure of activity and context (EC)	When they combine the justifications of the E and C categories.
7. Person, structure of activity and context (PEC)	When they combine the justifications of the P, E and C categories. For example, “because we will not come again, just a week,” “because I feel satisfied every time I come here, and also had a field trip today”.

Acknowledgments

This work was supported by the R & D Project "Developing healthy habits and physical education through Educational Video-Games and Motor Plays for Hospitalized Children and Adolescents", Ref. EDU2010-20010 of the Ministry of Education and Science of Spain. The authors would like to especially thank the professional research group that developed the intervention in school. Dr. Carmela Quirce, D. Norberto Marrero, D. Pedro Toledo, Ms. Elena Santos, Ms. Silvia Vera, Luis. Navarro, D. Salvador Nuñez, and D. Joaquin García. We also wish to extend our thanks to San Fernando Duggi School for the development of the training intervention with the active game and game engine, to the children who participated in it and to their families.

References

Aguilar Cordero, M. J., González Jiménez, E., García García, C. J., GarcíaLópez, P. A., Álvarez Ferre, J., & Padilla López, C. A. (2011). Obesidad de una población de escolares de Granada: evaluación de la eficacia de una intervención educativa. *Nutrición Hospitalaria, 26*(3), 636–641.

Alfageme González, M. B., & Sánchez Rodríguez, P. A. (2003). Un instrumento para evaluar el uso y las actitudes hacia los videojuegos. *Revista Pixel-Bit, 20*, 17–32.

Amigo, I., Busto, R., Pena, E., & Fernández, C. (2013). Prevalencia de sobrepeso y obesidad en los niños de 9 y 10 años del Principado de Asturias: el sesgo de la valoración de los padres. *Anales de Pediatría (Barcelona), 79*(5), 307–311.

Ardoy, D. N., Fernández-Rodríguez, J. M., Ruiz, J. R., Chillón, P., España-Romero, V., & Castillo, M. J. (2011). Mejora de la condición física en adolescentes a través de un programa de intervención educativa: Estudio EDUFIT. *Revista Espanola de Cardiologia, 64*(6), 484–491.

Avontuur, T., de Jong, R., Brink, E., Florack, Y., Soute, I., & Markopoulos, P. (2014). Play it our way: customization of game rules in children's interactive outdoor games. In *Proceedings of the 2014 conference on interaction design and children (IDC '14)* (pp. 95–104). New York, NY, USA: ACM.

Bacardí-Gascon, M., Pérez-Morales, M. ªE., & Jiménez-Cruz, A. (2012). A six month randomized school intervention and an 18-month follow-upintervention to prevent childhood obesity in Mexican elementary schools. *Nutrición Hospitalaria, 27*(3), 755–762.

Berlanga, L. A. (2013). Body mass Index in children according to nutrition knowledge of their parents. *AGON International Journal of Sport Sciences, 3*(1), 6–12.

Borràs Rotger, P. A., Vidal Conti, J., & Ponseti Verdaguer, X. (2008). Escuelas promotoras de salud; intervenciones y estrategias para incrementar el nivel de actividad física: revisión y recomendaciones. In *Libro de ponencias de la IV Congreso Internacional y XXV Nacional de Educación Física*. Córdoba: Universidad de Córdoba.

Calatayud Sáez, F., Calatayud Moscoso del Prado, B., & Gallego Fernández-Pacheco, J. G. (2011). Efectos de una dieta mediterránea tradicional en niños con sobrepeso y obesidad tras un año de intervención. *Revista Española de Pediatría. Clínica e Investigación, 13*(52), 553–556.

Canary Islands Government. Encuesta de Salud de Canarias de 2009. Retrieved on May 15, 2014 from: http://www2.gobiernodecanarias.org/sanidad/scs/contenidoGenerico.jsp?idDocument=a900df0c-082a-11e0-a822-57ec4778ee0a&idCarpeta=11f7902a-af34-11dd-a7d2-0594d2361b6c.

Cantallops Ramón, J., Ponseti Verdaguer, F. J., Vidal Conti, J., Borràs Rotger, P. A., & Palou Sampol, P. (2012). Adolescencia, sedentarismo y sobrepeso: análisis en función de variables sociopersonales de los padres y del tipo de deporte practicado por los hijos. Retos. Nuevas tendencias en Educación Física. *Deporte y Recreación, 21*, 5–8.

Chin, A., Paw, M. J., Jacobs, W. M., Vaessen, E. P., Titze, S., & van Mechelen, W. (2008). The motivation of children to play an active video game. *Journal of Science and Medical in Sports, 11*(2), 163–166.

Collazos, C. A., González, C. S., & Gutierrez, F. (2014). *Patterns for monitoring and evaluating collaborative learning processes in videogames*. LAP Lambert Academic Publishing.

Cussó Segura, X., & Garrabou Segura, R. (2007). La transición nutricional en la España contemporánea: las variaciones en el consumo de pan, patatas y legumbres (1850–2000). *Investigaciones de Historia Económica, 3*(7), 69–100.

Estudio de prevalencia de la obesidad infantil. (2011). Estudio ALADINO (Alimentación, Actividad física, Desarrollo Infantil y Obesidad). *Revista de Pediatría de Atención Primaria, 13*, 493–495.

ExergameFitness.com Retrieved on May 15, 2014 from: http://www.exergamefitness.com/.

Ezzati, M., & Riboli, E. (2013). Behavioral and dietary risk factors for noncommunicable diseases. *The New England Journal of Medicine, 369*, 954–964.

Feliu Rovira, A., París Miró, N., Zaragoza Jordana, M., Ferré Pallás, N., Chiné Segura, M., & Sabench Pereferrer, F. (2013). Eficacia clínica y metabólica de una nueva terapia motivacional (OBEMAT) para el tratamiento de la obesidad en la adolescencia. *Anales de Pediatría (Barc), 78*(3), 157–166.

Fleiss, J. L., & Cohen, J. (1973). The equivalence of weighted kappa and the intraclass correlation coefficient as measures of reliability. *Educactional and Psuchological Measurement, 33*, 613–619.

González Cabriles, W. J. (2013). Aspectos socioeconómicos y familiares asociados en niños y adolescentes obesos. *Revista de Ciencias Sociales (Ve), 19*(1), 120–130.

González Jiménez, E., Aguilar Cordero, M. J., García García, C. J., García López, P., Álvarez Ferre, J., & Padilla López, C. A. (2012). Influencia del entorno familiar en el desarrollo del sobrepeso y la obesidad en una población de escolares de Granada (España). *Nutrición Hospitalaria, 27*(1), 177–184.

González Marqués, J., Fernández Guinea, S., Pérez Hdez, E., & Santamaría, P. (2004). Sistema de evaluación de la conducta en niños y adolescentes. In de C. R. Reynolds, & R. W. Kamphaus (Eds.), *Manual. Adaptación española del BASC*. Madrid: TEA.

González, C. S., & Navarro, V. (2015a). A structural theoretical framework based on motor play to categorize and analyze active video games. *Games and Culture*. http://dx.doi.org/10.1177/1555412015576613, 1555412015576613, first published on March 26, 2015.

González, C. S., & Navarro, V. (2015b). Métodos y técnicas para la evaluación de la experiencia emocional de niños y niñas con videojuegos activos. In *XVI Congreso Internacional INTERACCIÓN 2015. Vilanova i la Geltru. Spain*.

González González, C. S., Navarro, Adelantado, V., & Cairos, M. (2013b). EMODIANA: un instrumento para la evaluación subjetiva de emociones en niños y niñas. In *Proccedings of Interacción 2013. Madrid, España*.

González González, C. S., Toledo Delgado, P., Padrón, M., Santos, E., & Cairos, M. (2013a). Including gamification techniques in the design of TANGO: H platform. *Jurnal Teknologi, 63*(3), 77–84.

González González, C. S., Toledo, P., Collazos, C., & González, J. L. M. (2014). Design and analysis of collaborative interactions in social educational videogames. *Computers and Human Behavior, 31*, 602–611. February, 2014.

Hourcade, J. P. (2015). *Child computer interaction* (1st ed.) Retrieved on 01 July from: http://homepage.cs.uiowa.edu/~hourcade/book/child-computer-interaction-first-edition.pdf.

Hsin-Yuan Huang, W., & Soman, D. (2013). *A practitioner's guide to gamification of education*. Research Report Series Behavioural Economics in Action. Rotman School of Management. University of Toronto, 10 December, 2013..

Ibrahim, A., Gutiérrez-Vela, F., González-Sánchez, J. L., & Padilla-Zea, N. (2012). Educational playability. Analyzing player experiences in educational video games. In *Proceedings of ACHI 2012: The fifth international conference on advances in computer-human interactions* (pp. 326–335).

Jiménez, M. (2006). Cuando barbie se come a Garfield. Publicidad y alimentación: niños obesos buscando la perfección del cuerpo adulto. *Trastornos de la Conducta Alimentaria, 3*, 245–263.

Kain, J., Uauy, R., Leyton, B., Cerda, R., Olivares, S., & Vio, F. (2008). Efectividad de una intervención en educación alimentaria y actividad física para prevenir obesidad en escolares de la ciudad de Casablanca, Chile (2003-2004). *Revista Médica de Chile, 136*, 22–30.

Klünder-Klünder, M., Cruz, M., Medina-Bravo, P., & Flores-Huerta, P. (2011). Padres con sobrepeso y obesidad y el riesgo de que sus hijos desarrollen obesidad y aumento en los valores de la presión arterial. *Boletin Medico del Hospital Infantil de Mexico, 68*(6), 438–446.

Lanningham-Foster, L., Foster, R. C., McCrady, S. K., Jensen, T. B., Mitre, N., & Levine, J. A. (2009). Activity-promoting videogames and increased energy expenditure. *Journal of Pediatrics, 154*(6), 819–823.

Lanningham-Foster, L., Jensen, T. B., Foster, R. C., Redmond, A. B., Walker, B. A., & Heinz, D. (2006). Energy expenditure of sedentary screen time compared with active screen time for children. *Pediatrics, 118*(6), 1831–1835.

Llargués, E., Franco, R., Recasens, A., Nadal, A., Vila, M., & José Pérez, M. (2009). Estado ponderal, hábitos alimentarios y de actividad física en escolares de primer curso de educación primaria: estudio AVall. *Endocrinología y Nutrición, 56*(6), 287–292.

Llargués, E., Recasens, A., Franco, R., Nadal, A., Vila, M., & Pérez, M. J. (2012). Evaluación a medio plazo de una intervención educativa en hábitos alimentarios y de actividad física en escolares: estudio Avall 2. *Endocrinología y Nutrición, 59*(5), 288–295.

Lund, H. H., Klitbo, T., & Jessen, C. (2005). Playware technology for physically activating play. *Artificial Life and Robotics, 9*(4), 165–174.

Maddison, R., Mhurchu, C. N., Jull, A., Jiang, Y., Prapavessis, H., & Rodgers, A. (2007). Energy expended playing video console games: an opportunity to increase children's physical activity? *Pediatric Exercise Science, 19*(3), 334–343.

Magielse, R., & Markopoulos, P. (2009). HeartBeat: an outdoor pervasive game for children. In *Proceedings of the SIGCHI conference on human factors in computing systems (CHI '09)* (pp. 2181–2184). New York, NY, USA: ACM.

Martínez Costa, C., & Pedrón Giner, C. (2002). Valoración del estado nutricional. In AEP (Ed.), *Tomo 5. Gastroenterología, Hepatología y Nutrición, Protocolos diagnóstico-terapéuticos en Pediatría* (pp. 313–318). Madrid: AEP.

Mellecker, R. R., & McManus, A. M. (2008). Energy expenditure and cardiovascular responses to seated and active gaming in children. *Archives of Pediatrics & Adolescent Medicine, 162*(9), 886–891.

Menendez García, R. A., & Francisco Diez, F. J. (2009). Publicidad y alimentación: influencia de los anuncios gráficos en las pautas alimentarias de infancia y adolescencia. *Nutrición Hospitalaria, 24*(3), 318–325.

Molina Puche, M., & García Sola, F. J. (2011). Tratamiento de la obesidad desde el área de Educación Física. *Revista Digital Buenos Aires, 16*(156).

Muñoz, F. (2000). Influencia de los programas de Televisión en la salud y el comportamiento de los niños y adolescentes. In C. García-Caballero, & A. González-Meneses (Eds.), *Tratado de Pediatría Social* (2ª de, pp. 689–694). Madrid: Ediciones, Diaz de Santos.

Padilla, N., Collazos, C. A., Gutierrez, F., & Medina, N. (2012). Videojuegos educativos: teorías y propuestas para el aprendizaje en grupo. *Ciencia e Ingeniería Neogranadina, 22–1*, 139–150 (Bogotá).

Parlebas, P. (2001). *Juego, deporte y sociedad. Léxico de praxiología motriz*. Barcelona: Paidotribo.

Planas Juan, T., Moreo Mir, I., Vidal Thomàs, C., Perello Beau, M., MirallesXamena, J., & Pérez Mariano, D. M. (2012). Hábitos de alimentación y actividad física en un instituto de Educación Secundaria secundaria de Baleares. *Enfermería Clínica, 22*(3), 144–147.

Rodríguez Martín, A., Novalbos Ruiz, J. P., Villagran Pérez, S., Martínez Nieto, J. M., & Lechuga Campoy, J. L. (2012). La percepción del sobrepeso y la obesidad infantil por parte de los progenitores. *Revista Española de Salud Pública, 86*(5), 483–494.

Roman, V., & Quintana, M. (2010). Nivel de influencia de los medios de comunicación sobre la alimentación saludable en adolescentes de colegios públicos de un distrito de Lima. *Anales de la Facultad de Medicina, 71*(3), 185–190.

Roset Salla, M., Ramón Cabot, J., Salabarnada Torras, J., Ferrer Romà A,Bernal de Barbara, S., & Jiménez Pascua, T. (2011). Formar en nutrición a padres de niños de un año de edad. Estudio Enim Mataró, ¿podemos proporcionar buenos hábitos desde el inicio?. X Congreso Nacional de la SEEDO. *Revista Española de Obesidad, 9*(2), 95.

Salinas, J., González, C. G., Fretes, G., Montenegro, E., & Vio, F. (2014). Bases teóricas y metodológicas para un programa de educación en alimentación saludable en escuelas. *Revista Chilena de Nutrición, 41*(4), 343–350.

Sánchez López, A. M., Aguilar Cordero, M. J., González Jiménez, E., Padilla López, C. A., Álvarez Ferre, J., & Ocete Hita, E. (2011). La Obesidad como factor pronóstico de la falta de motivación en el niño y en el adolescente. X Congreso Nacional de la SEEDO. *Revista Española de la Obesidad, 9*(2), 99.

Seitinger, S. (2009). Designing for spatial competence. In *Proceedings of the 8th international conference on interaction design and children (IDC '09)* (pp. 123–130). New York, NY, USA: ACM.

Serra Majem, L., Ribas Barba, L., Aranceta Bartrina, J., Pérez Rodrigo, C., Saavedra Santana, P., & Peña Quintana, L. (2003). Obesidad infantil y juvenil en España. Resultados del Estudio enKid (1998–2000). *Medicina Clínica (Barc), 121*, 725–732.

Serra-Majem, L., Ribas, L., Ngo, J., Ortega, R. M., García, A., & Pérez-Rodrigo, C. (2004). Food, youth and the mediterranean diet in Spain. Development of KIDMED, mediterranean diet quality index in children and adolescents. *Public Health Nutrition, 7*, 931–935.

Spanish Agency for Food Safety. (2005). Estrategia NAOS. Estrategia para la nutrición, actividad física y prevención de la obesidad. *Invertir la Tendencia de la Obesidad*. Retrieved on May 15, 2014 from: http://www.naos.aesan.msssi.gob.es/naos/ficheros/estrategia/estrategianaos.pdf.

Spanish Agency for Food Safety and Nutrition. (2008). *Subdirección General de Coordinación Científica. Guía para una escuela activa y saludable. Orientación para los Centros de Educación Primaria. Programa piloto Perseo*. Ministerio de Sanidad y Consumo. Retrieved on May 15, 2014 from: http://www.perseo.aesan.msps.es/docs/docs/guias/escuela_activa.pdf.

Spanish Ministery of Health. Encuesta Nacional de Salud de España 2006 y 2011/12. Retrieved on May 15, 2014 from: http://www.msssi.gob.es/estadEstudios/estadisticas/encuestaNacional/home.htm.

Spanish Society for the Obesity Study. (2013). *La obesidad ahora si una enfermedad de peso*. Retrieved on May 15, 2014 from: http://www.seedo.es/index.php/la-obesidad-ahora-si-una-enfermedad-de-peso.

Sturm, J., Bekker, T., Groenendaal, B., Wesselink, R., & Eggen, B. (2008). Key issues for the successful design of an intelligent, interactive playground. In *Proceedings of the 7th international conference on interaction design and children (IDC '08)* (pp. 258–265). New York, NY, USA: ACM.

Tan, B., Aziz, A. R., Chua, K., & Teh, K. C. (2002). Aerobic demands of the dance simulation game. *International Journal of Sports Medicine, 23*(2), 125–129.

Wetzsleon, R. J., Swanson, K. S., & Pickett, K. (2008). Energy expenditure and ground reaction forces of an active video game, dance dance Revolution, in healthy weight and overweight children. *Medicine and Science in Sports and Exercise, 40*(5), S255.

Working Group of the CPG for Prevention and Treatment of Child and Adolescent Obesity. (2009). *Guía de Práctica Clínica sobre la Prevención y el Tratamiento de la Obesidad Infantojuvenil de 2009*. Madrid: Ministerio de Sanidad y Política Social.

World Gastroenterology Organization. (2011). Guía Mundiales de la Organización Mundial de Gastroenterología. *Obesidad*. Retrieved on May 15, 2014 from: http://www.worldgastroenterology.org/assets/export/userfiles/Obesity_MASTER_SP.pdf.

World Health Organization. (2003). *Dieta, nutrición y prevención de las enfermedades crónicas. Ginebra*. Informe de una consulta de expertos conjunta FAO/OMS. Informes Técnicos OMS núm. 916.

World Health Organization. (2004). *Estrategia mundial sobre régimen alimentario, actividad y salud de la 57ª Asamblea Mundial de la Salud*. Resolución WHO_57.17. Retrieved on May 15, 2014 from: http://www.who.int/dietphysicalactivity/strategy/eb11344/strategy_spanish_web.pdf.

World Health Organization. (2011). *Recomendaciones sobre la promoción de alimentos y bebidas no alcohólicas dirigida a los niños*. Retrieved on May 15, 2014 from: http://www.who.int/dietphysicalactivity/publications/recsmarketing/es/.

World Health Organization. (2014). *Obesidad y sobrepeso*. Retrieved on May 15, 2014 from: http://www.who.int/mediacentre/factsheets/fs311/es/.