Design and development of a 2D video game
for the improvement of cognitive abilities

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Summary

The project consists on the design and development of a video game which tries to improve the cognitive development, the attention and the memory of children between five and seven years old. *Holidays* is a 2D video game based on pastimes and simple games developed in order to achieve that objective

Throughout this whole document, the complete process of design and development of the video game will be described and explained. This includes the initial technical report, the design of the game, its development and its testing and possible improvements.

Keywords

Educational, cognitive abilities, attention, pastimes.

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Chapter 1: Technical proposal

1. Introduction:

Nowadays we live in a technological world surrounded by tablets and smartphones during our whole day. Almost since their birth, children grow up with technological devices, interact with them and also understand them as quotidians elements of their lives.

As time goes through, schools are getting more and more involved in the technological evolution and trying to implement new tools in the pedagogical methods in order to obtain a greater educational quality and increase the interest of the students. It is proved that the students show a major level of disposition to the learning if some technological support is used during it, providing a less monotonous and traditional learning.

The development of the video game is proposed as a complementary tool in the educational field in order to improve the cognitive development of the students as well as the attention and the memory. In order to achieve that objective, a 2D video game has been developed based on pastimes and simple games, all of them related with a common story that will make the player travel through a family summer holiday. Those pastimes can also be played individually. Some examples of them could be visual discrimination or memory games.

Due to the fact that the game is designed for children between five and seven years, the artistic idea is the use of simple and colorful objects, environments and characters which the children can easily recognise and relate with quotidians aspects and situations of their lives. Also the sonorous aspect is the use of music and sounds that can match with the academic field and also the thematic of the game. In order to reach the most number of people as possible, it will be developed for Windows 10 and Android

2. Related subjects:

Main subjects:

- VJ 1203: Programming I
- VJ 1208: Programming II
- VJ 1227: Game Engines
- VJ 1223: Art of the Videogames
- VJ 1209: 2D Design

Complementary subjects:

- VJ 1236: Techniques of Production and sound Realization
- VJ 1238: Foundations for the Design of Educational Games

3. Objectives of the project:

- Learn how to write a professional technical report
- Provide a motivating learning tool for the children
- Improve the attention, memory and cognitive development of the players
- Promote the use of new technologies as a learning method

4. Planification:

1. Technical proposal (12 hours):
   a. Attendance to the technical proposal classes (8 hours)
   b. Composition of the technical proposal (4 hours)

2. Investigation (8 hours):
   a. Research of the different types of activities to develop (4 hours)
   b. Investigate the aspects and concepts of the game engine used (4 horas)

3. Definition of the different levels (10 hours):
   a. Election of the pastimes (2 hours)
   b. Adaptation and design of the pastimes (8 hours)

4. Creation and development of the story (20 hours):
   a. Creation of the story and the characters (17 hours)
   b. Creation of auxiliary dialogues (3 hours)

5. Art design (110 hours):
   a. Design of the characters (50 hours)
   b. Design of the backgrounds and graphic elements (30 hours)
   c. Design of the different scenes of the game (30 hours)

6. Sound design (10 hours):
   a. Design of the ambience music (6 hours)
   b. Design of the sound effects (4 hours)

7. Programming (115 hours):
   a. Implementation of the games and levels (75 hours)
   b. Implementation of the scenes and the flow chart (30 hours)
   c. Implementation and coherence of the sounds (10 hours)

8. Documentation (15 hours):
   a. Composition of the final report (12 hours)
   b. Composition of the defence (3 hours)

The following table represents the estimated number of hours dedicated for each task, it is divided into eight weeks. The initial planification of the project's development suggests two months of working in order to cover all the features of the game and the 300 hours of work demanded by the VJ 1241: Final Degree Project subject. This distribution is made thinking of the weekends as working days. With this consideration, the planification results in a total of 5 hours/day during 60 days.

TASK	Hours	W1	W2	W3	W4	W5	W6	W7	W8
T1: Technical proposal	12	8	-	-	-	-	-	-	4
T2: Investigation	8	5	2	1	-	-	-	-	-
T3: Definition of the different levels	10	-	5	5	-	-	-	-	-
T4: Creation and development of the story	20	-	10	5	5	-	-	-	-
T5: Art design	110	-	30	25	20	10	15	8	2
T6. Sound design	10	-	-	-	-	2	6	2	-
T7: Programming	115	-	15	25	25	15	20	15	-
T8: Documentation	15	-	-	-	-	-	2	3	10

Table 1. Initial planification of the project

5. Expected results:

- Achieve the creation of an easy-to-use tool for children including simple pastimes with a flashy design to increase the interest in playing
- Achieve the creation of a story which allows the implementation of all the pastimes and games proposed in a possible situation for the player
- Try to prove the video game created with children of the indicated age in order to test and verify its effectivity and acceptation

6. Tools:

Main tools:

- Unity3D (in its 5.5 version)
- Adobe Photoshop CC 2014

Complementary tools:

- MonoDevelop
- Audacity
- Microsoft Office Word 2013
- Microsoft Office PowerPoint 2013

TASK	TOOLS
T1: Technical proposal	Microsoft Office Word 2013
T2: Investigation	-
T3: Definition of the different levels	-
T4: Creation and development of the story	-
T5: Art design	Adobe Photoshop CC 2014
T6. Sound design	Audacity
T7: Programming	Unity3D and MonoDevelop
T8: Documentation	Microsoft Office Word 2013 Microsoft Office PowerPoint 2013

Table 2. Tools used for each task

Chapter 2: Related Work

This chapter is dedicated to all the games, video games, multimedia resources and pedagogical methods that have influenced or have been used as reference for the development of the project *Holidays*. Also the previous work that has been done during the degree and could help for the project has been included.

1. References

The view of video games as a waste of time is changing as life goes on. According with some articles of websites like *Forbes* [1] and *USNews* [2], video games have become a part of life and they are now more than just entertainment for our free-time.

The number of video games designed as a tool for education is increasing. For the development of this project, a research of some video games has been done with the objective of learning how a video game of this features could work. The collection of Pipo's educative games [3] is a good example of them. There are simple games which teach the player grammar or the numbers as some examples:

Figure 1. Game example 1

Figure 2. Game example 2

As we can see, the use of simple and recognizable objects is one of the main features of this type of games. The interface tries to be simple and the less annoying during the game time. The use of bright and pleasant colors is an important election to make the game more attractive and playable.

Also some games which were created just for entertainment have been discovered and used as a perfect way of teaching concepts to the students. Some examples could be *Angry Birds* or *Candy Crush*. The mechanics of *Angry Birds* and the way the games works is a perfect tool for physics' lessons.
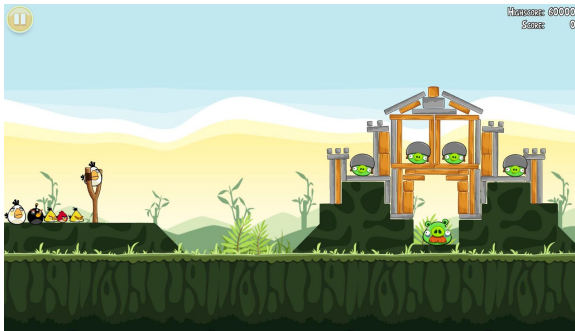
Figure 3. Angry Birds   *Figure 4. Candy Crush*

One of the most famous and played video game nowadays, *Minecraft*, has been adapted to the teaching needs by the development of *Minecraft: Education Edition* [4]. A tool which provides the student a whole world full of missions which hide homework. In addition, those missions can be done individually or in groups

Figure 5. Minecraft

The famous educational TV program *Dora: The Explorer* has also been taken into account and some of its features have been implemented in the video game. For example the use of two languages trying to teach while entertaining. Also the feeling of conversation between the character and the viewer (player in case of the video game) has also been implemented so the player can feel he is part of the story.

2. Previous work

For the subject VJ 1234: Techniques of Advanced Interaction, José Daroqui Plaza and I developed the game *Hand-Eye Training*. It is an interactive videogame with aim of improving the attention, the coordination hand-eye and the cognitive abilities of the player. The exciting feature of the project is the implementation of an advanced interaction device (DIA). The device includes four ultrasound sensors which measure the distance between the player and each sensor. The game was developed with *Unity3D* and *Arduino*, this last one was used as a way of communication between the device and *Unity*.The game was developed with *Unity3D* and *Arduino*, this last one was used as a way of communication between the device and *Unity*.

The game concept consist of four lights, each one assigned to a sensor, of different colours which are turned on randomly. When the light is on, if the player approaches his hand to the correct sensor, he will earn a point and the light will change, if not, he will lose one point. There is a timer to add more intensity and competitivity to the game. [5]

Figure 6. Hand-Eye Training background

Figure 7. Hand-Eye Training How to play
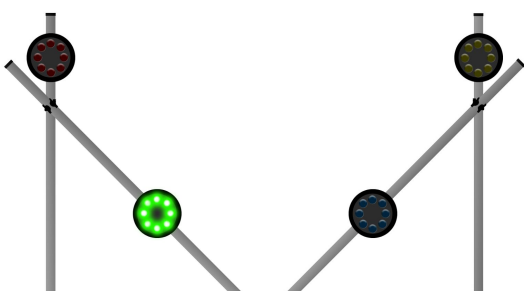
Figure 8. Green light on
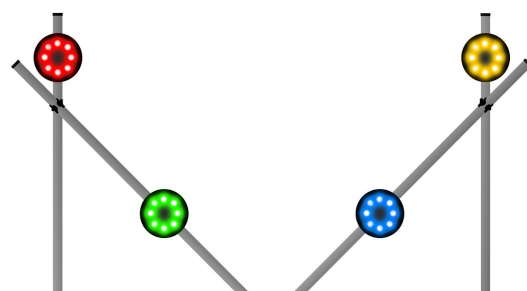
Figure 9. All lights on

Chapter 3: Design

1. Statement

Holidays is a 2D educational video game for children between five and seven years old based on pastimes adapted for a game. The main aim for the game is to improve the cognitive abilities of the player as well as his memory and attention. In order to accomplish that purpose, a research of differents activities, games and pastimes has been made trying to deal with all the problems exposed and finding an interactive way of surpassing them. There has been a total of four games designed with two possible themes that will been explained below.

The based-on-click game mechanic provides the player an easy and enjoyable way of understanding and playing the game. By the use of that mechanic, besides of the develop of the game for PC, it is developed for mobile and tablet, which nowadays are more common devices in children's life than maybe computers and makes the game more reachable for families and the public target.

The initial idea was to design a set of different pastimes which the player could select depending on his preferences or needs. Although this possibility remains in the final version of the game, there has also been implemented another way of playing the game. This way is the creation of a story that can lead the player throughout all the games designed giving a meaning to all the video game. As the game's name, *Holidays*, suggests, the plot of the story is the adventures the player takes part in during his summer holidays after finishing the classes.

The first idea for the characters was to create one main character, a children, and a guide character to help during the story. This idea was finally changed by the removal of the main character, trying to make the player feel that he is the character of the game and all the dialogues and events are directed to him.

As the game is thought for being played by children, all the features of it, such as the dialogues or the proper story, are designed to be simple and easy to understand. There are indications at the start of each game explaining how it has to be played. Moreover, the style of art that is used in the game is also an important election taking into account the public target the game is trying to reach.

All this different features will been explained deeply in the sections below.

2. Story

The main purpose of the game's story is to give all the pastimes and games designed a relation between them and make the experience of the player more enjoyable than the one obtained by just playing them. As explained before, the lack of a main character is made on purpose trying to immerse more the player in the experience of the game and making him feel the main character.

A quick synopsis for the story could be the summer holidays that a child have with his father after finishing the classes at school. As a way of not repeating the whole story every time the player wants to play, it is divided in four chapters.

2.1 Chapter 1: Do not forget anything

It is the first day of summer holidays after the school classes have ended. Once the player has arrived at home, the guide character (thought to be related with a father) takes part in the scene. After a short conversation, the first important interaction of the player with the game happens. As a reward for obtaining great marks during the scholar year, the player has the opportunity to choose the destination of their travel, there are two options, beach or forest.

The election of the destination determines the theme of the game the player will play, this election changes the objects used in the activities and the background. Continuing with the story, the first game will appear, in which the player has to prepare his luggage for the travel selecting the objects indicated.

2.2 Chapter 2: Looking for the treasure

After the first activity is completed, both, player and guide character, will travel to the destination selected. Once they arrive there, the guide character will find what seems a piece of paper splitted up and will encourage the player to put all the pieces together.

Then, the second activity will trigger in order to complete that task and see what those pieces of paper form. A puzzle has been implemented for this game. The design of the puzzle depends on the theme chosen at the start of the game. As a result of this game, the player will find out that those pieces of paper were a treasure map.

2.3 Chapter 3: Memory matters double

Once the treasure map is reorganized and composed, the guide character has the idea to look for the treasure and see what it has inside. When they found the chest treasure, they open it. It contains a deck of cards with the ones the player has to play the third activity designed.

The draws of the cards are the same objects as the ones the player has played with in the first activity. There are two cards per objects, which means twelve cards in total. The objective of this game is try to put the cards into pairs.

2.4 Chapter 4: Memento of the travel

This is the last chapter of the game, once the pairs level is completed, the summer travel will end and the player and the character guide will have to go home. At this point, the guide tells the player to collect some objects, they change depending on the theme, so he will never forget the travel.

After that, the last game starts, the objective of the game is to collect a certain number of objects in the time given. Once it is completed, the player will go back home and the game will be ended.

3. Aesthetic

According to the ages indicated as the public target, the game counts with an colourful and simple design to help the recognition and association of the different objects and backgrounds. Making the appearance of the game more attractive for children is maybe the most important part due to the fact that they are highly influenceable by what they see, also if they do not understand the objects the experience would be less enjoyable.

3.1 Characters

The first idea was to create a main character, in this case a child, like mostly of the games do. That idea was discarded in order to make the player feel like the main character so the whole game will interact directly with him and not with a character.

He will be responsible for the presentation of the pastimes and the connection between them with the story explained before. After a huge research of which type of character could fit better in the game taking into account the style thought for it, the character decided is the one shown in the Figure 10.

Moreover, he will give advices to the player if they are required and also encourage the player when he has done something correct.

3.2 Backgrounds

Figure 10. Guide character

The game counts with three main backgrounds and another one which is a combination of them used in some scenes.. A gaussian blur has been applied in all of the backgrounds trying to focus the attention of the player in the game, the objects that appear and also the guide character.

The first background designed is the bedroom, is the initial background of the game if we decide to start a new game and also the background used in the List game. There you see for the first time the guide character and also lets the player make the election of the holidays destination.
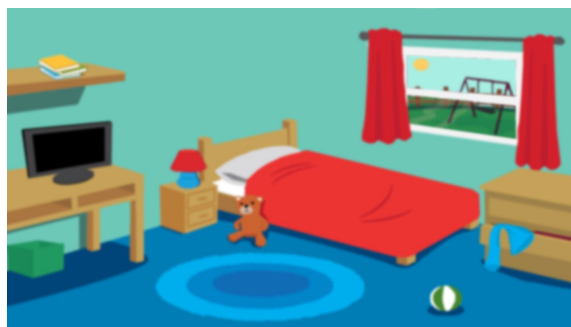
Figure 11. Bedroom background

The other two main backgrounds are the travel destination background of the story, this backgrounds are the forest and the beach. At the first chapter the player can decide where he want to go on holidays and that decision will make the background be one or another for the rest of the games.

Figure 12. Forest background

Figure 13. Beach background

As explained before, there is one last background made by the combination of the three ones already presented. This combination has been made with the objective of resuming the game in one image maintaining the design defined. Is the used for the main menu, game mode, games and chapters menu.

Figure 14. Menu background

3.3 Objects

The base and the most important part of the game is the twelve object that have been designed for the game. They have all been implemented in the game and give it a good-looking design. They are divided in two themes so there are six objects per theme. The election of those objects was made taking into account that the children had to know them, so they are objects that can be found in the quotidian life and even more if we are talking about going on holidays.

As the first set of objects we have the beach ones, it is composed by a beach umbrella, a swimming trunks, a towel, a sun cream, a float and a bucket with a shovel.

Figure 15. Beach objects

The second set of objects is the one used for the forest holidays travel. This set is composed by a binoculars, a pair of boots, a canteen, a compass, a tent and a flashlight.

Figure 16. Forest objects

The design of these objects was needed to be simple but effective so the player could recognize easily the object. In the case of the List game, the fast relation between the object and its name is vital, in the case of the Pairs game, it is indispensable not to feel confused with the objects or think they look similar.

All the objects has two more versions, the first one is each object with its border in white to highlight it when the player clicks on. The other version is a card with the object printed used in the third game, this version will be explained in a later section.

3.4 Graphic elements

The remaining graphic elements that can be found in *Holidays* are used to give the game a better appearance, help the player understand the game and also create a comfortable atmosphere. The style continues being simple but attractive, with bright colours

3.4.1 List

An important feature of the first game is the list. It is a piece of paper where the guide character has written all the objects the player has to take depending on the travel they are doing. Its design is simple to facilitate the understand of it.

All the objects are shown with a special text font trying to simulate the handwriting of a person. A red line is used to cross out the objects already selected.

There is one image per object crossed plus the first image where any object is crossed making a total of fourteen images.

Figure 17. Forest list

Figure 18. Forest list crossed
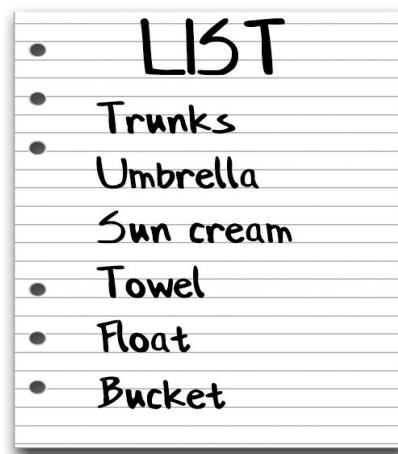
Figure 19. Beach list

3.4.2 Maps

Is the core idea of the puzzle game. It has a simple design in which the player can easily differentiate the elements that appear in it such as trees, a bridge, the path to follow or even the mark with the treasure chest. The style of the maps is meant to be an old treasure map as the ones used by the pirates, that's why the colour of the paper is a mix between white, yellow and brown. Also the edges ripped to provoke the feeling of abandoned, like if it has been thousands of years hidden.

There are two versions of the map, one for each theme. The beach map includes an umbrella and a towel as start points, the sea can be seen at the top of the map, there is also a path which leads to the position of the treasure chest. The whole path is surrounded by palm trees.
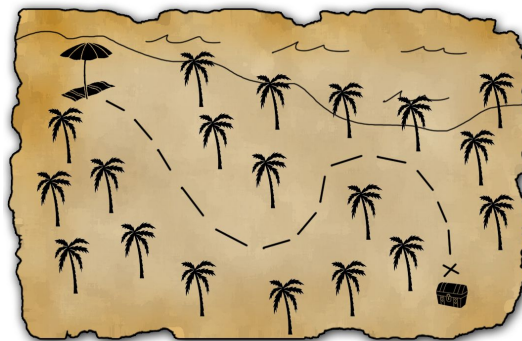
Figure 20. Beach map

The other version of the map is the forest one, which shows a woodhouse as the startpoint, the path leading to the treasure chest and environment elements such as pines and a river with a bridge. For the game, each map has been divided into nine parts so the puzzle can be constructed and its parts exchanged.
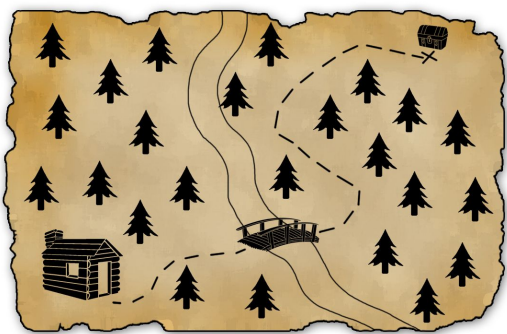
Figure 21. Forest map

Figure 22. Forest map divided

3.4.3 Logo

The logo designed for *Holidays* continues the concept of simplicity with elements easy to recognise with a quick view. It summarizes the concept of the game using pines and palm trees as the background for the name. The election of this trees is to represent the two different themes and destination travels the player can choose during the story.

Figure 23. Logo

3.4.4 Cards

The cards are the treasure hidden in the chest and the element used in the third game. Its design is thought to be simple and as a reminder of a real card. When the card is backwards the surface is in red and it has some white stripes. There is also a white line covering its edges. The logo of the game is also drawn at the surface of the card.

Figure 24. Card

The frontward design of the card is one of the objects with a white background and a red border, also the object has a black border. Each object has its own card design.
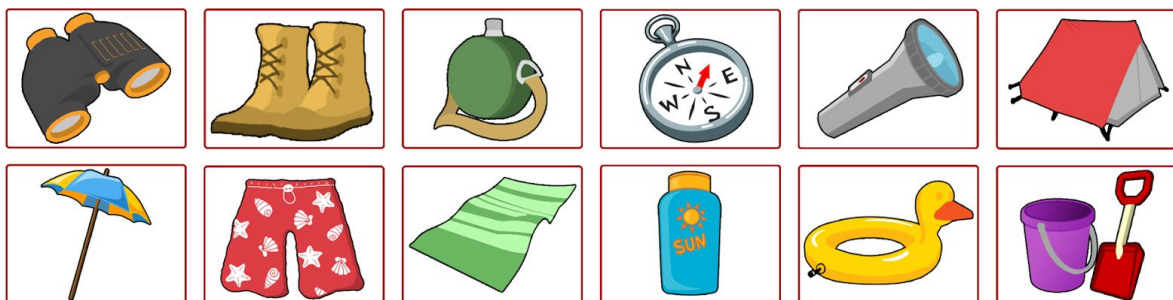
Figure 25. Objects' cards

3.4.5 Shells and flowers

The shells and the flowers, depending on the theme, are the objects collected for the last activity. There are two versions of each object, the difference between those versions is the colours, which are very distinguishable.
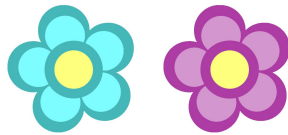
Figure 26. Flowers
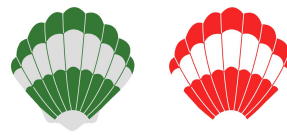
Figure 27. Shells

3.5 Buttons

There are three types of buttons designed for the game, each one accomplish the function that has assigned. All the buttons have their own version with a white line on the edge to be more visible when the player click on them

3.5.1 Menu buttons

The menu buttons have a wood board design in order to be visible during the gameplay and not confuse them with the background. Each of them has written the scene that they lead to when clicked.

Figure 28. Continue button

Figure 29. Main menu button

There are two special buttons in this set of buttons. This are the ones used to select which chapter the player wants to play. In order to distinguish between the theme the player wants to play for a chapter in the chapter selection menu, there is a button to select the beach one and another for the forest one. Each of them has the background of its theme painted in the wood board.

Figure 30. Forest play button

Figure 31. Beach play button

There is also a destination election button with the same design as the explained before but with the difference of the letters in the board. Instead of the shown ones, there is written the name of the destination travel.

3.5.2 Scene buttons

The scene buttons are only visible during the dialogues between games. Their function is to advance or go back through the conversations and continue with the game. They are white arrows located at the bottom right corner.

Figure 32. Previous and next buttons

3.5.3 Information button

This button is only used in the first activity on the game. Its function is to help the player with some information of the object in case he does not know which object is by only seeing its name.

Figure 33. Information button

3.6 Dialogues

A cartoon style is the one chosen for the design of the dialogues. The text of the dialogue will appear inside of a balloon, all of them are said by the guide character. There are two types of dialogues.

3.6.1 Story dialogues

On the one hand, there are dialogues designed for the development of the story. This ones appear at the middle of the screen and try to conduct the player through the game story between the pastimes.

Figure 34. Dialogue example

3.6.2 Auxiliary dialogues

On the other hand, there are auxiliary dialogues that will appear in the course of the game. They will let the player know if he is doing a good job in the activity. There are also special dialogues for the list game, those ones are used to help the player describing the object in the case it is needed.

Figure 35. Try again dialogue

3.7 Game scenes

The final design for all the scenes in the game includes all the elements explained before, such as backgrounds, buttons, dialogues and some other decorative ones. They try to be colourful and easy to understand so the player doesn't get lost navigating through them. Here are shown some of the menu, gameplay and dialogue scenes.

Figure 36. Main menu

Figure 37. Chapters menu

Figure 38. List gameplay 1

Figure 39. Puzzle completed

Figure 40. Loading scene

Figure 41. Dialogue 3

4. Levels and pastimes

Each pastime has been adapted for the ages indicated (from five to seven years old) and assigned to one level of the game, making a total of four levels. As explained before, if the player wants to play the game with the story, there are scenes with dialogues between the levels, if not, the option of just playing the pastimes exists. In all the levels the character guide will be situated at the bottom left corner and will explain the rules of the game, the main menu button will be situated on the bottom right corner.

4.1 Level 1: List

Is the first game designed for the project. Depending on the election the player has done of where he wants to go on holidays, the objects of the level change. If the player is playing the story mode, this election will accompany him throughout the whole story.

At the right part of the screen will appear the list with the objects, as game goes through, the objects will be crossed out. In the middle of the screen the player will found the four objects, one of the objects is the correct election and the only one with the theme selected, whereas the three objects left are all from the other theme (for example, if the theme selected is the beach one, the correct object will be the towel and the three other the canteen, the flashlight and the binoculars).

Although the language of the game is spanish, the name of the objects and some messages of the guide character are in english trying to teach some simple concepts to the player. This is why next to each object of the list is an information button. If the player clicks on it, the guide character will give the player a little explanation of the object.

Once the player has selected the correct option, the four objects will change with the same structure explained, only one will be the correct and the object will be crossed out from the list. If the player selects the correct object, the correct sound will be played and the guide character will say *Good Job!*, if it is not, the guide will say *Try Again!*. There is a total of six correct elections and the changes of the objects are predefined. The game ends when all the objects from the list are crossed.

Figure 42. List gameplay 2

4.2 Level 2: Puzzle

The second level of the game is the puzzle game. It consists of nine buttons with an image assigned randomly. This random assignment of all the images allows the player replay the level without knowing the solution and getting bored. Each image is one of the nine parts of the puzzle shown before, they are situated in the middle of the screen.

To change the images and compose the puzzle, the player has to click the two buttons he wants to exchange and the images of those buttons will change between them. If just one or both images changed are put in its correct spot, the correct audio will be played and the character guide will give feedback to the player with the message *Good Job!*. The game ends when the puzzle is constructed.

Figure 43. Puzzle gameplay

4.3 Level 3: Pairs

The third pastime implemented is the pairs game. At the beginning of the game there are twelve cards, two per object, visible for the player The assignment of the objects to the cards is made randomly. After a few seconds, the cards turn so the player has to remember the initial position of the objects and try to make pairs.

To select a card the player has to click on it and it will turn around, if the two cards turned contain the same object, they will remain visible for the rest of the game, if not, after a few seconds they will turn again. There is a timer implemented so if the player has not discovered all the pairs before the time is zero, the game will end.

Figure 44. Pairs gameplay

4.4 Level 4: Memories:

This is the las pastime implemented into the game. It consists of an auxiliary background viewed from the top where appears randomly a set of objects, the design of the objects and auxiliary background depends on the theme election.

The goal of the game is to obtain the punctuation required in the time given, if the time arrives to zero, the game will end. There are two type of objects and depending on which object does the player select, his punctuation will decrease or increase. When an object appears in the screen, the player will have a few seconds to click on and collect it, if he does not collect it, it will disappear and another object will spawn randomly.

Figure 45. Memories gameplay

5. Scenes

The first scene to appear when the player starts the game is the main menu, here there are two options. On the one hand there is the exit button, which will close the game.

On the other hand there is play button, if it is clicked, the buttons change and the new ones are story button and games button. If the next clicked is the story, the buttons will change showing the new game button and the chapters button. If the next button clicked is the new game one, the story and gameplay will start from the beginning, if it is the chapters one, the scene will change to the chapters menu.

The chapters menu shows the four chapters of the game if the player wants to play one specific chapter. For the first chapter there is an unique button which leads to the start of the story, for the rest of the chapters there are two buttons per chapter, each one leads to the beginning of the chapter with the theme selected.

When at first the play button is clicked, if the next election is the games button, the scene that will appear is the games scene. Here the player can select the activity he wants to play and the thematic of it.

Each scene excluding the main menu, when the options are play or exit, and the dialogue scenes has a main menu button which leads to the very first scene of the game.

Once an activity is finished there are three options: continue, which will continue with the story, main menu, which will lead the player to the main menu scene, and exit, which will close the game.

6. Sound design

The main purpose of the game audio is to give feedback to the player of what is happening and also make the experience more pleasant and immersive while not disturbing or distracting him.

With the idea of an educational game, the sounds needed to be simple. There is one short sound used each time the player makes a correct move in the games. The ambience music is played at the main menu, the chapters and the games menu, and also during the conversations of the game.

There is one sound effect added to the game, is a chest open sound, played once the player has completed the puzzle game and the guide character finds the treasure chest. Moreover, there are some special sounds only played in the first activity in order to help the player to understand the meaning of the objects he has to select. It is a human voice that spells the name of the object of which has been required the information in English. This feature is included because of the age of the players, they could not associate the word with the explanation given so the spell of it is a huge help and a way of teaching.

7. Technologies

Holidays is a 2D video game developed for Windows and Android in order to reach the most players as possible. The game has been developed with a laptop which includes Windows 10 (64 bits) as its operating system with this components:

- Processor: Intel® Core™ i7-4702MQ 2.2 GHz
- RAM: 16 GB DDR3 Low Voltage Memory
- NVIDIA® GeForce® GT 750M

7.1 Main tools

- Unity3D: is the game engine, in its 5.5 version, used for the develop of the game. Is a common engine used by students and indie studios with and active website [6] where everyone can find tutorials, assets for the games and forums
- Adobe Photoshop CC 2014: is the program used for the whole artistic design of the game. They have their own website [7] and a manual for the beginners [8]

7.2 Complementary tools

- MonoDevelop: is a text editor integrated in *Unity3D* used for the scripting process
- Audacity: software used for the edition of all the sounds and music of the game. The reason of this choice is its free-to-use license
- Microsoft Office Word 2013: word processor developed by *Microsoft* used for the writing of this document

Chapter 4: Development

This chapter is dedicated to the development of the project *Holidays*. Here will be explained how all the tasks planified in the technical proposal have been done in detail, all the work put in them and the difficulties found during the process.

1. TASK 1: Technical proposal

This first task describes the whole process of development of the technical proposal since the classes given to help in the composition of the document from the initial idea of the project until the final delivery of it. *Microsoft Office Word 2013* is the software used for it.

1.1 Attendance to the technical proposal classes

There were given four classes from the January 30th to the February 2nd with one class of two hours per day for all the students of the Final Project Degree subject.

In these classes, we were taught the best way of composing our Technical proposal, how to explain each section and also the distribution of the document following the example of proposal given [9].

The classes were divided into sections of the document mentioned before giving more time for the most complex sections like planification. Moreover, after each class, we had to upload the work done to a Google Drive folder and other student would correct it and give us some ideas.

1.2 Composition of the technical proposal

With the help of the classes and the guide explained before, the next step was to start the writing of the technical proposal. A brief synopsis of the project that was going to be developed, a planification as accurate as possible of all the tasks and the time estimated for each one, the tools that were going to be used and a list of the main objectives to be achieved throughout the development of the project.

The most difficult part of the task was to determine all the planification due to the fact that we had to divide a non created game into phases and assign them a number of hours for their execution. The main problem here is maybe the not expected problems that can delay the task to get done and the adjust of the time needed.

For the writing of this memory, this task has been revised, modified and extended in comparison with the first technical proposal. This readjustments are explained with more profundity in a later task.

2. TASK 2: Investigation

Once the technical proposal is done, the next step is to investigate and research for all the information needed for the project, like how the skills that *Holidays* tries to develop can be dealt with, including different examples, and the possibilities that the engine provides to implement those solutions.

2.1 Research of the different types of activities to develop

The first step before start the design and the programming of the game is make a wide research of the different types of pedagogical methods that are used in order to improve the cognitive development of the player as well as his memory and attention.

Nowadays, a great number of students show less interest in learning and in the school than before. This is why different teaching methods have been put in practice trying to reach all the students and make their interest on learning increase. With the appearance of the new technologies, a new way has been discovered.

As explained in the article [10], making the activities a desire of playing has to be one of the priorities. One of the best options for achieving that is presenting those activities in a ludic but joyful way like a game.

Each activity has to have a defined goal with a clear explanation of how them work and a simple and accurate language the player can understand with no problem, the excess of language can distract him. The variety of pastimes is an important aspect because repeating all the time the same activities and games makes the player feel bored, the idea is try to break the thought of monotony and repetitive.

The list of different activities that can be used to improve the skills mentioned before is endless, there are as much activities as our imagination lets us create. For example, to improve the attention can be used a famous type game of remark the differences between two similar draws or identify the object between a set that doesn't belong to the rest of the group, and the list continues. Here [11] [12] can be found some more examples.

2.2 Investigate the aspects and concepts of the game engine used

In order to make the start of the programming and implementation tasks easier, there were a research and documentation of some useful aspects and techniques of programming for the game and its level. *Unity* provides its web with a section [13] dedicated for questions and doubts that could interest a lot of people.

3. TASK 3: Definition of the different levels

3.1 Election of the pastimes

Taking into account the research made in the previous task and the advices from different teachers, the reason for the election of the pastimes has been based on their dynamism.

- List pastime: it improves the attention, the reading, the visual discrimination and the auditive comprehension of the player. It also teaches them vocabulary of the themes designed for the game.

- Puzzle pastime: the attention and the spatial orientation are the main abilities to develop, also the effectiveness in the realization of the tasks.

- Pairs pastime: is one of the best activities to improve the memory and the attention. For children, this type of games are very attractive and entertaining.

- Memories pastime: it improves the visual discrimination and the attention.

3.2 Adaptation and design of the pastimes

All the pastimes have been thought for a based-on-click mechanic. There has also been included sound effects to give feedback to the player. This last implementation has been done because of the ages of the public target.

For the first pastime. there has been added the explanation and spelling of the objects. Finally in the third and fourth pastime has been included a timer to develop the effectiveness and provided an extra challenge.

4. TASK 4: Creation and development of the story

This task describes the whole process of creation of the story, the initial idea, the final plot written, the characters used and the dialogues. It is also explained the process of adaptation from the initial story to the final story, thought for the ages indicated.

4.1 Creation of the story and the characters

The initial idea for the project was to show all the pastimes and activities with the adventures of a child at the school. During the activities the player would have the help of different classmates and teachers. This idea was discarded in order to not seem unrealistic because the public target is not older enough to maybe walk alone along the school and have adventures by their own. Moreover, the game is meant to be a pedagogical tool and help the player's development, the idea of walking along the school finding activities and adventures could be a bad influence for the players, it could make them try to feel the experience by themself instead of focusing on the classes.

Taking all the explained into account, the idea was changed into a family summer holidays. This change also brings the opportunity to select the destination of the travel, which will change the objects and the background used in the activities, a feature that would be more difficult to implement with the school's idea.

For the project there were two possible destinies defined, beach and forest. the election of these themes was made considering the aspects explained at the task 2, where is said that the game has to be easy to understand for the players. This is why those themes were the selected ones, both of them are typical travel destination and the players could recognise them and interact with a known environment.

Once the initial idea was discarded, the characters thought for the project were a main character, a child with the one the player could identify with, and a character guide who will accompany the child throughout the whole story and adventures.

Finally the character guide was the only one decided to design for the project, trying to make the player feels that he is the main character, all the game interacts directly with him and he is the one who experiment the story. The character guide is designed with the idea of relate him with the player's father, but its design will be explained later.

The election of the themes for the game was the most important decision to take of this phase due to the fact that all the objects and backgrounds designed for the pastimes needed to be recognizable by the player. Taking into account the ages of the public target, they couldn't be complex. The story itself does not change a lot between both of them, just some dialogue details.

4.2 Creation of auxiliary dialogues

During the activities there are some dialogues the guide character says trying to help the player and also giving him feedback of what is happening and how the game is going. There is an auxiliary dialogue at the start of each level explaining the rules of the current activity to the player.

Every action in the activities has a feedback from the character guide. This feedback changes depending on if the action is correct or incorrect for the completion of the game. If the action is correct, the guide tries to encourage the player to continue the game, if it is incorrect, the guide tries to motivate the player to try again.

The last auxiliary dialogue of the game is the explanation that is given to the player in the first game, the list. This type of dialogue will be explained in the section below.

5. TASK 5: Art design

The art design of the game needed to be simple and recognisable by the player. All the elements on the screen needed to be as clear as possible in order to not disturb the player. The use of bright colours is essential when the aesthetic is as important as it is in an educational game, it is the first thing a child will look at and if he does not like it, he probably will not play the game. They give more attractive to the game and make the player experiences a better time.

All the elements and backgrounds designed are based on images from the Internet used as references. For those modifications and the development of this task, the software used is *Adobe Photoshop CC 2014* and the hardware is a *Bamboo Wacom* graphic tablet. All the designs have been done in different layers and then combined or not and exported as a *.png (Portable Network Graphics)* file.

5.1 Design of the characters

As explained before, the only character that will appear in the final version of the game is the guide character. There has been a huge research done in order to find the best design that could fit better into the game.

As a guide throughout the story, the character designed for the game is a person the player can associate with a father. His appearance is the one of a man on his thirties, which is an approximated age for the player's' father. The smile reflects his kindness and that he is always willing to help, that's why he will give advices and encourage the player during the activities.

Figure . 46 Guide Character

In addition, he is wearing glasses to reflect his seriousness. Nevertheless, he is also wearing a T-shirt to give him a casual look according with the summer holidays' story.
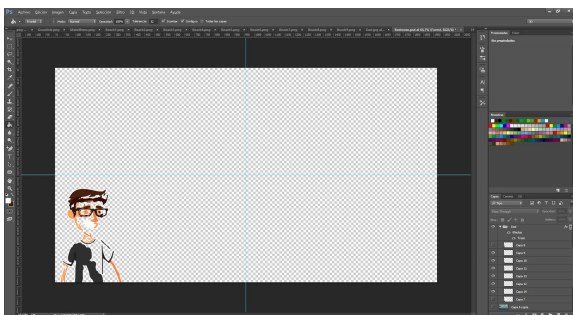
Figure 47. Guide character development 1
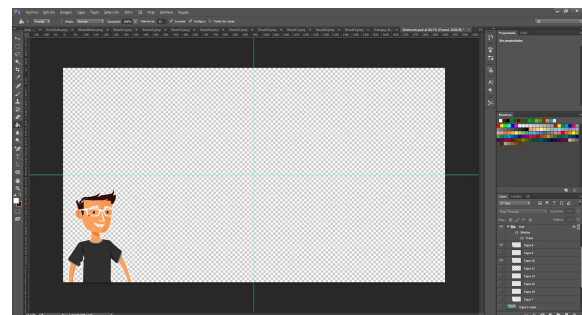
Figure 48. Guide character development 2

5.2 Design of the backgrounds and graphic elements

All the elements and backgrounds of the game are designed with a combination between cartoon and realism, in order to make the aesthetic more attractive but remaining its simplicity and easy understanding. The first designs of the game were the three backgrounds.

The first background created was the bedroom, it is a special space for every child, his special place where he can pass all the time playing, learning and enjoying. To give the appearance of a child's bedroom, there is a teddy and a ball on the floor.

The correct colours's election is an important choice, in this case the predominant colour of the image is the blue, added into the walls and floor. The blue represents charm and kindness, it also gives the viewer peace and serenity.

Figure 49. Bedroom development

The forest and beach backgrounds' colours were not chosen because of the feelings and emotions they transmit, they were selected in order to make the understanding of the game and its elements much easier for the player.
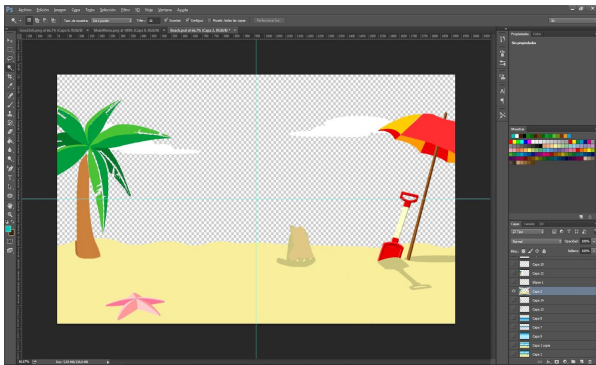
Figure 50. Beach development
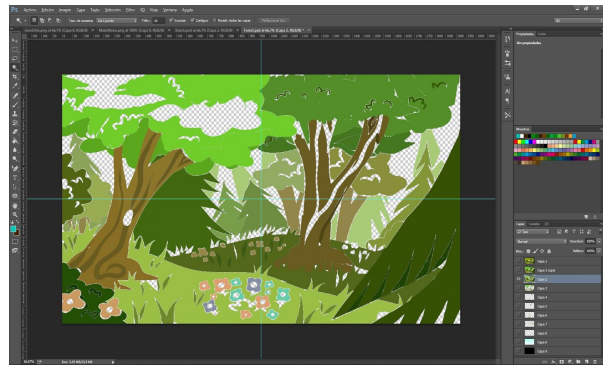
Figure 51. Forest development

For each theme there was a wide variety of different objects that could fit into the game. The final choices were made thinking on how common and familiar could them seem for the player. However, there are a lot of possible objects that could have worked as well like a sleeping-bag or a jacket for the forest. Also the elements of the list and the puzzle depend on the theme selected. Here are some examples of the phases of design of the objects and the graphic elements:
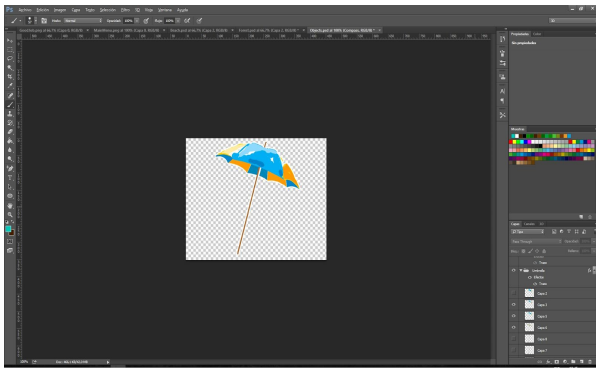
Figure 52. Umbrella development
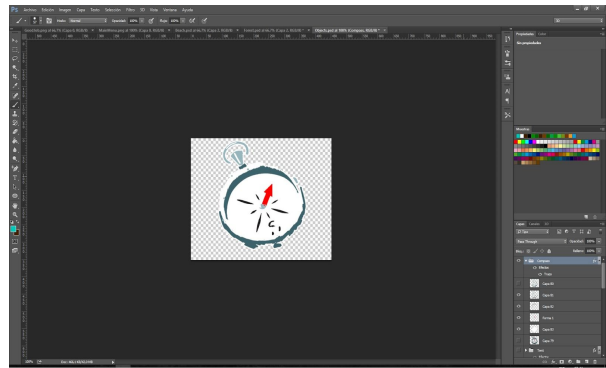
Figure 53. Compass development
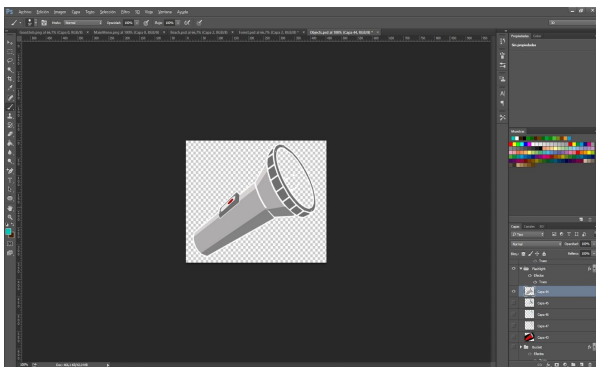
Figure 54. Flashlight development
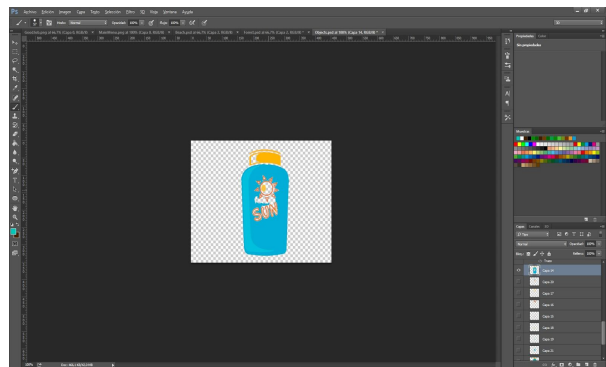
Figure 55. Sun cream development
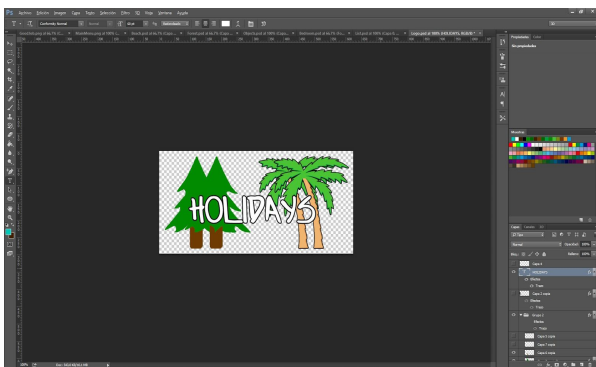
Figure 56. Logo development
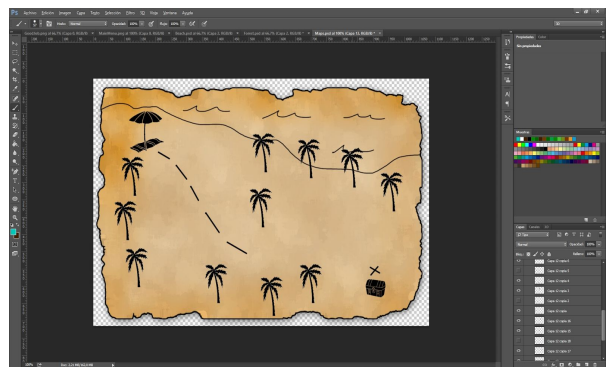
Figure 57. Beach puzzle development

5.3 Design of the different scenes of the game

All the scenes are composed using the backgrounds defined above with the inclusion of elements and designs. The menus' style is based on wood boards and text on it. Thanks to the gaussian blur applied on the backgrounds, the menu elements are more visible for the player and help its navigation.
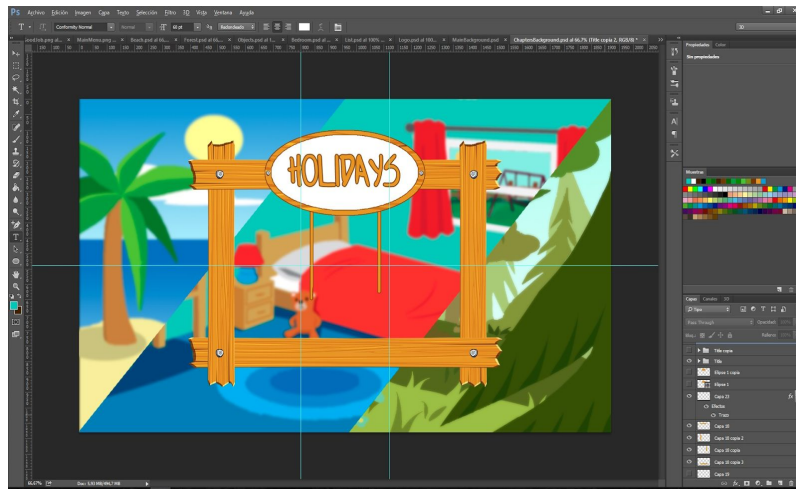
Figure 58. Main menu development

Figure 59. Chapters menu development
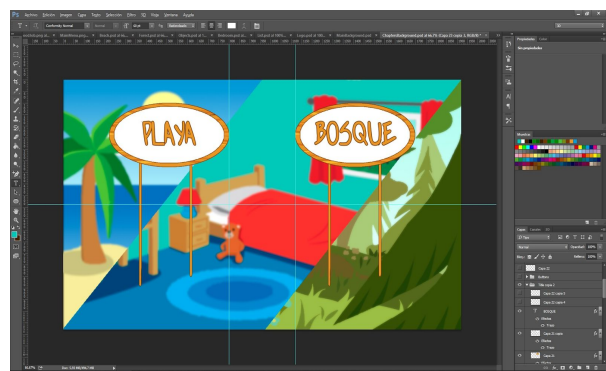
Figure 60. Games menu development

6. TASK 6: Sound design

The music and sound in this game is implemented to make the players' experience more enjoyable and give him some feedback of the game. All the sounds effects and the ambience music have been downloaded from royalty free music websites [14] [15]. The production and modifications them have been done with *Audacity*.

6.1 Design of the music environment of the game

The ambience music needed to be pleasant and lively. The main feature to avoid was that the music could distract the player and not let him focus on the game. The environment music is played at the menus and the dialogue scenes. It was a difficult research to do, due to the fact that there were a lot of samples on the Internet but only a few were useful for the game. The time dedicated for this task was bigger than the initially thought. With *Audacity*, the volumes of the music have been modified.
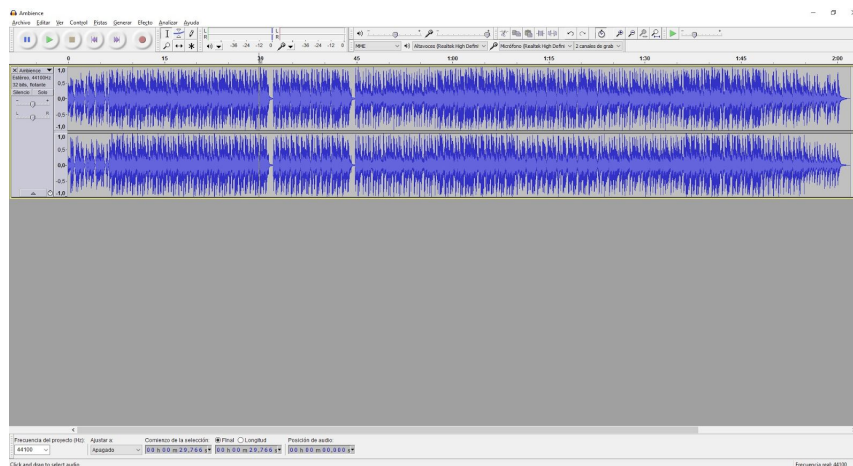
Figure 61. Modification of the ambience music

6.2 Design of the sounds played due to game events

The purpose of the sound effects is to give feedback to the player of what is happening in the game. The first one thought for the game was the correct sound, played when the player advances in an activity. There were a lot of useful samples on the websites named before. The one selected was modified with *Audacity* to make it shorter and lower.

After this, the next sound added was the treasure chest one. The result of this research was not as good as the research done for the correct sound, there were a lot of sounds with noise or that do not fit with the game's needs. The pronunciation of the objects used in the game list was recorded with a Samsung Galaxy S7.

7. TASK 7: Programming

Some important parts of the scripts of the different games or elements will be shown in order to make the explanation easier

7.1 Implementation of the different games and levels

As explained in the Game Design Document, the game is divided in four games which will be explained below. The order of games explained is the order of their appearance during the story mode. Although there are different thematics on the game, there is no need of creating a script for each game of each theme, public parameters have been used in order to let the change of sprites and backgrounds

7.1.1 Level 1: List

Is the first game which appears in the story mode. It consists on a sequence of elections of objects that are written in a list. There will be four objects in the screen at once but only one is the correct election, the player has to select the right one. Once he has selected it, the four objects will change. Depending on the selection of the player a message will be displayed by the guide character.

```
public void CheckClick(){
if ((round == 0) || (round == 3)) {
            ChangeImage (round);
            SIM.ChangeImage (round);
            TIM.ChangeImage (round);
            FoIM.ChangeImage (round);
            round++;
            dad.sprite = dadGame [0];
    } else {
            dad.sprite = dadGame [1];
    }
}
```

Code 1. FirstImController.cs - Function: CheckClick()

There are four buttons changing their sprites when the election is the correct one to make the game functionally, each button has its own script (called *FirstImController*, *SecondImController*, *ThirdImController* and *FourthImController* respectively). The sprite of each button during the whole game is predefined since the start. When a button is clicked, it activates the *CheckClick()* function shown above.

This function checks for the button clicked if it's the correct election, if so, it changes the sprite of its and also the sprites of the other buttons. Here is the code for the *ChangeImage(int roun_aux)* function:

```csharp
public void ChangeImage(int round_aux){
    correct.Play ();
    if (round_aux == 0) {
        myImageComponent.sprite = Images [round_aux];
    } else if (round_aux == 3) {
        myImageComponent.sprite = Images [round_aux];
    } else {
        if (round == 5) {
            gameObject.SetActive (false);
            mainMenu.gameObject.SetActive (false);
            for (int i = 0; i < endGame.Length; i++) {
                endGame [i].gameObject.SetActive (true);
            }
            for (int i = 0; i < info.Length; i++) {
                info [i].gameObject.SetActive (false);
            }
        } else {
            myImageComponent.sprite = Images [round_aux];
            round++;
        }
    }
    list.sprite = Lists [round_aux];
}
```

Code 2. FirstImController.cs - Function: ChangeImage()

This function is only called when the election of the button is the correct, this is the function for the first button, that's why it only works when the rounds are 0 or 3. If the round is the fifth one, it means the game will be finished so some buttons will be disabled and others enabled. For all the buttons, if the election is the correct a the correct sound will be played and the respectively object of the list will be crossed out.

If the player does not understand the meaning of the objects written of the list, he can claim for help clicking the information button, which calls the *NeedInfo(int n)* function. This script changes the dialogue of the guide character providing the player with a definition of the object to select.

```csharp
public void NeedInfo(int n){
    dad.sprite = info [n];
}
```

Code 3.FirstImController.cs - Function: NeedInfo(int n)

7.1.2 Level 2: Puzzle

The second game consists of nine buttons and an image divided in nine parts. Each part is assigned to a button randomly at the start of the game. The change of images between buttons depends on the buttons clicked, to know which button is clicked we use the function *PartClicked(int n)*, which pass the button selected to de *Update()* function of the Puzzle script.

```
public void PartClicked(int n){
    if (clicked1) {
            clicked2 = true;
            part2 = n;
    } else {
            clicked1 = true;
            part1 = n;
    }
}
```

Code 4. Puzzle,cs - Function: PartClicked()

Here we can see the main part of the *Update()*, where if there are two buttons selected, their images are changed and if the image is the correct one indicated by the array order, the correct_audio sound will be played and the guide character will send a message. When all the parts are in the correct position, the game ends.

```
if (clicked1 && clicked2) {

    int aux = images[part1];
    images [part1] = images[part2];
    images [part2] = aux;

    puzzle [part1].image.sprite = order [images[part1]];
    puzzle [part2].image.sprite = order [images[part2]];

    if (puzzle [part1].image.sprite == order [part1]) {
            correct [part1] = true;
            correct1 = true;
    }
    if (puzzle [part2].image.sprite == order [part2]) {
            correct [part2] = true;
            correct2 = true;
    }
    if (correct1 || correct2){
            dad.sprite = dadGame[1];
            correct_audio.Play ();
    } else {
            dad.sprite = dadGame[0];
    }
```

Code 5. Puzzle.cs - Function: Update()

During the assignment of the puzzle parts to each button, the possibility of assignment of the correct image in the correct button exists

```csharp
images = new int[]{-1, -1, -1, -1, -1, -1, -1, -1, -1};
selected = new bool[]{ false, false, false, false, false, false, false, false, false};
correct = new bool[]{ false, false, false, false, false, false, false, false, false};

for (int i = 0; i < end.Length; i++) {
        end [i].gameObject.SetActive (false);
}
for (int i = 0; i < puzzle.Length; i++) {
        while (true) {
                int rand = Random.Range (0, puzzle.Length);
                if (!selected [rand]) {
                        puzzle [i].image.sprite = order [rand];
                        selected [rand] = true;
                        images [i] = rand;
                        if (i == rand) {
                                correct [i] = true;
                        }
                        break;
                }
        }
}
```

Code 6. Puzzle.cs - Function: Start()

7.1.3 Level 3: Pairs

This is a card game in which the player has to make pairs of the same objects. At the start, during the first seconds all the objects are visible, then they turn around so it's impossible to know which object is hidden there. When the player touches the card, it turns around so the object is visible. If the second card clicked has the same object than the first one, the pair will be found and will be visible for the rest of the game, if not, both cards will be hidden again. The game will end when all the pairs are discovered. The position of the cards are assigned randomly.

```csharp
if (start) {
      if (pair1 && pair2) {
            if (button [part1].image.sprite == button [part2].image.sprite) {

                  correct [part1] = true;
                  correct [part2] = true;
                  p_counter++;
                  dad.sprite = gameDad [0];

                  correct_audio.Play ();
                  if (p_counter == ((button.Length) / 2)) {
                        EndGame ();
                  }
                  pair1 = false;
                  pair2 = false;
            } else {

                  dad.sprite = gameDad [1];

                  if (!changing) {
                        Hide ();
                  }

                  seconds = Time.time - changeTime;
                  seconds = 1 - seconds;

                  if (seconds <= 0) {
                        button [part1].image.sprite = hide;
                        button [part2].image.sprite = hide;
                        pair1 = false;
                        pair2 = false;
                        changing = false;
                  }
            }
      }
}
```

Code 7. Pairs.cs - Function: Update()

The assignment of the images to each button is made randomly so the game can be replayed. Here is the code used for those assignments, taking into account that there can only be two cards per object and two consecutive buttons can not have the same image. The function *Hide()* is the used to turn around the cards.

```csharp
count = new int[]{ 0, 0, 0, 0, 0, 0};
pairs = new int[]{ -1, -1, -1, -1, -1, -1, -1, -1, -1, -1, -1, -1 };
correct = new bool[]{ false, false, false, false, false, false, false, false, false, false,
false, false };
        for (int i = 0; i < button.Length; i++) {
            while (true) {
                int rand = Random.Range (0, images.Length);
                if (count [rand] < 2) {
                    if (i > 0) {
                        if (rand != pairs [i - 1]) {
                            pairs [i] = rand;
                            count [rand] = count [rand] + 1;
                            button [i].image.sprite = images [rand];
                            break;
                        }
                    } else {
                        pairs [i] = rand;
                        count [rand] = count [rand] + 1;
                        button [i].image.sprite = images [rand];
                        break;
                    }
                }
            }
        }
        Hide ();
```

Code 8. Pairs.cs - Function: Start()

```csharp
    void Hide(){
        if (!start) {
            startTime = Time.time;
            countdown = true;
        } else {
            if (!changing) {
                changeTime = Time.time;
                changing = true;
            }
        }
    }
```

Code 9. Pairs.cs - Function: Hide()

As explained before, there is a timer at the start which makes the objects visible during a few seconds in order to develop the memory skill of the player. There is also another timer which takes control of the time between the objects been visible and its turns around if both cards do not contain the same object. The player has a minute to find all the pairs.

7.1.4 Level 4: Memories

This game is based on the attention and the time reaction of the player. Once the player has clicked the start button, the game will start as well as the timer. The player has to collect ten objects of the same type in one minute. Those objects appear randomly on the screen but there is only one object to interact with.

The position of the objects in the screen are predefined since the start of the activity, when the player had clicked on the active object, it will disappear and other random object will appear. There are two types of objects and depending on which object the player clicks on, he will earn or lose a point. If the player has not collected the ten objects in the minute given, the game will end. Here is the code used in order to make the objects appear in the screen

```
if (startGame) {
        collected.text = "TOTAL: " + points.ToString () + "/10";
        timer.text = seconds.ToString ("f0");
        seconds = Time.time - startTime;
        seconds = 60 - seconds;
        if (seconds > 0) {
                if (change) {
                        rand = Random.Range (0, souvenirs.Length);
                        change = false;
                        souvenirs [rand].gameObject.SetActive (true);
                        hideSec = 1000;
                        Hide ();
```

Code 10. Memories.cs - Function: Update()

If the object that is shown in the screen is the incorrect one, the player has not to click on it in order to make a new one appear. After two seconds, if there has not been any interaction with the object, it will disappear and a new one will appear. Here is the code for the two-seconds timer:

```
hideSec = Time.time - hideCountdown;
hideSec = 3 - hideSec;

if (hideSec > 0) {
        if (clicked != -1) {
                if (clicked == rand) {
                        if (souvenirs [rand].image.sprite == images [0]) {
                                points++;
                                dad.sprite = gameDad [0];
                                correct.Play ();
                                if (points == 10) {
                                        EndGame (0);
                                }
                        } else {
                                if (points > 0){
                                        dad.sprite = gameDad [1];
                                        points--;
                                }
                        }
                }
                souvenirs [rand].gameObject.SetActive (false);
                clicked = -1;
                change = true;
        }
} else {
        souvenirs [rand].gameObject.SetActive (false);
        change = true;
}
```

Code 11. Memories.cs - Function: Update()

7.2 Implementation of the different scenes

All the scenes are connected by the *MenuCtrl* script. Depending on the situation, the function *LoadScene(string name)* or some other auxiliary functions are needed. Those functions are triggered by the buttons of the screen like play, chapters explained in the Art Design. Also the *MainMenu* scene has been selected as the first scene to appear when the game is executed.

The main scenes of the game are the main menu and the proper games, also the chapters election menu and the games election menu. All of them are connected by buttons which provides a smooth transition.

```
public void LoadScene(string name){
        SceneManager.LoadScene (name);
}
```

Code 12. MenuCtrl.cs - Function: LoadScene(string name)

There is also a "fake" feeling of scene change with some buttons but is just de enable and disable of other buttons in order to create another scene. This change happens for example in the transition from the main menu to the game mode menu.

```
public void Play(){

        play.gameObject.SetActive (false);
        exit.gameObject.SetActive (false);
        mainMenu.gameObject.SetActive (true);
        story.gameObject.SetActive (true);
        games.gameObject.SetActive (true);

}
```

Code 13. MenuCtrl - Function: Play()

All the scene changes between games or dialogues have been implemented individually, adding to each button de *MenuCtrl* script indicating the scene to load or the action to accomplish on its OnClick() parameter.
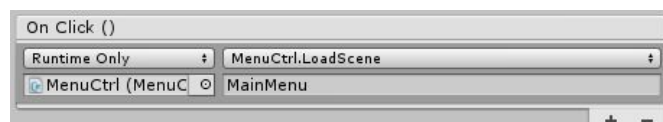
Figure 62. Button implementation

7.3 Implementation and coherence of the sounds in the game

There are two main sound elements in the game, the ambience music which appears in all the menu and dialogue scenes to make the experience more pleasant and enjoyable and the sound effect which triggers when some event occurs in the game (a correct answer in the game). The Figure 63 shows the implementation of the ambience music into the game engine, the option Play On Awake is activated so the music will start since the start of the scene.
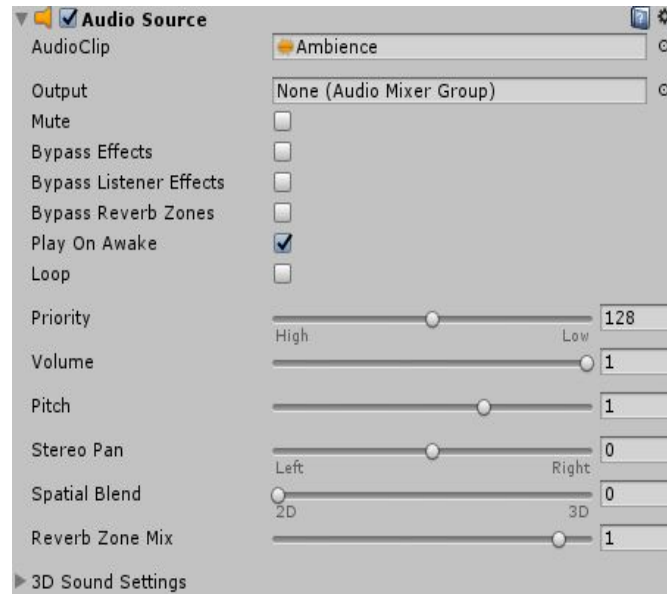
Figure 63 . Audio implementation

The correct sound effect is played when the player advance in the game he is playing. The audio is implemented in the appropriate script using an AudioSource parameter so when, for example in the third game explained, the player discovers one pair of objects, the correct sound will be played giving the player some feedback of how the gameplay is going. The Play On Awake parameter in this case is disabled. Is the same case for the chest sound effect, although it is triggered when the player advances in a dialogue.

8. TASK 8: Documentation

The final task of the planification is the composition of the final report and its defence. The software used for the development of the document is *Microsoft Office Word 2013* and for the development of the defence, *Microsoft Office PowerPoint 2013*.

8.1 Composition of the final report

The writing of the final report document has been done following the final report guide given [16] and modifying some aspects in order to cover all the features of the project

8.2 Composition of the defence

The defence of the project is based on a summarized explanation of the development of the project with the support of a powerpoint and a playable demo of the game.

Chapter 5: Results

This chapter is dedicated to the final results of the project. At the beginning of the project there were some objectives fixed and some results expected, now it is time to check if those expected results have been achieved.

The expected results defined at the start of the project were:

1. Achieve the creation of an easy-to-use tool for children including simple pastimes with a flashy design to increase the interest in playing

2. Achieve the creation of a story which allows the implementation of all the pastimes and games proposed in a possible situation for the player

3. Try to prove the video game created with children of the indicated age in order to test and verify its effectivity and acceptation

The main goal of this project was to create a pedagogical tool for children between five and seven years old trying to improve their cognitive abilities. As exposed in the first objective, the game needed to be easy to use and had a colourful style. This objective has been completed, the based-on-click mechanic and the explanation of each level's rules makes *Holidays* an easy way of learning and entertaining. The development of the story, second objective, has also been accomplished, it was adapted for the ages indicated.

Figure 64. In-engine screenshot 1
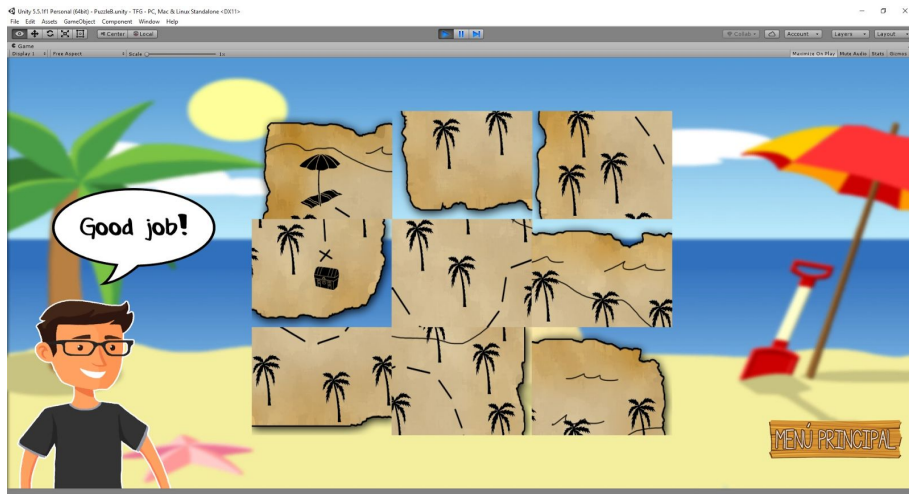
Figure 65. In-engine screenshot 2

Although the last objective has also been achieved, the game has been tested by children of the ages indicated, it would be a great opportunity of improvement if the game could have been tested in a classroom. A lot of new ideas, improvements and future projects would have came out during those sessions.

During the development of the project, some videos have been recorded in order to show the result of the work done:

List game video: https://www.youtube.com/watch?v=sQsPA9lg7XY

Puzzle game video: https://www.youtube.com/watch?v=RipnehiyVko

Pairs game video: https://www.youtube.com/watch?v=bKLJFNnIUNQ

Memories game video: https://www.youtube.com/watch?v=2N6rdTXmuoA

Chapter 6: Testing & Evaluation

In order to verify the functionality of the game, it has been tested with three children between five and seven years old. The purpose of these tests is to determine the features implemented that work properly as thought and the aspects that should be revised and improved in the future.

Overall, according to the ages and the activities designed, the results have been positive The games were adapted correctly and the level of difficulty was not too high, which was one of the biggest fears. The evaluation process has been divided in three parts, each one representing one of the pastimes.

- List game: this activity has been easier for the seven years old children because they have a higher reading level. Despite the difficulties the five year old player could have found, all of them have been able to finish the game thanks to the help given by the guide character. Moreover, the sounds implemented helped the children because at those ages, in school the English language is taught principally by speaking.

- Puzzle game: it has result the most difficult game for all the children. The main problem was the monochrome map, it was difficult for them to distinguish the different pieces of the puzzle and the correct position to place them. There were two suggestions given, the first one was to add more colours to the image and elements on the map, the second one was to change the mechanic of the game. Instead of being based-on-click, it would be easier if it was based-on-dragging.

- Pairs game: it may has been the most successful game. On the one hand, the timer supposed a challenge for the players because it forced them to pay attention and not waste the time given. They had to stay focused on the activity. On the other hand, it generated a little stress and competitivity due to the fact that they never want to lose. Although it could frustrate the children, it helped them to deal with those feelings.

- Memories game: it has been an easy activity for all the children. The five year old child had more difficulties because of the timer and the speed of the game.

As explained before, the game *Holidays* includes sounds to give feedback and help the player to complete the different levels. It was confirmed that these sounds, as well as the messages from the guide character, were motivating for the children.

As a result of the evaluation, some ideas came up in order to improve the game:

- Inventing more games and activities with an increase of the game story to connect all of them. It would bring more possibilities of playing.

- Adding more themes in order to have more destinations to travel to, for example the snow or a city.

- Designing more objects per theme in order to be less repetitive. It would be a great idea for the older children.

- Creating more designs of the guide character.

- Changing the functioning of the list game in order to make it more randomized.

- Improving the puzzle activity by changing the based-on-click mechanic for a based-on-drag one.

- Developing the game for iOS.

Chapter 7: Deviations from the project

During the development of the project *Holidays*, the initial planification estimated at the technical proposal has been changed. Although the tasks have remained the same as the presented at the technical proposal, the hours dedicated to each one has been modified. Here there is a reminder of the initial planification:

TASK	Hours	W1	W2	W3	W4	W5	W6	W7	W8
T1: Technical proposal	12	8	-	-	-	-	-	-	4
T2: Investigation	8	5	2	1	-	-	-	-	-
T3: Definition of the different levels	10	-	5	5	-	-	-	-	-
T4: Creation and development of the story	20	-	10	5	5	-	-	-	-
T5: Art design	110	-	30	25	20	10	15	8	2
T6. Sound design	10	-	-	-	-	2	6	2	-
T7: Programming	115	-	15	25	25	15	20	15	-
T8: Documentation	15	-	-	-	-	-	2	3	10

Table 1. Initial planification of the project

The investigation of the possible abilities took more time than the estimated at the start of the project, there were a lot of pages for research and a lot of ideas for games and pastimes. All the cognitive abilities, like the attention, that wanted to be improved with the game needed a deeper study in order to understand the problems that can suppose for the children and the best way to face them.

There is a difference of 20 hours between the time estimated for the art design and its final time for development, this is due to the reuse of some graphic elements like the buttons, all of them have the same style with the change of the word written on them. The biggest consequence of the decrease of hours in this task is because of the lack of a main character. As explained before, the initial idea was to have a character that the player could associate with him, this idea was discarded in order to immerse more the player into the game and make him feel part of it.

The creation of the story, the programming and the sound design tasks have had a little decrease of the number of hours for their development. Even though there are some tasks done, like the testing, that are not considered in the planification, the reduce of hours explained before helped for their realization.

Although all the tasks seem to have reduced their time needed for their development, the final task, the documentation, has increased a considerable number of hours in comparison with the initial planification. When the planification was done, all the work that this task needed was thought to be faster and easier. During its writing, the explanation of all the aspects of the game and their development needed a more exhausting work including all the details explained clearly and adding all the necessary images, tables and codes used.

Here is a more accurate table of the actual development planification:

TASK	Hours	W1	W2	W3	W4	W5	W6	W7	W8
T1: Technical proposal	12	8	-	-	-	-	-	-	4
T2: Investigation	15	7	5	2	-	-	-	-	-
T3: Definition of the different levels	10	-	5	5	-	-	-	-	-
T4: Creation and development of the story	17	-	10	5	2	-	-	-	-
T5: Art design	90	-	30	15	20	10	10	3	2
T6. Sound design	8	-	-	-	-	-	6	2	-
T7: Programming	110	-	20	35	25	15	10	5	-
T8: Documentation	38	-	-	2	-	-	3	10	23

Table 3. Final planification of the project

Chapter 8: Conclusion

In order to give my personal opinion and explain the experience acquired during the whole process of development of the project, the chapter will be written in first person.

Due to the wide variety of possible projects proposed and the doubts created for choosing one, my election was influenced by my sister. She works as a teacher in a school and has always exposed the need of short games which keep the attention and motivation of the children and use them as a pedagogical tool.

Moreover, children live nowadays in a digital world and they are surrounded by technological devices since their birth. The new educational methodologies want to improve the digital competence, so it is necessary for teachers to have different ways to work on it. That is why the educational games' market is at its peak.

During these four years of degree I have been taught a lot of different and interesting subjects. I would remark the importance of some of them to create my own project:

- VJ 1209: 2D Design and VJ 1223: Art of the Video games: the techniques learned with this subjects were very useful for the development of all the artistic design and the aesthetic of the game.

- VJ 1203: Programming I and VJ 1208: Programming II: both helped with the implementation of repetition control structures and loops with stop condition or iteration control.

- VJ 1227: Game Engines: it was useful for the development of the project with the game engine Unity 3D.

Talking about my personal experience during the creation of *Holidays* with more detail, a remarkable aspect would be the challenge that it has supposed to me. Besides the difficulties found in programming and investigation, I have always been motivated with the project because is the reflection of the knowledge obtained during the degree.

The biggest difficult I found was the research and election of the pastimes and its adaptation and implementation into a video game. There were a lot of possibilities and a lot of different ways to design them. Another aspect in which I thought for a long time was the artistic design of the game, because it had to be simple but attractive for a child, with bright colours and recognizable elements in order to facilitate the learning combined with the entertainment.

At the beginning, I planned to use English as the main language for the game, but taking into account the ages of the players, it was a better option mixing English and Spanish in order to make the game easier for the youngest players. That's why the explanations of the guide character are in Spanish but the objects are written in English.

One of the objectives was to provide a motivating learning tool for the children. From my point of view, this objective has been accomplished because the activities proposed are usually played by hand, and using new technologies, the game has an extra motivation, which is related with other objective planned.

The main objective was to improve the attention, memory and cognitive development of the player. Despite the fact that it would be necessary a long period of time to verify its effectiveness, it is confirmed that it works with children.

During the project development, I have learned the different ways to face the problems that children have in order to learn and being concentrate for a period of time. It has also improved my level of programming and the ability to detect the troubles in the code and their resolution. Moreover, the writing of the technical report has helped me to learn new vocabulary and expressions related with the video game industry. The language required to use for its writing supposed an extra difficulty because it is not my mother tongue.

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