

RESEARCH

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**VIDEO GAME BASED ON THE *GAME-BASED LEARNING*  
METHODOLOGY AS A MEANS OF COMMUNICATION FOR THE  
FORMATION OF EATING HABITS IN CHILDREN WITH CELIAC  
DISEASE**

**JUEGO DE VÍDEO A PARTIR DE LA METODOLOGÍA *GAME-BASED*  
*LEARNING* COMO MEDIO DE COMUNICACIÓN PARA LA  
FORMACIÓN DE HÁBITOS ALIMENTARIOS EN NIÑOS CON  
ENFERMEDAD CELÍACA**

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**ABSTRACT**

This study proposes the design of a video game based on the game-based learning methodology as a means of communication to facilitate the formation of healthy eating habits in children with a diagnosis of Celiac Disease (CD). The need arises from what is observed in the professional practice in the nutrition consultation, where mothers of celiac patients express as their main concern the fact that the child, exposed to various social and academic activities, in which they are not necessarily with their company, be able to comply with the gluten-free diet, the only treatment for CD. The research is based on the concept and clinical manifestations of CD, the use of games as a teaching resource (game-based learning), and the theoretical vision of the constructivist paradigm of learning. Due to its characteristics, this research is congruent with the Feasible Project, at a descriptive level and is supported by documentary research using the analysis technique and the documentary record as an instrument for obtaining information. It was developed in two phases, a preparatory

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phase where the necessary documentary information was obtained to fulfill the proposed objectives and a design phase that consisted of the development of the instructional components of the video game and the approach to a prototype. The video game designed is then an educational game (serious game) called El Mundo de Celia, which consists of a world in the form of a board, composed of three levels, where the participant must overcome nine challenges in total, and by practicing the game, you can achieve a greater understanding of the disease and finally apply this knowledge in daily life, achieving the consolidation of healthy eating habits adapted to the celiac condition that allow you to improve your health.

**KEYWORDS:** Celiac disease - Game-based learning - educational video games - serious games - game-based learning – communication.

## RESUMEN

En este estudio se propone el diseño de un videojuego basado en la metodología *game-based learning* como medio de comunicación para facilitar la formación de hábitos alimentarios saludables en niños con diagnóstico de Enfermedad Celiaca (EC). La necesidad surge de lo observado en la práctica profesional en la consulta de nutrición, donde madres de pacientes celíacos manifiestan como preocupación principal el hecho de que el niño, expuesto a diversas actividades sociales y académicas, en la cuales no necesariamente se encuentra con su compañía, sea capaz de cumplir la dieta libre de gluten, único tratamiento para la EC. La investigación se fundamenta en el concepto y manifestaciones clínicas de la EC, el uso del juego como recurso para la enseñanza (*game-based learning*), y la visión teórica del paradigma constructivista del aprendizaje. Por sus características, esta investigación resulta congruente con el Proyecto Factible, en un nivel descriptivo y se apoya en la investigación documental utilizando la técnica de análisis y el registro documental como instrumento para la obtención de información. Se desarrolló en dos fases, una fase preparatoria donde se obtuvo la información documental necesaria para el cumplimiento de los objetivos propuestos y una fase de diseño que consistió en el desarrollo de los componentes instruccionales del videojuego y la aproximación a un prototipo. El videojuego diseñado es entonces un juego educativo (*serious game*) llamado El Mundo de Celia, que se compone de un mundo en forma de tablero, compuesto por tres niveles, donde el participante debe superar nueve retos en total, y mediante la práctica del juego, puede lograr una mayor comprensión de la enfermedad y finalmente aplicar estos conocimientos en la vida diaria logrando la consolidación de hábitos alimentarios saludables adaptados a la condición celiaca que permitan mejorar su estado de salud.

**PALABRAS CLAVE:** Enfermedad Celiaca - *Game-based learning* - videojuegos educativos - *serious games* - aprendizaje basado en juegos – comunicación.

## **VIDEOGAME A PARTIR DA METODOLOGIA *GAME-BASED LEARNING* COMO FORMA DE COMUNICAÇÃO PARA A FORMAÇÃO DE HÁBITOS ALIMENTARES PARA CRIANÇAS COM DOENÇA CELÍACA**

### **RESUMO**

Neste estudo se propõe a criação de um videogame baseado na metodologia *game-based learning* como forma de comunicação para facilitar a formação de hábitos alimentares saudáveis em crianças com diagnóstico de doença Celíaca (DC). A necessidade surge do observado na prática profissional na consulta de nutrição, onde mães de pacientes celíacos manifestam como preocupação principal o fato de que a criança, exposta a diversas atividades sociais e acadêmicas, nas quais não necessariamente se encontra na sua companhia, seja capaz de cumprir a dieta livre de glúten, único tratamento para a DC. A pesquisa se fundamenta no conceito e manifestações clínicas da DC, o uso do jogo como recurso para o ensino (*game-based learning*), e a visão teórica do paradigma construtivista do aprendizado. Pelas suas características, esta pesquisa resulta congruente com o Projeto viável, em um nível descritivo e se apoia na pesquisa documental usando a técnica de análise e registro documental como instrumento para a obtenção de informação. Foi feita em duas fases, uma fase preparatória onde se obteve a informação documental necessária para o cumprimento dos objetivos propostos e uma fase de design que consistiu no desenvolvimento dos componentes instrucionais do videogame e a aproximação para um protótipo. O videogame projetado é então educativo (*serious game*) chamado El Mundo de Celia, que está composto por um mundo em forma de tabuleiro, composto por três níveis, onde o participante deve superar nove desafios no total, e mediante a prática do jogo, pode se obter uma maior compreensão da doença e finalmente aplicar estes conhecimentos na vida diária alcançando a consolidação de hábitos alimentares saudáveis adaptados a condição celíaca que permitam melhorar seu estado de saúde.

**PALAVRAS CHAVE:** *Doença Celíaca - Game-based learning - videogames educativos - serious games - aprendizado baseado em jogos – comunicação.*

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## **1. INTRODUCTION**

Celiac Disease (CD), is a condition in which the individual's immune system identifies gluten as an antigen (a substance foreign to the body), specifically gliadin found in wheat and other related proteins present in cereals such as: barley, rye and, to a lesser extent, in oats; triggering an immune reaction in people with a genetic predisposition, causing a series of symptoms that start from damage to the intestinal villi that results in a defect in the absorption of nutrients in the digestive tract (Fabiano, F., Lista, D. , Torres, J., and Urquiola, A., 2013, p. 204, and Ministry of Health of Argentina, 2014, p. 5).

The only effective treatment for this condition is to remove this "antigen" from the diet, that is, the patient must have a gluten-free diet throughout their life, the earlier the appropriate eating plan is started, the faster it will be the recovery of the intestinal mucosa and the disappearance of the symptoms.

In the nutritional consultation, one of the concerns most expressed by the mothers of these children is adherence to treatment. When the child is young, their diet depends on the mother or the adult who is responsible for their upbringing, but as they grow up they become more independent and their social circle widens. This change, in most cases, includes the possibility that the child is exposed, being without the adult, to the presence of foods that can cause harm, and then supposes a deep understanding of their condition and treatment. , which allows them to develop the necessary will to refrain from consuming these foods that trigger symptoms again. Added to this is the fact that the literature records adherence to a gluten-free diet that vaguely reaches 45% of the cases of children (Amigo cited in Aznar, 2009, Bravo and Paz, 2011), where approximately 70% of the cases find the diet difficult to follow and more than 40% do not know what to eat. (Bravo and Paz, 2011)

Currently, there is a large amount of information available on the Internet about this condition. Different resources have been used such as children's stories about the disease and some recreational resources. However, these types of resources have been made thinking especially of that child who still depends on their mother.

In recent years, technology has been gaining ground as a facilitator of the teaching and learning process and communication mediator, and in that range of technological tools that are currently available are video games. Playing is a natural activity of the human being and through play, social and cognitive skills are developed and learning is motivated (Perrota et al; Kenny and MacDaniel; Kirriemuir and McFarlane; Higgins et al, cited in Contreras, 2016).

With this, the question arises, in what way can a video game facilitate the teaching of content associated with celiac disease, promoting, in the child, the formation of eating habits appropriate to that condition?

## **2. OBJECTIVES**

Based on the situation, it is established that the general objective that guided this study was to design a video game based on the game-based learning methodology to facilitate the formation of appropriate eating habits in children diagnosed with Celiac Disease. To achieve the general objective, the following specific objectives were conceived:

- Define the aspects of the game-based learning methodology to be developed in the video game.
- Characterize the nutritional profile of the child between 7 and 10 years old, diagnosed with celiac disease.
- Establish the body of recommendations according to the nutritional profile of a child between 7 and 10 years old, diagnosed with celiac disease.
- Develop the instructional components that make up the video game.
- Outline the design of the video game based on the instructional components developed.

### **3. METHODOLOGY**

As specified by the Libertador Experimental Pedagogical University (UPEL) (2016):

The Feasible Project consists of the research, elaboration, and development of a proposal for a viable operating model to solve problems, requirements, or needs of organizations or social groups; It can refer to the formulation of policies, programs, technologies, methods, or processes. (p. 21)

According to this definition, this research responds to the aforementioned characteristics since it aims to provide a solution to the need detected through the design of a video game as a communication medium based on the game-based learning methodology to facilitate the formation of adequate eating habits in children from 7 to 10 years of age with a diagnosis of Celiac Disease. Likewise, it is located at a descriptive level and is supported by documentary research using the analysis technique and the documentary record as an instrument to obtain information.

To fulfill the general objective of this investigation, the procedure carried out could be divided into two phases:

- Preparatory phase: comprised of the contextualization of the study topic and the documentary review that allowed the consolidation of the theoretical framework where the contents are established, as well as the strategies and methods to be used in the design of the video game proposed from the instructional point of view, taking into account the aspects related to the game-based learning approach and the components that must integrate the game in order to be classified as a «video game».

The analysis of the collected information made it possible to establish an approximation to the nutritional profile of the child with CD, as well as a body of recommendations for the healthy diet of this type of patient. Likewise, it allowed us to outline the activities that would be included for the fulfillment of the learning objectives of the video game.

- Design phase: made up of the development of the proposed instructional design for the video game where its purpose is contemplated as well as the learning objectives that users are expected to achieve, the strategies and methods to be applied, and finally, the activities they must overcome in order to achieve the proposed objectives. In this phase, some of the graphic components suggested for the game were selected, as well as a programming language to achieve an approximation to a functional prototype that would allow the reader to visualize, at least partially, the materialized final product.

To develop the instructional design, an adaptation of the design model proposed by Prof. Joel Aguilar, professor at the Metropolitan University and the Simón Bolívar University (Caracas, Venezuela) with extensive experience in the area of instructional design, was carried out. According to this model, the instructional design is made up of a series of preliminary components (justification, need, context, and purpose), essentials (expressions of achievement, content structure, and evaluation strategies), and specifics (strategies, methods, techniques, resources, and execution criteria), all of these can be reformulated, modifiable and even merged; This plasticity of the model and its versatility were decisive in the selection.

In this phase, the outline of the game was also made starting from its instructional components and the programming of one of the activities using the Scratch language. The second activity or challenge that would be contained in Level 2 of the game was selected for this.

The aspects related to the development of the proposal, emphasizing the instructional design where the purpose, the learning objectives, the contents are found, as well as the activities designed for the proposed video game and finally the approach to the game prototype is described in the section below.

## **4. RESULTS**

The proposed design from the instructional point of view is presented below for a video game that works as an ally in the formation of adequate eating habits for children with a diagnosis of Celiac Disease. Likewise, reference is made to the aspects related to an approach to the game prototype based on its instructional components.

### **4.1. Instructional design of the video game**

#### **4.1.1. Justification**

Celiac Disease (CD) is an autoimmune disease that develops in genetically susceptible people in which the individual's immune system identifies as an antigen a group of proteins called prolamines, which includes gluten, that can be found in various cereals such as : wheat, barley, rye and to a lesser extent in oats. (Fabiano, Lista, Torres and Urquiola, 2013, p. 204, and Ministry of Health of Argentina, 2014, p. 5)

The problem with this reaction is that the action of the immune system results in damage to the gastric mucosa of the patient that progressively prevents the absorption of nutrients, a fact that manifests itself with gastrointestinal symptoms (in cases of the

classic form of the disease) and the compromise of nutritional status with delayed growth and development of the patient. (Polanco and Ribes, 2010, Fabiano, Lista, Torres and, Urquiola, 2013, and Ministry of Health of Argentina, 2014)

Therefore, the only possible treatment to reverse this condition is to eliminate from the diet all those foods and products in general (such as medications) that contain prolamines. There is no pharmacological treatment. (Polanco and Ribes, 2010, and Fabiano, Lista, Torres, and Urquiola, 2013) For this reason, it is vitally important for celiac patients to develop a deep understanding of their disease and treatment in order to achieve recovery.

In this sense, having a tool that allows, in simple language, to provide the patient with information about the disease and its treatment is very useful.

#### **4.1.2. Instructional need**

When cases of children diagnosed with Celiac Disease arrive at the nutrition consultation, one of the concerns expressed by mothers most frequently is the uncertainty about whether the child will be able to comply with the diet in the absence of the mother, taking into account the social pressure to which they may be exposed at times inherent in their academic and social activities. This fact depends to a large extent on whether the patient has understood in the deepest possible way what his/her disease is about, how the treatment is complied with, and what are the consequences of non-compliance. Therefore, from the moment of diagnosis, the child must be provided with sufficient information about their condition.

In the case of children, it is very important that the information is presented according to the cognitive development that they have reached in accordance with their age. For this, using technological tools is a smart decision since they allow the transmission of information by adapting the language and strategies used for it, since it motivates the learner, in this case, the patient, to want to learn.

#### **4.1.3. Context of the instruction**

It is an educational video game aimed at children aged 7 to 10 years old with a diagnosis of Celiac Disease who have prior knowledge of their condition.

#### **4.1.4. Purpose**

Share a compendium of knowledge that allows the participant to recognize the characteristics of celiac disease and its treatment, and based on this, propose a plan of healthy habits adapted to their condition expressed by complying with a gluten-free diet with based on basic criteria acquired as you overcome the various challenges of the game.

#### **4.1.5. General objective**

Recognize the characteristics of celiac disease and its treatment, as the different challenges presented in the game are overcome, to apply this knowledge in daily life, achieving the consolidation of healthy eating habits adapted to the celiac condition that allows to improve the health status of the participant.

#### **4.1.6. Learning objectives**

- Develop a platform of concepts related to the area of knowledge.
- Apply the conceptual and theoretical framework to recognize the characteristics of celiac disease and its treatment.
- Characterize the components of a healthy diet adapted to the celiac condition.

#### **4.1.7. Selected contents**

Because CD is a condition in which the patient's immune system reacts to the presence of gluten contained in the food they eat and this reaction causes damage to the gastric mucosa that deteriorates their health, in the absence of pharmacological treatment, the only possible and effective treatment is precisely a change in diet that consists of the removal of all that food that contains gluten and any other nutrient that may exacerbate or cause symptoms to appear, depending on the severity of the damage.

For this reason, the contents selected to be approached through the use of the game, focus on information about what the disease is, what causes it, and how it can be improved. These contents are presented in the table below (see Figure 1)

**Table 1.** *Suggested content for the video game.*

<b>Level</b>	<b>Content</b>
Level 1	1. Definition of Celiac Disease. 2. Classification of Celiac Disease. 3. Most common symptoms of Celiac Disease.
Level 2	4. Gluten as a trigger for symptoms. 5. Foods that contain gluten. 6. Recognition of commercial foods with gluten.
Level 3	7. What is the gluten-free diet. 8. Learn what foods are allowed, risky, and not allowed 9. Treatment goals and notions about healthy eating adapted to celiac disease.

**Source:** self-elaboration

#### **4.1.8. Assessment strategies**

Due to the fact that it is the design of a video game, the challenges that the player overcomes represent a formative evaluation, with each challenge overcome yielding a message, different in each case, to reinforce knowledge.



Likewise, overcoming all the challenges together will yield a score that allows the player to go to the next level, with the globality of the activities being a summative evaluation. In Figure 2 you can see the activities that the participants must carry out.

**Table 2.** *Evaluation activities that will make up the challenges of the game.*

Level	Activity	Description	Content addressed	Reward
1	Catch the words that relate to the definition and types of celiac disease.	In this activity, the participant must make the main character collect the words that are related to the definition of CE previously given in a box that appears on the screen and avoid those that are not related.	1,2	Score
	Skip the cubes identified with pictures that reflect symptoms of CD.	In this activity, the participant must manage to dodge by jumping those cubes that appear on the road identified with images that reflect symptoms of CD.	3	Score
2	Choose the molecules identified with the word gluten and remove them so that they do not reach the intestine.	A graphic representation of the stomach is shown receiving different nutrients and molecules connected to the intestine. The participant must take those identified as "gluten" and remove them so that they do not reach the intestine.	4	Score
	Help Celia make breakfast with foods that do not contain gluten.	A fridge full of food is displayed on the screen. The participant must select those that do not contain gluten to make their breakfast.	5	Score
	Select foods identified as gluten-free to help Celia fill her grocery cart. Remember to avoid reaching the end of the tour with some unwanted food.	A scene is shown on the screen where the avatar walks through a supermarket. The participant must select and place in the cart foods labeled as gluten-free. Similarly, in this challenge, a character appears who, without the main character noticing, introduces inappropriate	6	Score

3	Leave in the trunk the words or images related to what is the Gluten-Free Diet (GLD).	<p>food into the cart. The participant must be attentive and take them out before reaching the end of the tour.</p> <p>For this activity, a trunk full of words and images appears on the screen. The participant must make the main avatar extract from the trunk all those words that are not related to what the DLG is and leave only those that are.</p>	7	
	Organize the food by placing it in the basket to which it belongs.	<p>For this activity, the main avatar has three baskets identified with the phrases: "eat", "not eat" and "risky". The participant must get Celia to organize the foods presented in the correct baskets.</p>	8	Score
	<p>Drive each of the tracks to achieve each of the goals of celiac disease treatment. Remember to avoid those foods that are an obstacle for you to have habits that keep you healthy.</p>	<p>In this activity, the protagonist avatar must drive through three race tracks, which increase in complexity, in order to achieve each of the main goals of CD treatment. Unhealthy foods will appear along the way that the participant must avoid in order to continue and reach the goal.</p>	9	Score

**Source:** self-elaboration

#### 4.1.9. Learning strategies and methods

The strategy used is Game-based learning that consists of the integration of real games in the learning process, usually to teach specific skills or achieve a specific objective (Israel, 2017, p. 3). The GBL relies on the use of the game as a mediator for the better understanding of content, which is immersed in the game, or the development of specific skills.

The factors that are stimulated in the participant by the video game and that make the learning process effective are: motivation, concentration, attention, and emotion (McFarlane, Sparrowhawk and Heald; Malone and Lepper; and Keller and Kopp cited in Padilla, González, Gutiérrez, Cabrera and Paderewski, 2009)

Through the game screens, demonstration scenes will be used, which will allow the participant to understand the concepts presented through the presentation of situations and examples related to the disease.

#### 4.2. OUTLINE OF THE GAME BASED ON THE INSTRUCTIONAL COMPONENTS

It is suggested as a name for the video game «El Mundo de Celia», using «Celia» as a name for the character who performs the actions refers to the term «Celiaquía» which is the condition that is addressed with the game. Likewise, the names of the rest of the characters are associated both with the condition and with the specialists involved in its treatment.

The game consists of three characters:

- Celia: is the central character with whom the participant plays, communicates, and develops most of the actions.
- Dr. Glutenfree: he is a narrator who appears at the beginning of the game and during the development of the challenges that are related to the definition and symptoms of the disease, to give feedback and assign scores.
- Nutrigirl: is a narrator who appears at the beginning of the game and during the development of the challenges that are directly related to eating, to give feedback and assign scores.

Based on the proposal of Padilla, González, Gutiérrez, Cabrera, and Paderewski (2008) for the design of this educational game, a structure is suggested according to the structuring of the selected contents. Thus, we start from the concept of «World» which corresponds to the interface, the place where the actions take place. In the world, a didactic unit is taught. In turn, the World is made up of "Levels" in which the conceptual and procedural contents for the assimilation of concepts are covered. Finally, each Level is made up of «Challenges» or tests to be carried out that correspond to the activities at the time of instruction. An example of this equivalence is shown in Figure 3.

**Table 3.** *Example of correspondence between the structure of the game and elements of the teaching process.*

<b>Playful aspect</b>	<b>Factor in the Teaching process</b>	<b>Example</b>
World	Didactic unit	Celiac Disease
Level	Conceptual and / or procedural content	Gluten-free diet / Recognition of gluten-free foods.
Challenge	Activity	Get Celia to eat only gluten-free foods.

**Source:** self-elaboration

In the particular case of "Celia's World", the World, is made up of three Levels. Level 1 covers the contents corresponding to the concept of Celiac Disease, its definition and, some attributes such as symptoms and classification of the disease. Level 2 covers the concept of gluten as a trigger for CD, and attributes of this concept such as foods that contain gluten and the recognition of commercial foods that also contain it through the use of labeling symbology. Finally, level 3 covers conceptual content such as "Gluten-free diet" through its definition, as well as procedural content such as the recognition of allowed, not allowed, and risky foods and foods that fall within a healthy diet adapted to the celiac patient.

The objective of the game is to ensure that Celia, the main character avatar of the game, remains in excellent health throughout all the games by overcoming each challenge. At the start of the game, Celia has three lives that she can lose and regain. Lives are lost when the challenge is not completed with the required number of points and are recovered with a specific amount of points obtained by overcoming the challenges. The definitions of the concepts are given by Celia and the narrators in the introduction of the game and reinforced by the narrators during the development of each level.

It is very important that the scheduling of activities starts from a bank of elements. For example, if the activity consists of collecting words associated with a concept, the programming must have a bank of words both associated and not associated, with sufficient quantity, so that different words appear randomly in each game, thus avoiding the activation of rote knowledge.

The game starts with the main screen where the participant can select if they want to read or listen to Celia's story. Once the selection has been made, on the second screen, through the use of interactive text balloons, graphics (which are present regardless of the option selected) and sound (which appears only when the participant selects the "listen" option or when he/she clicks in the text balloon) Celia explains who she is and that she has been diagnosed with the disease. The next screen presents a series of interactive worksheets, and illustrations, with information about what Celiac Disease is and is not and the implications it has for the patient, explained by "Dr. Glutenfree" and "Nutrigirl". Then a screen is shown where Celia, Dr. Glutenfree, and Nutrigirl appear with a series of natural and industrial foods, where it is explained which ones contain gluten, which could be a risk, and which do not contain gluten. Finally, using interactive speech bubbles, Celia takes a count, showing that she has begun to understand how the disease works.

Subsequently, a screen appears where Celia's world is observed as a board with the 3 levels that make it up and that the participant must overcome to reach the end of the game. The levels will be identified with iconography allusive to the contents and connected with a path in which the participant advances when they pass each level.

The first level of the game consists of two challenges. For its part, the second and third levels are made up of three challenges each. To advance to the next, the participant must overcome the previous challenge.

At the beginning of this activity, the character of Dr. Glutenfree appears to give the instructions of the challenge and in the same way, he will continue to appear throughout the development to give reinforcement messages whether the patient is correct or if he makes a mistake. This form of feedback is constant in each of the activities.

The words will appear in a fall, some related and others not, so that the child must select only the correct ones. It is very important to emphasize again that the game must start from a bank of food, words, graphics, images; that allows each game to be different from the previous one, which means that the correct and incorrect words will not always be the same in order to prevent rote learning.

At the beginning, as in each activity, one of the characters gives the instructions and accompanies the development of the game, in the particular case of this activity, this role is played by Celia, the main avatar of the game.

### **4.3. APPROACH TO THE PROTOTYPE**

In order to demonstrate the feasibility of the proposal, the approach to a functional prototype was proposed by coding in programming language one of the activities proposed for the game in its instructional design.

#### **4.3.1. Selection of the tool to approach the prototype**

To approach the prototype of the video game, different programming tools were reviewed. From this review, Scratch was finally selected as a tool for this purpose.

Scratch is a visual programming language based on blocks "unlike other programming languages such as python, php, among others, which need to be written in symbols or codes, in Scratch we only have to drag and join blocks." (Academy Pop, 2019) In this way, ideas are expressed to develop interactive stories, games, and animations. Scratch also functions as an "online community where children can program and share interactive media... with people from all over the world" (Scratch, 2019)

The main reasons why this tool was selected after reviewing it were:

- Is free.
- It is easy to use.
- Allows the inclusion of all the elements that are part of a video game.
- It allows the development of the activities included in the instructional design of the video game proposed in this research.
- It is a language that can be easily modified in such a way that it allows the periodic updating and improvement of the game.

For this first phase, a single activity designed for the game was developed. The activity corresponds to the second challenge of Level 2 of the game, with which the fifth content would be addressed. It is very important to remember that at the time of this

activity the participant has received a quantity of information both in the introduction and in previous activities, which facilitates the overcoming of this challenge.

In this case, a standing version of the avatar is used as the narrator that represents Nutrigirl, who is in charge of giving the instructions of the game, at the beginning of the game, verbally and in writing. Communication occurs through text balloons with part of the instructions that the participant receives.

Scratch has a section called "Study" where the programmer can group different projects related to each other. So, with this tool, in the first instance, the different activities and contents of the entire game could be programmed, which would rest in the same Studio titled in the same way as the video game. However, the way it is designed from the instructional point of view makes it important to have a sequence in the resolution of the different activities or challenges. For this reason, it is important to design the game as a single block, where it is necessary to pass the first level to move on to the second, and so on. In this sense, by reviewing different Scratch forums it was found that some programmers suggested, for this purpose, trying to encode an intermediary software, in some other programming language (such as Python, for example), which allows the connection of Scratch with a database, so that the player's progress can be saved; this would form a phase following the implementation of this research (Technoguyx, 2009 and Monrroy, 2009).

## **5. CONCLUSIONS**

Direct observation of patients in the consultation is a situation that definitely raises awareness. Each case is particular, different. However, when it comes to patients with chronic diseases, which by their nature affect all aspects of that patient's life, sensitization occurs more rapidly.

Taking this into account, the branch of health education was selected to link it with technology, specifically with ICT, in the search for a resource that would allow, in some way, to improve the quality of life of this type of patient, and in this case, child patients diagnosed with Celiac Disease.

For this reason, the general objective of this research was "To design a video game based on the game-based learning methodology to facilitate the formation of adequate eating habits in children with a diagnosis of Celiac Disease." In order to achieve this objective, five specific objectives were raised based on the documentary review and the analysis of the information reviewed.

In the first place, the aspects of the game-based learning approach to be developed in the video game were defined, understanding that it is mainly characterized by the use of real games as allies for teaching and learning, whether they already exist and have been adapted for this purpose, or that since their conception have been created based on defined learning objectives (serious games) without losing their playful characteristics in any case. Thus, the most relevant aspects of the GBL to be developed in the video game were precisely the use of the game as a teaching resource and

mediator of the learning process and the conservation of the playful aspect of the game even when, in this particular case, it was conceived starting from previously defined learning objectives.

The second objective proposed was "To characterize the nutritional profile of the child aged 7 to 10, with a diagnosis of Celiac Disease" to achieve this, an investigation of different bibliographic sources and clinical studies were carried out. Understanding that most of the studies do not refer to specific age groups, but rather categorize adults and children in general, the information reviewed was sufficient to understand that the profile of the child diagnosed with this disease before treatment is associated with some of the symptoms of the condition such as: underweight, with muscle hypotrophy and growth retardation, as well as manifestations caused by the specific deficiency of some nutrients, such as iron deficiency anemia.

In contrast, in the treated child, an adequate weight and in some cases overweight will generally be observed, the activation of the growth process, and although some nutrient deficiencies will persist while the mucosal damage is reversed, in general, achieving a feeding balanced, its nutritional condition will be adequate.

The third objective was to establish a body of nutritional recommendations for children with a diagnosis of CD. This was possible based on the "Energy and Nutrient Recommendations for the Venezuelan population", and taking into account the possible nutrient deficiencies that could arise.

The fourth specific objective was the development of the instructional components of the game. In this sense, it is important to highlight that in the instructional design achieved, it was established as a purpose for this video game to share a compendium of knowledge related to celiac disease and its treatment so that the user can recognize the characteristics of the disease and from there, propose the compliance with the gluten-free diet from a broader understanding of the condition. With a clear purpose, it is expected that the game users, as they overcome the different challenges presented, can achieve a greater understanding of the disease and finally apply this knowledge in daily life, achieving the consolidation of healthy eating habits adapted to the condition that improve their health.

A video game was then designed, based on the constructivist paradigm of learning, called "Celia's World", whose board forms a world (which would become the didactic unit) composed of three levels (containing the concepts and procedural knowledge) and each level composed of challenges (made from the activities established in the design). The first level is made up of two challenges that encompass conceptual content and levels 2 and 3 each contain three challenges to overcome that mostly contemplate procedural content.

Finally, the fifth objective consisted of an outline of the game based on the instructional components developed, which was achieved through the diagramming and graphing of some of the game screens, as well as programming, using the Scratch language, of one of the challenges of level 2 of the game in order to leave evidence of its feasibility.

Thus, all the objectives set for this study were satisfactorily achieved, even promoting the approach to a prototype that would allow the concept of the game to be visualized.

In closing, it is pertinent to highlight that the development of this research made clear the importance of teaching in all areas, in this case in the field of health, seeing the patient as a learner. Likewise, the imperative need for new forms of communication and instructional intervention, well planned and correctly grounded from the pedagogical point of view, to achieve learning in patients. These new interventions must be linked to the latest advances in technology, linguistics and with the methodologies that are being applied worldwide, such as the use of video games as mediators and facilitators of the teaching and learning process, so that they are motivating and significant.

## **6. RECOMMENDATIONS**

Based on the experience obtained during the development of this study, the following recommendations are specified:

- Establish alliances with organizations involved with the dissemination of information about Celiac Disease so that with a multidisciplinary team made up of nutritionists, programmers and medical specialists, this resource can be optimally developed.
- For the development of this game, the use of a programming language that allows the connection with databases is recommended because the connection between activities and levels is very important. The activities are prelatory to each other, so it is necessary that if the participant makes a mistake, they can try again starting from the point where they left off and not from the beginning.
- Once the resource has been developed, it is suggested that it be expanded and updated periodically, including new content and activities for the inclusion of new levels that allow a little more depth and reinforce the knowledge obtained, as well as maintaining the playability of the resource, the latter, a crucial feature to keep the player motivated.
- The versatility of the design of this video game allows its extrapolation to other topics within the health field. In this sense, it is recommended to adjust the contents in order to use it as a resource for teaching healthy lifestyle habits that include other aspects in addition to food and that are adapted to the current Venezuelan context.

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