LudoPor
Word Games Creation Platform

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While I have done a lot of work on this project, it would not have been possible without the help of many great people. I would like to thank my mother and my wonderful girlfriend who have encouraged me in everything I have ever done. I also owe a great amount to my thesis supervisor, Rui Prada whose advice and criticism has been critical in this project. Next I would like to thank the Ciberduvidas community, especially Ana Martins, for having the time and will to try and experiment my prototypes. A special thanks is owed to my good friend António Leonardo and all the users that helped in this project especially the ones in the weekly meetings.
Abstract

This thesis presents an approach for creating Word Games. We researched word games as Trivial Pursuit, Scrabble and more to establish reasons for their success. After this research we proposed a conceptual model using key concepts present in many of those games. The model defines the Game World with concepts such as the World Representation, Player, Challenges, Links, Goals and Performance Indicators. Then we created LudoPor - a prototype of a platform using some of the referred concepts. The prototype was made using an iterative design starting from paper prototypes to high fidelity prototypes using user evaluation tests to help define the right path. In this task we had the help of many users including persons of Ciberdúvidas (a Portuguese language community). Another objective of LudoPor was to create games for Ciberdúvidas that would be shown in their website.

Keywords

Word games, Game Creation Platform, Prototyping, User evaluation, Game World, Word games Mechanics
Resumo

Esta dissertação apresenta uma abordagem para um modelo para criar Jogos de Palavras. Para a elaboração desta plataforma pesquisamos em jogos como o Trivial Pursuit, Scrabble e outros para sabermos as razões do seu sucesso. Depois desta pesquisa propusemos um modelo conceptual utilizando conceitos chaves presentes em muitos desses jogos. Este modelo define um Mundo de Jogo e os seus conceitos como por exemplo o Tabuleiro, o Jogador, os Desafios, os Objectivos e os Indicadores de Desempenho. De seguida criámos o LudoPor - uma plataforma utilizando alguns desses conceitos. Esta plataforma foi desenhada iterativamente começando em simples protótipos de papel até um protótipo de alta funcionalidade sempre utilizando testes com utilizadores como linha de orientação. Para ajudar nesta tarefa tivemos a ajuda de muitos utilizadores incluindo pessoas do Ciberdúvidas (uma comunidade de língua portuguesa). Este protótipo de alta funcionalidade tem também como objectivo criar jogos para o Ciberdúvidas de modo a que possam ser utilizados na sua página da Internet.

Palavras-Chave

Jogos de Palavras, Plataforma para criação Jogos, Prototipagem, Testes Utilizador, Mundo de Jogo, Mecânicas de palavras
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Introduction

“Video games are an untapped resource in the field of education and will remain so until adequate teacher resource is provided.” - Maja & Paul Pivec (2008), Games in Schools Report

1 Thesis

This thesis is an applied investigation to develop a conceptual model that can be used to create successful word games. Due context, we chose creating word games.

It starts by researching work on successful Word Games to gather a set of characteristics present in those games. After we propose a model and guidelines for creating Word Games. Finally we create a platform that allows the creation of word games based on that model. This platform will supply a community with the tool for creating their own games.

So the contributions of this thesis include:

- A research work about success elements in Word Games.
- A conceptual model for creating games with those success elements.
- A platform with the key concepts of the conceptual model that can deliver word games that supply Ciberdúvidas to use in their website.

2 Motivation

In the last 20 years, video games have infiltrated our way of life. Either by watching other people play, by playing ourselves or by seeing the immense marketing associated to video games, they have established in our lives in an incredibly robust way.

Since the beginning, video games have been seen and made as entertainment. As creating games is a difficult task and games vary on the player age, industry has grown focused on pré-teen and teen entertainment.

The market may have started like that, but players have grown up and didn’t stop playing [1]. In fact, according to a study made by ISFE (Interactive Software Federation of Europe) the average game player age in Spain is 26 years old, in Finland is 30 years old and United Kingdom is 33 [2].
Having that many players more 26 years which surely have responsibilities such as work or family, they lack the time to play commercial games that take hours and hours to finish. So, many of them are turning to the called casual games.

Casual games are games that are distinguished by their simple rules and lack of time commitment required. They require no long-term time commitment or special skills to play. Many of these games focus on relaxing the player. They are comparatively low production and distribution costs for the producer. Since this games have simple rules it is easy to distinguish them by their gameplay.

There are several types of gameplay in the casual gaming such as Click Management, Hidden Objects, Adventure, Match 3 or more and Word games. Word Games had a recent grown in the number of available games and popularity as we can see in the following figure 1.

Note that the score stated in the figure represents a formula for calculating the most popular games. The score is calculated in weekly basis and it is represented in the following equations

\[ \text{Score} = \sum_{i}^{\text{WeeksInRank}} \text{ScorePerWeek} \] (1)

\[ \text{ScorePerWeek} = 11 - \text{WeekRank} \] (2)

For example, a game A which has been at the number 1 for 15 weeks will get a Total Score of 150 (as stated in the following equation 3). These equations, the scores and the data have been collected by Casual Charts. [3]

\[ \sum_{i}^{5}(11 - 1) = 150 \] (3)
As we can see in figure 1, the scores in Word games are conclusive about the popularity of the genre. Could this popularity be used not only for relaxing, but also for teaching purposes? Well recently a report about the use of games in schools has been conclusive about this issue.

As stated in “Games in Schools Report” [4], made for an ISFE-EUN Partnership, games can not only provide a valuable resource in schools, but can extend outside the classroom and provide a platform for study aids. Also this report states that some professions, namely medical ones, have been quicker on the uptake of these technologies. Some examples have been documented.

One interesting conclusion for the study is that the games used for helping education are usually developed for that purpose. When such a game is used it will tend to be a commercial-off-the-shelf (COTS), often a recreational game, or a commercial game that has been modified for the desired learning outcome.

So concluding word games are popular, can be used for education and are made for a specific content. Therefore it raises the need of a platform for creating word games which can be usable by teachers, educators and others that have little knowledge in creating computer games.

3 Context

Ciberdúvidas is a community specialized in the Portuguese Language. In their internet portal, they answer questions sent about several subjects concerning all aspects of Portuguese, for example, the origin of words, grammatical issues, etc. In addition, the portal shows articles, promotes debates about current Portuguese Language issues and helps the support of the language around the world.

They want to add some dynamic and interactive content, such as games to increase diversity in the website. So they cooperated with us to provide information and help in creating a platform that allows them to create such games. The games in their website should support the Portuguese content, for example, show some content about grammar and in the end display a game about that content. The games themselves should not be the main reason the users go to the website, but to increase motivation for them.

Since the platform is to be used by this community, the games generated must have some distinct characteristics, they should be able to be educational and use word games. They must be able to approach an adult audience (the main target of the website) and that could be distributed over the
internet. Also the fact the games are supportive to a subject indicates that games created should be small and fast (0-15 min) to play, so it should use appropriate mechanics and motivation.

The platform is focused to be used by a community that have little or none computer programming skills so the platform has to be graphical and should be easy to work with.

4 Document Overview

Besides this Introduction this thesis is divided in four main chapters: Related Work, Conceptual Model, Implementation of the platform and Conclusion.

In Related Work is approached the research made for the thesis, why such research was made and what conclusions could we retrieve from it.

Based on the Related Work we propose a solution for creating Word Games. In the Conceptual Model we describe the key concepts that we determined in reviewing successful word games, as well as options and benefits and how it can be used.

After designing the Model we try it by designing and implementing a prototype. Since the prototype is to be used by Ciberduvidas we made the prototype in an iterate way, testing it with end users to assure that it will allow future users to easily create games.

Finally in the Conclusion we summarize the methodology and review the next research step.
Related Work

1 Introduction

The purpose of this chapter is to review successful word games, their mechanics and other platforms related to this thesis. The goal is to help develop a model for word games and a platform to allow a community of persons to create word games. It is important to refer that the community has little knowledge in programming games. For that reason the platform has to be simple to use, but capable to be used with diverse educational content.

This chapter is divided in four major sections, Word Games, Game Mechanics, Educational Game Platforms and Conclusions. Word Games shows several word games and has the purpose to review the most successful word games. These games are played has a source of entertainment, but they also have an educational purpose. The most important characteristic to retain of those games is the way that they are played – its mechanics.

Section Game Mechanics discusses how the Word games reviewed are played. Separating the way that they are played from other components such as setting or story is very important so that the future platform create games that use predefined mechanics. In this way, we expect a level of involvement by players in the created games that would not be possible to obtain otherwise.

In the third section we review word game platforms to understand what is already made and possible problems in creating such a platform.

Finally the fourth section – Conclusions. Here we show some interesting characteristics found in the games reviewed, the game mechanics used, good game design techniques and issues of the currently used platforms.

2 Word Games

In the following section we are going to review word games. It is shown characteristics like where and by whom the games were created, by how many persons they are played, how they are played, variations of those games and some educational considerations.
2.1 Crosswords (1913)

Crosswords had their origins in United States being created by “Arthur Wynne”. They were published in “New York World” journal in the year 1913. However a version of this game was found in Ancient Egypt.

It is normally played alone, but it can be resolved by one or more persons. Consists in filling several words formed by white cells. Some words are displayed vertically while others are horizontal.

To find those words it is necessary to solve clues or answer questions. The words cross between them so filling a word it can fill some cells of the words that it crosses, becoming easier to find those words.

The layout of the black cells in crossword is varied, but follows several tendencies depending on their origin like we can see in the Figures 2, 3 and 4.

Crosswords have several variations using some different kinds of clues or questions. For example, themes where it is asked questions concerning a theme. One of the most popular variation, because of it increased difficulty, are the cryptic crosswords where every question is a puzzle itself using several mechanics like anagram, charades and other of difficult resolution.

There are many competitions of this game. Recent example of it was the world championship organized in 2007 in Brazil by World Puzzle Federation with 23 teams of several countries and with 95 individual competitors.

Crosswords are very dependable of the question which makes the game easily adaptable to a learning context and diverse educational content. It can be used for vocabulary, general knowledge and grammar at some extend. It can also be used for text interpretation. The answers are written letter by letter so there isn’t any luck involved. However, the facts that after responding a word we know
letters from the words it crosses and that we know the size of the word, helps guessing the words without knowing the real answers.

2.2 Hangman (1884)

The first references to Hangman were found during the British Victorian times, in 1894 being mentioned on the book "Traditional Games" of Alice Bertha Gomme’s. In that book had the name of "Birds, Beasts and Fishes" [8].

It is normally played in pairs and consists in a player choosing a word another finding it. In order to find the word, the player must choose letters of the alphabet. When a chosen letter belongs to the word every occurrence of the chosen letter are revealed by the other player. But if the letter does not belong to the word then the player has failed. In such case a part of the hangman is drawn.

When the hangman is fully drawn (6 parts) the player choosing letters loses the game. If he can find the word then he wins. Usually words have some letters revealed (first and last) to make the game more logical and less luck dependent.

There are not many variations of this game, but sometimes are letters chosen with specific themes or hints can be given to help finding the hidden word. It can be also used with an expression instead of a single word.

Hangman is a small game where a player guesses a word. It makes the game casual and fast to be played. Also the game can be used within an educational context by making questions to help guessing the right word. This allows that the game to be used within almost educational context. The game also does not have any luck associated to help finding the answer.

Like crosswords the game also has hints (one can ask for a letter of the alphabet before knowing the answer) which helps in finding answers.

2.3 Scrabble (1931)

This famous board game was made in 1931 by an architect called Alfred Mosher Butts in United States. It was made during the time of the big depression where he and many persons lost their jobs. At the time the game was named Lexico and had no success. The proposals for big game companies and even its patent were refused. Some years later in 1938 with the huge popularity of
crosswords, Alfred evolved its design. He thought that had chance in succeeding with the game but had the same fate that in 1931. Only after the Second World War in 1948, the two brothers Brunot acquired the rights to manufacture the game and trusted it would sell. After some retouch like renaming, the game was finally trademarked. Took them 4 years to the game to start profiting but finally, the president of Macy's (a big department store network in United States) discovered the game while on vacation. He liked the game and ordered some for his store. Within a year, everyone “had to have one”[10].

Scrabble board has 15 for 15 spaces and each can only contain one tile. There are 100 tiles, 98 have a letter and a score written (in the English version) and the remaining two have nothing written. There is also an opaque bag to put the tiles.

The game is played by connecting letters in a player possession with the ones in the table in order to make words.

In the beginning all tiles are put in the bag and each player gets seven tiles. Then the first player makes a word placing it in the centre of the board. Each player can make one or more words each turn. When his turn ends he must get tiles from the bag until he has seven again. If a player cannot form words then he must either pass the turn or exchange tiles with the ones at the bag. He can exchange up to seven tiles, but he cannot choose the tiles that he will get from the bag. Also while exchanging them he must hide the tiles from everyone.

When a player forms a word his score is added with the sum of each score of the letter of the word. The pieces that have nothing written can be used for any letter, but they have no score. The board has four types of special spaces which increase the score of words formed in top of them. There are Double Letter Score (doubles the score of the letter placed in top of it), Triple Letter Score (triples the score of letter placed in top of it), Double Word Score (doubles the score of the word placed in top of it) and Triple Word Score (triples the score of the word in top of it).

If a player uses all seven tiles in the rack in a single play, a bonus of 50 points is added to the score of that play. These bonus points are not affected by premium squares.
The game ends when everyone passes the turn twice in succession or when all tiles are drawn and a player empties is rack.

In the end each player's score is reduced by the sum of his/her unplayed letters. In addition, if a player has used all of his or her letters, the sum of the other player's unplayed letters is added to that player's score.

Scrabble pieces vary from language to language, because they may have different alphabet and the number of the words that have the same letter change drastically. So each language has their own letters and score [11].

There are hundreds of tournaments of Scrabble each year only in US. National Scrabble Association organizes and sanctions more than 250 tournaments. The greatest one is the “United States Scrabble Open” that in 2007 had 625 participants and prize money of 25 thousand dollars and even TV broadcast [12].

Scrabble is a game indicated to enlarge and improve the player vocabulary. It is very orientated to this task and it is difficult (but not impossible) to use this game for other educational content. One way of doing it is by limiting the words that can be made to pre-established themes.

2.4 Trivial Pursuit (1979)

Trivial Pursuit was made in 15 December of 1979 by Chris Haney and Scott Abbott. During an argument of who was the best player they decided to make a game to take out the doubts. In a couple of hours this two friends made the rules of Trivial Pursuit. Two years later they started a company along with two more friends and had the game ready to be sold. After some problems and complications (mainly monetary since they sold by 15 dollars a game that costed 75) things finally began to go their way. Chieftain Products Ltd. became their Canadian distributor beginning October 1, 1982 and in 1983 they introduced the game to the Selchow & Righter game company for the United States market. As the result over 20 million games were sold [13] just in 1984.
Each player (or team of players) plays with its own piece. As seen above in figure 7 Trivial Pursuit pieces are peculiar. They have cylinder shape, and has space inside to put 6 wedges. Each wedge resembles a slice of a pie.

As we can see in figure 8, the board has also a peculiar shape since it has a circle form with 6 connections to a hexagonal centre. It resembles a car wheel with 6 spokes. The spaces in end of each spoke are the called headquarter spaces.

The game has many questions divided in 6 different categories of different subjects. Each category has one colour. Each space on the board has one of the six categories associated and each headquarter space have different categories.

To move the player piece he must roll a 6 sided dice to know the number of spaces that he can move. In the case that the player stops he must answer a quest on of that space category. If he answers correctly he can play again. If the space where he answered correctly was a headquarter space then the player gets a wedge of that category colour. If the player does not answer correctly, his turn passes and the next player starts to play.

Each player starts at the hexagonal centre and the game objective is to collect all the wedges and them return to the centre. Once he returns to the centre he must answer correctly to a question in a category chosen by the rival players. If he answers correctly wins the game.

Like in Crosswords, the fact that this game depends on the questions has made a number of different variations of theme questions like Pop Culture or Lord of the Rings.

In an Educational aspect the fact that Trivial Pursuit has multiple mechanics (multiple choice and Questions and Answers) and is completely dependable on the question makes it very flexible for educational purposes. It is usually used for general knowledge, but can be used for any educational
issue. Another relevant characteristic is that it is a game that requires some time playing. It is not quick or fast like Hangman.

2.5 Word Chain (1879)

This game was invented in the late 19th century by Lewis Carroll, author of *Alice in Wonderland*. It was originally called ‘Doublets’, but it is more commonly known today as Word Chains or Word Ladders. It made its first appearance in 1879, in the pages of a magazine called *Vanity Fair*, and it has been a form of Word Puzzle ever since.

Word Chain is a game in which one word is turned into another through a process of substituting single letters. A new valid word (excluding proper nouns) must be formed each time a letter is replaced. Originally, Lewis Carroll made this game in a way that only words of the same length were to be used and the first and the last letter must be related. Today it is normally played without these restraint and leads to two more word transformation, adding a letter and removing one. In addition the game can also use another word transformation to form words – anagrams (using the same letters in a different order).

There are some variations of the game like Word Golf, where players score points according to the number of steps taken. As in regular golf, the player with the lowest score at the end of the game wins. Other somewhat popular variant is playing the game using another word transformation – letterbank (take all non duplicate letters in a word and use them to create new words, you must use all letters, but you can use them as often as you wish).

Word Chain is a game made to be educational and to train and expand player’s vocabulary. It is a game a bit difficult to play since it needs a large vocabulary. It is suited to be played alone. Since this game was made focusing vocabulary then it is difficult to adapt to other educational context.

2.6 Boggle (1972)

Boggle was invented by Alan Turoff in 1972. Like other board games the game failed when first introduced to the public. However various consumers sent letters to Boggle manufacture (Parker
Brothers) sparked interest in the game and in 1976 was relaunched. With some fine tuning by Parker's internal designers and an expensive print campaign, the game had huge success [17].

The game begins by shaking a covered tray of sixteen cubic dice. Each die has a different letter printed on each of its sides. The dice settle into a four by four tray in a way that only the top letter of each cube is visible as the tray seen in Figure 10. After they have settled into the grid, a three-minute timer is started and all players simultaneously start to play.

Each player searches for words that can be constructed from the letters of sequentially adjacent cubes. Adjacent cubes are horizontal, vertical or diagonal neighbours. Words must be at three letters long, may include singular and plural (or other derived forms) separately, but may not use the same letter cube more than once per word. Each player records all the words he or she finds by writing on a private sheet of paper. After three minutes have elapsed, all players must stop writing and game ends.

After that, players start counting their scores. To know their score each player counts the number of words that he found and their length. Score is counted like this: 3 and 4 letter words count 1 point, 5 letter add 2 points, 6 letter count 3 points, 7 letter sums 5 points and finally 8 or more letter add 11 points [18].

There are several variants of the game, but the most successful was Boggle Master that had a five by five board and twenty dice allowing more words to be made.

Despite the success of Boggle it never had competitive tournaments. Organized play is made by some official clubs linked to educational institutes like the University of Michigan Boggle Club or Dartmouth Union of Bogglers at Dartmouth College.

Boggle is much like Scrabble in its educational purpose and is a game that is indicated mainly to enlarge and improve vocabulary. It is also a game that uses a time factor. I can be good because it makes the games faster and promotes competition increasing motivation to play. But, in the opposite, the time factor can frustrate players.
2.7 Scattergories (1988)

Scattergories is a party game made by Milton Bradley Company. It was produced by Hasbro and published in 1988.

The game is started like this: first 12 categories are chosen from the existing 144, and then a special dice (a twenty-sided dice with the most common letters written instead of numbers) is rolled. After that players have three minutes to remember a word beginning with letter revealed by the dice for each category.

In the scoring phase each player’s answers are compared, if the answer is unique (no one else wrote the same word) then the player gains one point. Otherwise, either if he did not answer nor had the same answer that one of the players he does not get any points. The game promotes alliteration, (repetition of a lead sound in a phrase) by adding extra points when this happens in proper nouns. For example, in a category “Name” and having the letter “P” an answer like “Peter Pan” would get 2 points (if no one else answered it).

After that another round is played by re-rolling the dice and restarting the timer. The game ends at the third round and the player with the highest score by them wins \[^{[19]}\].

Since Scattergories depends heavily on the categories, the game has many variants. It is easy to create them; it just requires creating new categories. Some examples of commercial variants include a children version or a bible version. Also many players play using the alliteration in all answers and not only in proper nouns.

Scattergories is a game easily adaptable to educational purposes, because it just needs to create educational questions and categories. It also uses time factor in games which like in Boggle may be good since increases motivation. It has also a characteristic – the fact that each answer must be unique to score. This characteristic and the fact that everyone answers are shown and compared teaches other players and promotes knowledge.

2.8 Bookworm (2003)

Bookworm began as an experiment by PopCap head Programmer Brian Fiete. He tried to make a word game that wasn't timed but made possible to have interesting words. After the game
designer Jason Kapalka made the basic theme, the game was developed in six months by a team of 4 persons. It was released in February 25, 2003 and got an almost instant success. Today is present in all big casual games Portals like PopCap Games, Steam, Shockwave Games, BigFish Games, Microsoft Gaming Zone, RealOne Arcade and many others.

The game is a word-forming computer puzzle. From a grid of available tiles (each with its own letter), players connect them to form words. As words are formed, they are removed from the grid and the above tiles collapse to fill the available space.

There are several types of tiles, they can be Green, Gold, Sapphire, and Diamond tiles which increase a player score as seen in Fig 12. These tiles appear more often when big words are formed. In opposite, there are Burning tiles that can make a player lose the game. They automatically move down by burning the tiles below and when the bottom of the board is reached the library is burned (representing the end of the game). These tiles appear more often when small words (3 letter length) are formed.

Bookworm is a Word Searching game and its main educational purpose is confined to vocabulary. It has a very good characteristic that the finding small words create red (burning) tiles and finding big words creates tiles that increase score. That is an incentive to create bigger words since to the majority of players score isn’t incentive enough.

2.9 Chicktionary (2007)

Chicktionary was published by Kewlbox and was made by Blockdot and was launched in March, 17 of 2007. It was made popular for its integration with Microsoft Live Search.

The game is an online variation on the game of anagrams. Using only seven letters (represented by chickens) the goal is to fill the quotas of 11 three-letter words, 10 four-letter words
(like “NOTE” as seen in the following figure 14), 10 five-letter words, 3 six-letter words and 1 seven letter-word. These words are represented by sequences of eggs in an egg rack. Once a word is displayed on the box lightens up Word (if new word) or Duplicate (if existing word).

The game has some options – shuffle (where the position of the words changes), help, Hint (a tip is searched in live search and the results displayed), give up (a word is answered and live search gives its definition) and skip that ends the current game and restarts it.

Chicktionary has some interesting characteristics. One of the most interesting is the hint button that searches in live search for a hint and displays the results. This increases motivation since it allows another path to guess a word. Another is that once a word is found it is searched with the live search engine for definitions.

Once a player finishes a round by filling up all the sequences of eggs, she or he gets 20 points. A player can accumulate those points and trade them with live prizes.

A curiosity of this game is that it is associated to boost Microsoft Live Search share in the market at the expense of their closest competitors (Google and Yahoo).

Chicktionary is an interesting game since it merges two mechanics - letter rearrangement and questions or answers (when using the hint button). It makes this game indicated for general knowledge, but easy to adaptable to any educational content.

2.10 True or False Quiz (unknown)

Quiz is a form of a game where players (one or many) try to answer various questions quickly. In this particular example it is used a True or False mechanic. This kind of Quizzes has an almost infinite range of uses since almost all the questions can be used and they determine the quiz.

Normally these quizzes are two types: the ones that are used to teach something and the one used to test or consolidate previous knowledge.

The ones that teach usually follow some kind of learning line, with no time limit involved. Also they all correct the questions, explaining the wrong ones.
When they are used to test or consolidate previous knowledge they use time limit. They are also difficult and some questions are used to test only certain matters. They usually correct the answers, but only after they are all answered.

True or false quizzes allow diverse educational content since its mechanic can use a large possibility of questions. They also easy to correct, but have a luck factor applied since a person can try to guess the answer and have decent results, because it only can be true or false. This makes this kind of game bad in evaluating knowledge.

2.11 Mad Libs (1953)

Mad Libs (play on ad lib, from Latin ad libitum - as you wish) is a simple game created in 1953 by Leonard Stern and Roger Price, who created the game as a joke between two writers.[23]

The Mad Libs book has on each page a short story with open spaces (or gaps) to fill. In each gap is written a lexical category like noun, verb and many more that describes what is to fill. Each player asks in turn for a word to fill the gap. When all the gaps are filled then the story is read. Usually this creates a comic and nonsensical story.
There is a usually known educational variant used in tests and exams. By using the word on the present tense the player must conjugate the word in the correct tense to fill the gap correctly.

Although we don’t know if the game is a variant of the educational version or vice-versa, for this work the educational versions of the game are the ones we are interested in.

The educational variant is very good in assessing knowledge since it is flexible and allows many different uses in an educational context.

2.12 Match Games (unknown)

This game is very common to find in the Internet and is normally found in many learning books. We can’t find the origin of such game or a generally known commercial version. The game is very simple and it’s usually seen as exercise instead of a game.

Match games requires only connecting two or more elements of the game.

Games like this are seen in websites like, for example, “Ludo Tech – jogos para distrair e aprender” [24] and “Education Place” [25]. These games are used either to teach or to train aspects of grammar, vocabulary or some text interpretation.

3 Game Mechanics

In this section, the focus is identifying and describing the mechanics of the reviewed word games. What are their characteristics and indications and discuss the problems and advantages of using each one.

3.1 Questions and Answers

In is basic form this game mechanic consists in someone (player or not) asking a question to a player. The player must remember or discover the answer. Trivial Pursuit and Crosswords are good examples of how this mechanic can be used. There are two subtypes of this mechanic – direct questions and questions with hints presented below.
When questions are *direct* there are pre-conceived answers, but they cannot be told to the player. Direct answers are to be answered fast and short usually with only one or two words. Since it leads to smaller answers it is easier to correct.

*Questions with hints* are questions that have hints which help the player find the answers. By example, the game of crosswords shows the size of the word and may even show some letters of it.

This whole mechanic of *Questions and Answers* has one problem – it is difficult to do automated correction correctly. In direct questions it is only possible by accepting as correct various equivalent answers. But even then we cannot program the game with having every synonym that the answer has. This problem is present in Trivial Pursuit where a written answer is equivalent (but not the same) that the players answer. In those cases usually team asking the questions recognizes and allows the answer. When using hints we can force an exact answer, but it is frustrating for many players.

The mechanic has a very good characteristic, it is very luck independent since a player can try and guess an answer, but he or she has to do it with his own knowledge.

### 3.2 Multiple choice

Frederick J. Kelly is credited with creating *multiple choice* questions in 1914 at the University of Kansas [25]. One of the first uses of *multiple choice* questions was to assess the capabilities of World War I military recruits.

This mechanic is similar to the *Questions and Answers* with the difference that the correct answer is shown together with some wrong answers instead of *Questions and Answers* does not show any kind of answers. There are several subclasses of the mechanic depending on the purpose that the *Multiple choice* is made.

*Multiple choices* may have the disadvantage of having luck involved thus players may rather guess instead of trying to determine the correct answer. One other problem of *multiple choices*, is that it must be very well elaborated, or it can create ambiguity in interpreting the question. In that case it may result in an incorrect answer even that the reasoning is of the player is right.

On the other side *multiple choices* is easy to correct since they allow automated correction and can be a fast way to assess knowledge.

Multiple questions can take two different forms – *Dual Answer* and *True or False.*
**Dual Answer** is a *multiple choice* that has only two answers. The correct answer depends on the sentence that it is inserted. It is usually used in grammar so that it is possible to test difficult situations where two similar words can be used. In this situation the luck factor became more critical as there are fewer options.

*True or False* is a mechanic where the player has to find out if a sentence is true or false. The player has to use his own knowledge to assert the sentence. It is sometimes required that the player justify its answer. This technique is used to stop some players that try to guess the answer by luck (the luck became more critical due the lack of choices). This also shapes the mechanic almost in a Question and Answer mechanic.

### 3.3 Matching

A popular way to test player’s knowledge is to make them play a game that requires *Matching* two elements. Match games are played by a player creating a sort of connection, such drag and drop in the digital version or a line in the paper version, between two or more elements of the game, such as words and a sentence, two words or two sentences or many other possibilities. The classical *Matching* game, is having two columns and having to connect elements from the left column to the right column.

Match Games is a type of mechanic that tries to consolidate knowledge, or train memory of players. Most times this is used in definitions and to complete sentences. This mechanic is capable to be corrected automatic, since it is just needs to know what are the correct connections between elements.

### 3.4 Filling in the Gaps

*Filling in the Gaps* is a game that can be also a form of assessing knowledge. It consists in having open spaces that the player must fill in other to complete a sentence or a text. It can be played in two basic ways that can change its the educational value.

The mechanic purely for entertainment consists in having one player asking another for words that the first does not know where they are going to be put. That creates nonsensical but humorous text. It is used in Mad Libs.
The mechanic for education is played with the player knowing the text. It exists usually in two different methods. One is using several options (*multiple choices*) for each gap. The problem of using this method is that creates the problem of the luck factor (as seen in *multiple choices*). Another is showing the word (on a present tense) first so that the player has to conjugate the word in the correct tense of the phrase. This mechanic is easily adaptable to other educational content.

It is very good to consolidate knowledge since it requires to interpretate the text while training grammar. It is also of easy correction since it is just necessary to check the word filled.

A problem of filling in gaps is that it is necessary to create a whole text to make one exercise and the gaps in the text must not allow second interpretations or the player can become confused.

### 3.5 Word Forming

*Word Forming* is the mechanic that using a limited number of letters a player forms one or more words. It is one of the most popular mechanics of the games in casual games that were distributed using the Internet.

This mechanic is indicated for vocabulary. Can be used for other subjects like grammar or text interpretation, but it is more difficult to adapt because the mechanic is difficult to control since there are many words and their formation depends on the player knowledge. The most effective way in controlling is to limit the formed words to a category.

The correction of this kind of mechanic is pretty straightforward. It is just necessary to see if the formed word exists and is valid or not. It is possible to be done automatically provided that we have a list of all words in digital form.

Many of the games reviewed use this mechanic - Scrabble, Word Chain and Chicktionary. Several forms of *Word Forming* exist being the most popular the variations *Board Word Forming*, *Letter Rearrangement* and *Word Substitution*. *Board Word Forming* is the type present in Scrabble. It’s played by having a limited number of letters and form words by joining them with more already made.

Other type of *Word Forming* is *Letter Rearrangement*. In this type we have a limited number of letters and the task is to form words using those letters. The main difference between this type and *Board Word Forming* is that *Letter Rearrangement* does not need pre-made words. Chicktionary is an example of a game using this type of *Word Forming*. Finally *Word Substitution* is type of *Word
Forming where from a previous word we replace a letter to another at our choice to form another word. This type is used in Word Chain.

3.6 Word Searching

This mechanic is played by having a grid and searching a word in the letters on that grid. It is also popular but unlike Word Forming it is used mainly in a non digital context, like for example The Word Search in magazines or newspapers.

Originally the game was played by searching words in the 8 directions on a grid. As soon a direction was chosen it couldn’t be changed. However it is normal to see games where you can change direction after a letter is chosen like in Bookworm. Also all the words were shown before searching. Today almost all the reviewed games use a random letters in the grid.

Educationally this mechanic is very similar with Word Forming. It’s more entertainable than didactic. It is indicated for vocabulary but it is easier to adapt into asserting any educational subject. The biggest problem of that is that like the answers are shown since they are simply in the grid. So the mechanic rewards good searchers (provided that if they see the answer they will recognize it) and not people that knows the answer.

One good characteristic is that this mechanic is easy correction and is possible to have automated correction as well – it is just necessary to have a list of solutions for each grid (if pre-made) or assert if the word made exists and is valid.

3.7 Combining Game Mechanics

It is clear that the mechanics that we reviewed are simple and offer a straightforward gameplay. However sometimes it is necessary to use a mechanic indicated for a subject but need one or more characteristics of another mechanic. For that it’s common combining 2 or more mechanics. For example in filling in the gaps merged with multiple choices makes a game mechanic where a number of limited options are shown for each gap. The purpose of this merging may be to use the interpretation of the text of the mechanic Filling in the Gaps with an automated correction of the mechanic Multiple choice.

Usually either Questions and Answers or multiple choice are used to merge with another mechanic. Questions and Answers if the intention is to reduce the luck factor, make games more
difficult to be guessed while *multiple choices* is used if the purpose is more to help correction by making automated correction.

Although the preference for *Questions and Answers* or *Multiple Choice* the fact is any mechanic can be merged, creating different and original mechanics.

### 3.8 Comparative Table

<table>
<thead>
<tr>
<th></th>
<th>Questions and Answers</th>
<th>Multiple Choice</th>
<th>Matching</th>
<th>Filling in the gaps</th>
<th>Word Forming</th>
<th>Word Searching</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Luck</strong></td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Adaptability to Content</strong></td>
<td>Easy</td>
<td>Easy</td>
<td>Easy</td>
<td>Easy</td>
<td>Difficult</td>
<td>Difficult</td>
</tr>
<tr>
<td><strong>Hints</strong></td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Automated Correction</strong></td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<p>| | | | | | | |</p>
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<thead>
<tr>
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<th></th>
</tr>
</thead>
</table>

Table 1 - Word Mechanics Comparative Table

### 4 Platforms

This section is related to educational game platforms. These are programs currently in use by educators to create games. By evaluating their functionality and identifying their problems we can address problems that can trouble users. We can also identify good solutions to use in our future platform.

#### 4.1 Eyeland Studio

*Eyeland Studio* is not a platform for creating games but a series of customized games for webmaster’s use for a cost. The source code can be licensed to generate unique versions of the games or hire Eyeland Studio Inc to customize the game. There are over 53 customizable games to use. They also make available a few platforms for single mechanics like quiz maker, word search or crossword puzzle. This system is used by Porto Editora in his site “Sítio dos Miudos” [27].
The games that exist in Eyeland Studio website are, in most extend, purely entertainable with some exceptions that are educational (mostly word games).

Among them exists 8 interesting games – Leopardy and Creepy Crossword that explores the Questions and Answers mechanic; Word Scramble that uses the mechanic Word Forming using the type Letter Rearrangement; Wacky Wordsearch, Word Cube game and Wacky Word Wiz using a Word Searching mechanic; The Word Jumbler using mechanic Word Forming using the type Letter Rearrangement allied with Fill in the Gaps.

The biggest problem of this system is that lacks flexibility. The games can be customized, but only once (although a person can hire Eyeland Studio Inc several times).

4.2 Hot Potatos

Hot Potatos is a group of programs (JBC, JMatch, JQuiz, JCross, JMix and JCloze) that can create a different game, automatically creating a website code with it.

The mechanics approached are Fill in the Gaps (JCloze), Multiple Choices (JBC), a drag and drop Matching game (JMatch) and two Questions and Answers – closed answer quiz (JQuiz) and a lead answer quiz (JCrossword).

The program is easy to use with slight interface problems, offer many options in customization and allows making an index or main page. The software is free, but to use in full extend it is necessary to perform a registration. Hot Potatos have a second program called the Masher that is used to manage sites using hot potatos exercises. This particular program is not free and it is necessary to buy a license to use Masher in full extend.
The program is available in many languages, but some options aren’t translated as it should be (like in case of Portuguese language some options appear in English). But you can translate yourself to any language or complete other people translations. Also there isn’t a way to preview how the website is going to be and customization of the website is limited.

One good aspect of Hot Potatos is it allows sending results by mail but the problem is that requires using a Perl script making it difficult for someone without system administration bases.

This program is used for many websites like Ludo Tech [29], Amitiés Françaises [30] and other.

4.3 Linnaeus Séquane - Générateurs d'exercices pour le Web

Linnaeus Séquane is a program made to create drag and drop Matching exercises on the Internet. Currently is used by Ludo Tech website [25] and some other sites to create their games. It is easy to use, pretty straight-forward. Also allows a good level of customization and it’s free under “Creative Commons” license.

On the downside it only allows to create games using one mechanic and even there only on one type of that mechanic. There isn’t a way to preview how the website going to be.

4.4 Inform7

This program is a platform to create Interactive Fiction Games. Also known as Text Adventures this kind of games was very popular in decade of 80’s. This games consisted in a text environment were the players could interact with the world by typing text commands. The games were usually focused on puzzles and had a very strong narrative and a very rich storyline.

Interactive Fiction Games are adventure games that rely on gameplay and setting. Inform7 is a complex program made to create standalone executable programs and not a website. Also Inform7 uses GPL and may be freely distributed with few restrictions. Games made under Inform7 may even be sold for profit.
Since the game type is complex allows several mechanics seen in Game Mechanics section such is the case of Multiple choice, Questions and Answers and Matching as basic actions. However all mechanics can be made using Inform7.

There are two main problems with Inform7, one is the complexity of interface as we can see form fig. 25 where exists about 8 tabs each window and another problem it is used natural language to make games in Inform7 making it complex and requiring a steep learning curve. Yet another problem is the language – although games made with Inform7 can be in any language the program itself uses only English to make games.

4.5 Moodle

Moodle is a project to give educators the best tools to manage and promote learning. It is basically an Open Source Course Management System (CMS), also known as a Learning Management System (LMS) or a Virtual Learning Environment (VLE). It has become very popular among educators around the world as a tool for creating online dynamic web sites for their students and has over 10 million users.

Moodle was created in 2001 by Martin Dougiamas and it is maintained by a big community of programmers, system administrators and educators.

The platform is divided in resources and activities. The resources are static content that is made available by the teacher or webmaster. Activities are the content that is interactive to students. There are many different activities like chat, forums, work assignments, lessons, books, wiki among many others. The most interesting activities for this related work are the quizzes which use the word mechanics stated earlier.
The main problem with this platform is made for use as a server and it requires technical knowledge from a system administrator to prepare and setup. Also Moodle aims to be a support for schools and disciplines so it is made to that context and not only for creating Word Games. The games that are made by it can only be used on Moodle and are not easily ported.

4.6 Comparative Table

<table>
<thead>
<tr>
<th>Platform List</th>
<th>Moodle</th>
<th>Eyeland Studio</th>
<th>Hot Potatos</th>
<th>Linnaeus</th>
<th>Séquane</th>
<th>Inform7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>Free</td>
<td>Ranging $150 to $500 per game</td>
<td>Free</td>
<td>Free</td>
<td>Free</td>
<td>Free</td>
</tr>
<tr>
<td>Games ready for Internet</td>
<td>Yes, but can only be used within Moodle</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Possible Game Mechanics</td>
<td>Matching; Questions and Answers; Fill in the Gaps; Multiple Choice</td>
<td>Matching; Questions and Answers; Word Forming; Word Searching;</td>
<td>Matching; Multiple choice; Fill in the Gaps; Questions and Answers;</td>
<td>Matching</td>
<td>All</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 - Platform Comparative
As we can see on the comparative table, in terms of possible game mechanics the platform Linnaeus Séquane is the less flexible and Inform7 and Moodle are the most flexible, but it needs to be adapted to the full text environment while all other platforms develop games that can be played in graphical way.

Since Inform7 is made to create Interactive Fiction Games it creates standalone executable programs while the others create games ready to be accessed in an Internet browser. Also Moodle is a platform and it allows games only in is platform and in the internet.

Finally in terms of pricing the most expensive option is the Eyeland Studio since the games with its customization cost about 150 to 500 dollars.

5 Conclusions

In this chapter we reviewed some of the most popular and successful word games which provided valuable information that can be used in the creation our word gaming platform.

One of the first and more important conclusions that were taken was that all the games are simple and their mechanics weren’t complex at all. Therefore they are very simple to play and allow a person to easily enter the game (for example, we just need to watch a game of Scrabble to understand how the game is played).

One other characteristic are that these are games hard to master. They have very long learning curve and they need a very good memory and good learning skills to master them. For example anyone can play Scrabble, but the best have huge knowledge of their vocabulary. In order to be good at those games requires learning a great amount of information and that’s one characteristic that we are interested – the educational purpose.

Another characteristic is that many of them are the called Party Games. These games are made to be played in small groups. Therefore requires a good amount of social interaction, making them adequate to be played in a community. This also adds an interesting aspect to games – the competition. Adding competition to educational games is a good technique to try to push its players to learn, but it’s also something to be careful about since not all players are competitive.

Most games that are not played in groups are games with few or none pressure. They were made to give the player a more relaxing time while they can also teach them some aspects.
Mechanics of such games were simple, but add interaction like searches on internet for Hints (Chicktionary) or a possibility of losing with the burning tiles in Bookworm with the purpose of increasing playability and decrease the monotony of these games when played for a long time. Also the red tile in Bookworm is a nice technique to try to push persons to be better - an educational purpose. Also in Chicktionary the fact that it makes search on the Internet for the definition of the word made adds an educational purpose.

Finally some of the games reviewed are “training” games – games where the player have the perception that he has little knowledge in some matter (like some grammar) and wants to train that aspect. These games are made to be educational. The mechanics used in this kind of games resemble ones used in tests and exams. In the large part this is good since players are familiarized with them and these are the most educational mechanics. However it is not very entertainable so players don’t play often and most times they play for little time.

About the platforms it was visible that the most common problem was the complexity made by using many mechanics and the huge possibility of possible content. There were problems in using different layout and customization of the games for non-experts such in case of Hot Potatos where a person had to change html code to fully customize the games. Also in platforms was understandable that none, except Moodle, did an integrated website. They focused on creating a webpage with a game and not a full or a part of the website. This may add some flexibility in creating websites, because it can be used games from many platforms.
1 Introduction

Many successful word games like Trivial Pursuit do not have only mechanic as their unique components in the whole game. They have players, spaces to navigate, tasks to complete, goals to win and more. These components help making the game more entertaining.

All these components that exist in the game constitute the Game World. In a basic definition the Game World is the universe that is represented in the game. These games that have a complex game world with story, several paths, players and different goals can create longer player experiences and add interest to a game. They enable this by forcing the player to learn about the Game World, explore it by delivering and fulfilling expectations to players.

Each game has its own game world and while some are very simple, like in the game Tetris, other can be very rich like World of Warcraft. The use of such complex game worlds has different effects on players. Some players like the richness of these game worlds and it increases their enthusiasm to play while others may be bored by the amount of time and effort used to detail the world especially if the story or setting adds little to the game. A common way used by games to reduce the time and information needed to present the game world is to use worlds or parts of worlds already known to players like using our own world.

We researched about the Game World and his relationship with successful word games and made a list of 5 key concepts. They are: a World Representation, Players, Challenges, Performance Indicators and Goals. In our model we chose a Board to represent the world.

2 Board

The Board is a common world representation used with success in many games like Trivial Pursuit or Scrabble. The board consists of a set of tiles that represent the environment of the game. They show where the player can go and the world layout. Each tile can be filled with a challenge. 

Fig. 27 - Set of empty Tiles
or it can be empty.

The use of the board as the world representation had the benefits of being very flexible, since it allows different contexts to be used (just like using maps for geo-positioning or timelines for time) and therefore allowing many types of games. Also, since it has been so widely used, it provides a familiar type of world representation to the majority of players. There were other possible representations of the world like 3d or platforms but none had the benefits stated earlier.

Boards can be either dynamic or static. Static boards are characterized by not having any changes relevant to gameplay by itself throughout the game. They are “player-centric” were the player actions are responsible for the changes on the board which increases the focus on the challenges.

Dynamic boards are different, because the board changes on its own throughout the game. For example a war game where non playing characters (NPC) fights each other and the player for resources. The evolutions of the NPC are parallel of the player and the world changes besides the player actions. In addition to other players there are some other elements that can influence dynamic game world like time or specific items. For example, the player has a special item that make a multiple choice challenge to remove an incorrect answer automatically.

Games may require the use of one or more different boards to describe the game world. Allowing several boards adds a possibility of having different rules and layouts on each board. For example, a game where in one board is dynamic and in another board where is static. It is important to allow this, because it may be necessary to extend the story or to stimulate players.

One very good example where the platform may need more than just one board is if the game uses a narrative pattern like the Heroes Journey [31]. This pattern is used in many successful films like “The Matrix” or “Star Wars” and it, depending on its formulation, has 17, 12, 10 or 8 stages. All the formulations have as common ground: there is a person (“hero”) in a normal world that suffers a Call to Adventure (in performing an ordeal) that he refuses. Then the hero is convinced to its ordeal by another character, the mentor. Thus forcing the hero to travel to another world where he will be presented to a number of tests and tasks meeting allies and enemies. Finally the hero approaches the lair where he must deal with its ordeal – the climax of the story. After dealing with it the hero retrieves the reward and after some more tests he travels back to the normal world with the reward and transformed by his experience. Although it is possible to use one board to represent both worlds but
applying this pattern to a video game becomes indicated to have at least two different boards with different rules to represent the normal world and the special world.

2.1 Links

The tiles are connected by links which can be of three types – directional, bidirectional or conditional. Links are very important since they help define the layout of the board as well as the paths that the player can travel.

In directional links the player can only move in one way. These links force the player in having to choose between paths, in case there is more than a single path, and blocks the possibility of the player to repeat a previous challenge. These links help making games more interactive and to involve the players. Also these links can increase the longevity of the game since most players may want to repeat the game to experiment other paths.

Bidirectional links offers the choice for the player to come back to the previous challenge. They are important since they add diversity to the games created by the platform and allows more freedom to players.

Conditional links forces the player to complete the condition before allowing advancing in the game. These conditions can be simple, as completing all challenges in a certain place or getting a key to pass a door or a gate. They are very important since they create a sense of accomplishment on players and can work to measure the advancement in the game.

Depending on if there are empty tiles (tiles without challenges) on the boards, it can exist links that lead to empty tiles. This can change the player experience since we can create games that rely more on exploration.

Adding complexity to the game world by increasing exploration can be a double edge sword. In one perspective it can motivate players in exploring the board, but can also bore players that simply want to go to the challenges. These links also give the player more freedom on the movement in the board and game.
designers have to be more careful when creating boards with links to empty tiles.

3 Performance Indicators

The Performance Indicators refers to very important concepts to the game since they can be used to add motivation and to evaluate player’s performance.

There are three Performance Indicators: score, time and items. These indicators can be applied in two ways: it can be applied on the game and therefore relates to the player throughout the game. Alternatively it can be applied to challenges themselves and concerns the player performance only in that challenge.

Score is an indicator of a player’s skills (usually numeric, but it could also be graphical) that the game designer chooses the challenges to have. Depending on the player performance the designer reward or penalize the player (in the latter case the player fails that challenge).

Game Time is a measure of time the player took to finish the game. The Game time is a representation of the time in the game world and not time on real life. In games time can be distorted, illogical and with its own economy (in some games players can trade time for items). Designers also introduce in challenges or goals several different time limits with rewards and penalties. Time just like score can be represented in a graphical or numeric manner and time limit can be added and remove at the designer wishes.

Finally items are object representations that the player collects and uses. Depending on the setting these can also be used as representation for player’s evolution throughout the game.

Items are important to players since they are relevant to the setting and story where the game world passes. It is also relevant that some players see some items not only for its usable aspect but as a trophy. In fact in some games it is the only use of the item. For example, it is motivating for a player to record its score in sort of an item, like stars in Super Mario, that just a number on screen.

4 Goals

There are several types of goals. They can be static or dynamic as well as primary, secondary or final. Static are the game goals that are pre-established in the creation of the game and no matter what are the player actions, they remain the same. For example, a game with a path where the player
starts in one tile and ends in a pre-established tile. In this case the player performance is irrelevant to the goal since it remains the same either; for example, the player finishes the challenges perfectly or just barely.

Dynamic goals adapt with the player’s actions and/or performances. An example of a game with dynamic goals would be a game where the finish depends on the player’s performance. If the player performs badly the game would lower challenges difficulty until the player gets better.

The difference between primary and secondary goals are that primary goals make the player advance in the game while secondary goals just rewards the player. The final goals end the game either by the player winning or losing. A game may have more than one final goal as it may have multiple endings of the game. Also a goal may be primary and final at the same time since a challenge may under certain circumstances make the player lose the game while in another circumstances the player may advance in the game.

The main use of secondary goals is to encourage players in completing different tasks for several reasons. One is to increase the playtime of the game; it can be sometimes used to show non-essential elements of the game world and to appeal to a feeling of accomplishment (for example, completing challenges with a higher difficulty than the required to advance in the game). The principal aspect of the secondary goals is they are not fundamental for the player to accomplish thus adding a feeling of freedom to explore, not only the world, but also other aspect of the game world (setting, story, etc).

5 Challenges

Challenges are specific tasks that the player must perform to advance in the game, for example, in trivial pursuit the challenges are the questions made to player when he stops on a space.

In this thesis we focus on word games. There are many different word games and for each there is an underlying mechanic. The study of the mechanics of successful word games shows the rules and gameplay that we can use to create the challenges in our platform.

In chapter 2 – Related Work we identified six word mechanics (questions and answers, multiple choice, matching, filling in the gaps, word forming and word searching) that are the core of the challenges.
These simple mechanics can lead to many different implementations and we can always add some gameplay element to the mechanic to change it. For example, adding a multiplayer support to a mechanic of multiple choices where both players compete for the fastest time. Although there can be many variations to these mechanics, in the reviewed games on the Related Work is normally used the simplest form.

For now we have been looking at challenges as self-contained but challenges are a part of the game world. So it would be normal that have mechanisms which allow challenges to adapt based on the player and the game evolution. For example in case a player who has low performance indicators the challenge could reduce the difficulty by providing a tip or increasing time limits.

In the same perspective of an adaptive challenge, they could adapt not only according to the player, but also according to context of the game or how many times the challenge have been played. For example, in Monopoly if a player stops at a land that no one owns he can buy it, but if he stops at a land already bought him must pay the rent.

It is important to have mechanisms to define the pace of the challenge, for example, if we want to impose to the player a fast game it is important that we can add a time limit.

5.1 Challenges feedback to player

It is important that the game designer can provide a feedback concerning certain situations to increase the evolvement of the player. It can also be used to stop some frustration or simply to add some educational content. This feedback are basically messages from the game for the player and can be shown as video, text, images, sound, presentations or even other games.

They occur in two situations: first after a player’s action, like a multiple choice where the player chose a wrong answer so the feedback shows a video illustrating his mistake and its solution. The second situation is when certain conditions are met, for example, in a game with time limit the game shows warnings for the player when it is near the end of the challenge.

5.2 Challenges feedback on the game world

The challenges have complete control on the player performance indicators (time, score and items). There are two types of feedback on the player performance, either the player passed the
challenge and he gets rewarded or he failed it and gets a penalty. Both rewards and penalties should depend on the performance in that challenge.

Both rewards and penalties happen with certain conditions – right and wrong answers and between time limits, but there can also have rewards for a specific answer.

They typically change score and time. Additionally, they can give or remove items of the player. It can even change the layout of the board influencing the player position, player movement or the links around the challenge, for example, a special challenge that can be played only once. This feedback is important to the players to encourage them to continue playing and to create a feeling of accomplishment. This feeling helps to distinguish him from other players.

6 Player

The player is the most important component of the game since the game is focused on making him learn and have fun.

The game worlds have three types of special spaces relating to players: the starting point that is where the player starts, the finishing point (or one of them, in case there are many finishing points) where the player ends and optionally one or more intermediate goals.

The starting point does not need any special representation on the game world since it is obvious where the player starts. The finish point has some indication to show that is different and is goal point for the player. Although it is usually a mark or a special position on the layout of the board like in Trivial Pursuit. Also we can also represent the intermediate goals in the board. Representing those goals adds a feeling of accomplishment to the player which increases motivation. The finishing point and the intermediate goals relates with section 4 – Goals. In case of the finishing point is implicit that the game ends there so reaching that point represents a final goal.

The most important aspects of players are their state and representation on the game world. The State of a player is basically their actual condition. There are games where the player is stateless, meaning the player does not change throughout the game. But there are games where the player has different states, like Trivial Pursuit where the number of wedges represent different states of the
player. We can also imagine a game where the state represents the player health or emotional state. The player state is normally a reflection of their performance throughout the game.

The avatar is the player representation in the board and, depending on players; it can be a motivation to customize avatars. For example to complete a set of challenges awards the player to a special hat, that distinguishes him from the other players. That provokes a feeling of accomplishment in that player. It could be important to allow the player to choose some features of the avatar in the beginning, like for example, the sex of avatar. Although these choices are motivating and adds immersion to players the game designer needs to be careful or can break the story.

Basically there are two kinds of avatar customization, one which the player is awarded with a special item, and “equips” on the avatar with the purpose of making it look different. In this customization is decided by the player. The second is a feedback of the game between the avatar and the player state – for example, if player fails a challenge the avatar will reflect that by having subtle changes (like displaying tears on the avatar eye representing sadness). This avatar changes are chosen by the game designer.

6.1 Player movement

An important aspect of players is their movement. The player movement depends of the World representation since we have chosen the Board as representation so this sub-chapter will relate to it. The player movement relates only to games where the player has a choice and therefore has to make a decision in its movement.

Player movement can be linear, like one tile for won challenges or random like in Trivial Pursuit (throws a dice). It can also dependent on player performance (for example, one tile of movement for a challenge won where the player barely passes and two tile for an almost perfect challenge) or even hybrid (random movement with bonus for good performance).

Also movement can be predictable or not. Predictable movement is if the player can understand that, by achieving a certain performance he will go to a certain point of the world. This implies that the player as enough knowledge of the world to understand where will he go.

A game may use this predictability in three ways: first he may not use predictability at all - a game where the places of the world where we go are revealed as we get there. Second way is using the complete predictability - a game where the player knows the complete game world and knows
what his movement will be. The third way is a mixed predictability, in those games the player is presented with a part of the game world, but there are certain conditions (for example, a magical item) that can transport the player to a point in the world that the player had no knowledge of, like the hidden levels in some Super Mario games.

7 Conclusion

This chapter showed and discussed how to use components of the Game World such as World Representation, Player and more as a foundation for creating language based games. We have shown the concepts of the Game World as well as its inclusion on this model.

Creating a game world by the use of a board consists of establishing 6 concepts:

1. Establishing the game world representation (dynamic vs. Static boards, number of boards necessary) as well as the size of the board.
2. The performance indicators (score, time and the use of items)
3. Game goals, establishing the primaries goals (needed to advance in the game), secondary’s (to increase motivation on players) and the final goals.
4. Challenges, where we have to choose where they should be (forming the base layout of the board), what mechanic does it use and how it is used. The designer must also choose the feedback given to the player and to the game world as well as challenges are adaptive or not...
5. Defining the layout of the board, after choosing where the challenge would be, we need to define the links between challenges. Choosing the type of each link (directional, bidirectional or conditional) and how they connect completes the layout of the board
6. Finally deciding where the player will start and if applicable where will the player end, as well as defining the player movement, the feedback the game on the player.
Implementation

1 Introduction

This chapter demonstrates the steps taken to create a prototype of a platform that can generate word games based on the concepts presented. This prototype (LudoPor) was created in an iterative method and receiving constant feedback by possible users.

The chapter shows the characteristics of the prototype, such as target audience and some considerations of it; what was used, how it was used and why was it used from the conceptual model and some technical considerations.

After the characteristics we show the prototype evolution, presenting several images of the system throughout its evolution showing what decisions were made and why were they made.

Finally we illustrate an overview of the architecture of this prototype and explain its modules.

2 Platform Characteristics

As previously explained in chapter 1 (Introduction – Context) the platform was created for the Ciberdúvidas community.

The platform (for now called LudoPor) has to be able to generate games that can be educational. Must also use word games and it was able to approach the target audience of the website – persons with more than 16 years old (although only the game designers can assure this). Also it was defined that the output of the platform would be self-contained flash game (a game that uses Adobe Flash format – “swf” and it compromised by one file with the game and all assets). The choice of using Adobe Flash format was made because of it is a format that allows embed assets and for integrating the games with the backend of Ciberdúvidas.

Also we were told that the main functionality for the games would be as a support to other features of the website.

The platform itself is focused to be used by a community that have little or none computer programming skills so the platform has to be graphical and should be easy to work with. Also it should, for added simplicity, “borrow” some aspects from computer programs normally used by the community. The most regularly used program for this type of community was Microsoft Word.
The conceptual model has many concepts, thus, creating a platform that uses all of them in a tested and substantiated method with only one person is a task that would require a substantial amount of time that we don’t dispose. In that manner LudoPor is a trimmed version of the concepts exposed on the conceptual model that possesses all the necessary features to properly test the model.

Since it was very important that the platform was completed the features that LudoPor included was the simplest and the fastest to implement. They include:

- Game world – uses an static board and single player
- Goals – define a point on the board as the final goals therefore creating a path to progress player evolution
- Performances indicators – uses score and time
- Challenge – uses two underlying mechanics, Multiple choice and Matching; also uses an Reward and Penalty system using right and wrong answers as feedback to Game world and text only Comments as feedback to player
- Links – uses only bidirectional link
- Player – does not have avatar customization, use only linear movement, use of start and end challenges

3 Evolution

The prototype was created using an iterative method and started after the research of the related work was made. It was tried to base the platform design on two major programs: Microsoft Word and Microsoft PowerPoint since these two programs are familiar to the community that use the platform. To base the prototype in these two programs we adapted aspects of is interface in LudoPor. This happened only in the low fidelity prototypes.

The prototype was made basically in two phases, the first – research about conceptual model and testing using paper prototypes and the second phase was creating a digital prototype and adapting the prototype to be used by the Ciberdúvidas community.
3.1 First paper prototype of LudoPor

The intention with this prototype was to learn and try to connect concepts of the process of creating games. It was needed to learn how the board, the challenges and the links would appear to the users of the platform and how they connect.

One very important aspect was to see if it was clear the hierarchy of these concepts – a Board that holds several Challenges connected between them by links and a Player that moves between challenges. Also another important concept was the use of start tile and finish tile. Finally the challenges and the reward, penalties and comments system were of extreme importance if users could use it correctly.

It was also the first prototype created for the project and it took 2-3 weeks development I created it and some three colleagues (with some experience in evaluating interfaces) helped by testing and raising questions and issues about it.

Since the prototype was created in paper the interaction between users and the prototype was made using little pieces of paper that simulated parts of the program. When the users would point to a drawn button or tried some other interaction we would say what would it happen and form a layout of the state of the program.

Following we can see some images of this prototype (figure 35, 36 and 37).

![Fig. 35 - Board of first paper prototype](image-url)
In figure 35 is visible the board, while the character and textbox options in figure 36 and the path and group challenge options on figure 37. In this prototype featured a great deal of customization, such as the possibility of adding textboxes and images that did not were important to challenges and gameplay. It also had a disconnection between tiles and challenges that allowed creating groups of challenges. This disconnection enabled to associate a single challenge or a group of challenges to one or many different tiles.

This prototype was evaluated by five users being three of them teachers that use the computer at a regular basis. This focus on educators was because they were the main target of the platform. The other two were young adults that worked every day using the computer and are most efficient in capturing interface problems.

Users were provided with simple tasks reporting what they should do. It was recorded if either the users were able to perform tasks or if they needed help. It was measured the total time of the session. Besides these stats were recorded notes of issues that users had when trying the prototype.

Users were presented with 11 tasks in this evaluation which were:

- Create one challenge of matching
- Create one challenge of multiple choice
- Create one comment to one of the challenges
- Create rewards and penalties to one of the challenges
- Creating a group of challenges by associating one or more challenges
- Create a path and associate tiles to challenges previously created
- Add a character
- Add Time and Score
- Add time limit to challenges
- Create another path and associate the new tiles to the previous challenges
- Customize the player
- Customize the rewards and penalties

The retrieved measures stated that users were unable to continue without help in 4 to 5 tasks and consistently failed in most of the first five challenges of creation. Basically the users were lost and did not understand what was to be done and how would it influence the game.

After those failures and my help they understood the interface they were able to complete more difficult tasks.

It was visible that most users (4) could not understand why the challenges and tiles were conceptually separated. The medium time of completing the tasks were about 40 min which most were spend exploring the interface.

In the notes taken from this evaluation were common that the users were lost and unable to start the tasks asked, difficulty understanding the state of the program and referred some problems of consistency with windows. Another problem was the hierarchy and the number of windows that was included. Therefore users simply forgot where the options were and how to get them.

On the good side once the interface was understood the prototype made persons “comfortable” to explore and everyone tested did explored many options. Also users found it very interesting and the teachers even thought of possible use of a completed prototype to its classes.

Since users had problems in understanding the interface it was obvious that the interface had to be simplified. To simplify the prototype interface we chose to remove options that users would rarely use such as textbox and images that add nothing to gameplay. We also and redesigned the options hierarchy to reduce the number of possible window and to fix consistency problems of some windows.

### 3.2 Game Prototype

After the first prototype evaluated we needed to think about how the generated games would have the required specifications. In order to establish that a possibly generated game was entertaining and can have an educational purpose, it was created a paper prototype.
The prototype used only gameplay mechanics and features that would be available to a generated game by the prototype of the platform at that time.

The game was created using images altered in order to create a board with a path and challenges (figure 38) as well as characters (figures 41), comments about the players performances (figures 39 and 40), and a question to the player. If the player succeeded it would advance to the next tile if not it would remain in the same tile. The game finished when the player answers correctly in the last tile (the red circle in figure 38). In that case he wins.
The evaluation of this prototype was made with a group of five young adults and later with more three young adults individually. The reason for testing in two different ways was that the group talked and interacted like if it was a party game. Although it is possible to the generated games to be played like that it is not likely since the games in the community would be as support of the website.

It was not taken any measurement of the player’s performance, but some notes were taken about the player’s feeling towards the game. They were also asked if they liked the game and if they would play it again later.

The results were very positive and encouraging, since they revealed that users had a visibly feeling of fun while they were playing the game. Some were a little bored at some point, because of the multitude of challenges, but everyone passed the challenges and liked the game. Most of the players when asked, said that would play similar games.

3.3 Final Paper Prototype

Following the last two prototypes, one final prototype was created to prepare for creating the platform in a digital format. This prototype consisted principally in solving problems stated in the first paper and games prototypes.

The focus on this prototype was to simplify the number and the hierarchy of options present on the first prototype. This goal was accomplished and the number of windows and options was simplified.

Fig. 42 - Board of the final paper prototype
Evaluation of this prototype was done thought a set of four experts (collages and persons with experience using and creating interfaces) and contacting some of the previous users to establish if the changes were working. The evaluation was done by presenting the same tasks to users. The results were good with users comparing the two prototypes and choosing the final as the easiest.

After some weeks tweaking the design and improving the process it was ready to create a high fidelity prototype.

### 3.4 Incomplete High Fidelity Prototype

This prototype was the first high fidelity prototype made, but could not be finished to a meeting held with people from the community of Ciberdúvidas. This prototype was created using Adobe Flex which a tool for creating flash programs is using in part a GUI Builder.

In this meeting was demonstrated a high fidelity prototype that allowed the test of the interface to two users. In this prototype existed several bugs and many features to be done.

The main objective to the two users that evaluated the prototype was for them explore and try the prototype. Users tried to create a matching challenge and customize the rewards and penalties.

The testing went pretty bad, first users were lost and had major problems even with losing their work because of bugs. They did not understand why the detachment between tiles and challenges existed. Without understanding this feature they couldn't understand the groups of challenges. Also the multiple choice implementation was recommended to change to properly adapt to their exercises.

This lead to some profound changes in the prototype since the problems in understanding the separation between tiles and challenges has always been reported by users.
The removal of this feature implied two aspects: the first is that one tile can only have one challenge and the second is the remove of the groups of challenges. These aspects greatly simplified the whole process of creating challenges.

3.5 High Fidelity Prototype

After some months completing the prototype a version with the complete interface was completed and was set to test with the community of Ciberdúvidas. It was made by a twin technology of Adobe Flex - Adobe Air. This technology was referred as a counterpart for the desktop what Flash is for the Internet. It was used because it allowed to add features such as integration with the Operative System while it did not force to remake the code of the previous prototype.

From this prototype from the previous incomplete the main differences was a simplified interface. We user some interaction methods (keyboard, left and right mouse buttons) for different options in opposition of the paper prototypes where there was many options available. The process was also simplified by removing the groups of challenges and assigning one challenge to a multiple choice or a matching.

Following are some screenshots (figures 46, 47, 48, 49).

![Fig. 46 - Board](image1)

![Fig. 47 - Matching Challenge](image2)
The evolution on this prototype was marked with the use of conversations by email with a responsible of Ciberdúvidas. The fact that the program was send by email instead of tested locally in a controlled environment did help in identifying some problems that the users had. These problems were some interface bugs and because of the lack of “briefing” created some mistaken mental images of the concepts and options in the platform. Regardless some communication problems that arose in understanding, what were the choices that made the bug occur; some changes have been made to the prototype in order to help end users to work with LudoPor.

The platform was complicated and did not adapt well to the user processes. There were several emails stating problems and complications regarding key features as saving files, opening files or creating challenges.

It was great to have a future user of the platform testing it and it was fundamental. The difficulties that happened were different from all others that we encountered and understanding the process of the users was critical for our platform.

In those changes included integration with the Operative System such as double click a file created by LudoPor and automatically opens the file, performance improvements to allow challenges with many questions and complete understanding of how they wanted that the mechanics interacted.
3.6 Final Prototype

The final prototype was the consolidation of the interface as well as a redesign of created games and for preparing more user interface tests. The implementation changed between the last prototype, because of performance issues that forced to use java and flash to effectually generate games.

The interface of this prototype is visible in the figures 49, 50, 51.
Evaluation was made with eight users and was retrieved notes about the experience and a video.

Users were hand-picked and divide themselves in three separate groups – group one is teachers or educators, the second is adults that spend 3-6 hours for week at a computer and finally the last group young adults that use the computer more than 10 hours per week.

The first group – educators was chosen for obvious reasons, since the target audience of the platform was this group. It also had four users out of eight so it is the group with the biggest user base. These users used the computer almost only for professional use spending 1 to 2 hours for week working with the computer.

The second group was adults that spend 3 to 6 hours for week at a computer. This group was chosen to find problems with the process and difficulties with understanding the concepts in the platform.

The third group was a group of experts; persons used to different interfaces and were tested to point out interface and process problems in the platform. This group helps pointing out certain aspects that they think will be obstacles to the correct functioning of the platform.

Since the last two groups are more familiar with different interfaces that the first group, they can evaluate more deeply the process and the concepts.

Between the user tests the prototype was corrected for some problems. For example in two situations the users were unable to complete their tasks because of bugs in the platform. Those bugs
were corrected before the platform was presented to another user. This bug correction created some problems in reviewing results since it is not the exact prototype that is evaluated by users.

Each user was presented with 8 tasks in this evaluation which were:

- Create one challenge of multiple choice following an example available
- Create one challenge of matching following an example available
- Creating a path (choosing a starting and ending challenge and creating a link between them)
- Add Time and Score to the game
- Create comments to one of the challenges
- Create rewards and penalties to one of the challenges
- Customize images (character, board background and challenges)
- Save project, Create a game and play it

The tasks were told, and not presented within a list, which allowed tests to run more freely. This choice troubled the review of the results but allowed more enthusiasm of the users.

In two tests users preferred explore the program for themselves instead of simply following the tasks that I would give them.

The complete results of the users are presented in Appendix A. Here we will present some graphics and comments. We present three figures with graphics representing the measures taken throughout the interface tests. In figures 54, 55 and 56 is presented the percentage of user who completed the tasks; the number of errors made and finally their time spend to complete the tasks.
Create challenge of multiple choice
Create challenge of matching
Creating a path
Add Time and Score
Create comments
Create rewards and penalties
Customize images
Save project, create a game and...

Fig. 54 - Percentage of completed tasks by group

Fig. 55 – Average error number by task and groups
There are some comments about the graphics, first it is visible that the group of educator clearly had more mistakes and spend more time in the tasks. Also the task with more problems was the creation of challenge of matching, followed by create challenge of multiple choice and creating a path. Also interesting is that the task of creating comments was more easily understood by educators and teachers than by the rest of the users.

Finally it was visible that the first group was more motivated to use the platform. They spend more time understanding it while other users completed the tasks following the script that I supply them.

The results were pretty encouraging with most of the users being able to complete all the tasks.

With the help of the statistics and some notes taken throughout the tests we were able to understand these problems in the following situations:

1. Icons sometimes do not work and confuse more the user that it helps. While more experimented users (group of young adults with more than 10 hours of weekly computer use and some of the adults with more of 3 hours of weekly computer use) understood at first the meaning of the icons on the board others (mainly from the group of teachers) did not understand those
icons especially the remove and edit icons on the challenges. The chosen solution was replacing the icons for a small label in order to clear any doubts.

2. Sometimes users try to find options on the side when they are accessible on the challenge. Unlike some assumptions that we used to had, the users when are confronted with the need for an option (like editing a challenge) they search on the side of the board instead of the challenge representation. Since this problem is linked with users that did not understand the icons, we opted to resolve the icons issue and wait for further testing.

3. Users did not understand that the editor is a close visual representation of the game that is about to be created. This would be solved if there was a preview button on the challenges and on the board so that users could see immediately the results of their changes.

4. Text of end challenge button, the problem is that users do not understand why the option is available. This option is purely decorative since it only allows the change of the text of the button on the created game in which players conclude the game.

There are two reasons for users do not understand the option: one is that unlike every other option this is only decorative so users try to "assign" one feature to it and since are unable to do it they fail in understanding the option. The second reason is linked to the previous bullet – they do not understand how the editor represents the game, since many didn’t create any game and do not have a mental image of the results. There are various possible solutions for this; one is to create a preview button for helping users to understand how the choices impact on the final games. Other is to clearly mark the option as decorative. Yet another
is to split the challenge edition in features decorative and other that have relevant gameplay to
the game. The chosen option was to create the preview.

5. The challenges in LudoPor did not ask for confirmation when tries to remove
elements. While the remove button has tooltips and in the board was added a confirmation for
removing a challenge, on the challenge itself it was not made the same confirmation about an
item. The solution was to add this confirmation.

6. The drag and drop on challenges is rarely used and it offers problems to users. The
use of drag and drop is useful and it is the only way to
switch two items in a challenge, but users were shown
challenges already randomized and they did not had to
use the drag and drop in their tests. Also the use of drag
and drop is sensible. If a user selects text from the
textbox and the mouse goes outside the textbox the drag
and drop of the item is automatically initiated. The solution
is to either to create a button to move the element or to stop drag and drop while the textbox is
selecting.

7. There is an image tooltip of the
challenge on the tooltip of the challenge in board.
This feature is not used by first time users and
confuses them. They did not understand that was
the preview so they tried to click it to edit the
challenge. The possible approaches are to identify
the preview or to transform the tooltip to a toolbox
with options. Further tests must be done to
establish the best course of action.

8. When editing challenges users read the top options (save, load, etc) as being of the
challenges since challenges are windows. As we can see on the following figure (fig.60), this
happened, because the options were visible, active and was right on top of the challenge being
edited.
This was solved by fading all of the previous options therefore blocking them and concentrating the user on the challenge.

9. Users, while they were exploring the program, requested the option to discard the changes made. Those options were created.

Except for problems 4 (preview), 6 (drag and drop) and 7 (image tooltip) all other changes are already done and the rest will be corrected in the next weeks. Then a new version of LudoPor will be created and tested.

Users also played the games that they generated using LudoPor and enjoyed themselves so they were not are disappointed by the outcome.

Following we present some screenshots with images of the generated games:
4 System Architecture and Technical Considerations

4.1 Adobe Flex

Flex is an open source framework released from Adobe for creating flash files. It uses the same technology that Adobe Flash uses, but in a different perspective. While Flash uses a designer point of view with animations, timelines, etc, Flex approaches a developer point of view using an automatic GUI builder, integrating with Eclipse, etc.

Flex was the chosen language to create the prototype since it allowed basic functionality, it is fast prototyping language, it is more focused in delivering rich content like videos, animations, all very useful when prototyping a game. Having learned actionscript (the language that flex uses) it allowed the use of a fast and stable compiler maintained by Adobe itself.

The problem with flex is that is a language focused integrally in the Internet and while it can be useful it is not obligatory to LudoPor. The goal of LudoPor is to provide a platform to create flash games and while the games would be online the editor does not need to be online. It is possible then to have an editor in another language that just uses Flex Compiler to create the games. Also the fact that flex is a language focused on the internet raises many security restrictions regarding its use on the desktop. For using desktop Adobe created Adobe Air that uses Flex with some integration with the Operative System. The main problem is that Air is on the first release and while provides some stability since it is largely based on Flex does not provide one key feature, that is executing other programs. So the use of another language and another module cannot be removed.

Against Microsoft SilverLight and JavaFx, Flex offers a great maturity since it is already established in the market, uses a technology that virtually everyone has and has proven to be fast, stable and reliable. But if we use general languages (like java or c#) there are less benefits. These languages also have GUI Builders and allow the use of flash compiler API and offer optimal libraries to access multimedia content which means that technologically they offer the same features that flex with easier integration with the desktop.

In the end I chose Flex, because it was a fast prototyping language that allowed to obtain good results at a fast pace. The community and the available content especially to learning was also a nice support of the language.
Another added point in favor of Flex was that I would always had to learn it since using other language like C# or Java required the learning of actionscript to create the final game in a swf format. Also I always wanted to learn it and by using it in the prototype it allowed me to fully understand what were their capabilities and potentialities.

4.2 Approached methodologies to connect flex and O.S. resources

Using Flex as the main technology in the prototype created the need to execute the outside Flex Compiler and as well as creating files and other.

The first attempt was to create a socket from adobe Air to a program written in C#. This attempt was successful and it was proven to work due the Proof of Concept by one of the Adobe employee.

This method while interesting forced to create custom installers that interacted with AIR installer, using C# made the necessity of using .NET while using Flex Compiler that was created in Java forced the use of a JRE and the adobe air itself forced the use of Air runtime platform. So to use the program later it needed the three runtimes which it is bound to create Problems.

The second attempt was to use one less known framework called FlourineFx Aperture Framework. This framework allowed the use of remote code by intercepting calls between adobe air and the O.S. While it was very useful it proven to be incredibly slow at some time and the lack of support and visible development left me looking for another alternative.

Finally it was used another framework called DJProject. This framework allowed a Flash file to be integrated on java program as an SWT widget. It also allowed the communication between the java and Flash file. This framework allowed the editor to be used without the adobe air, but pure flash generated files by flex. This approach was proven to be fast and allowing java libraries and the integration of O.S. proven to be the perfect choice.

4.3 Architecture overview
The architecture is currently in the following way:

As we can see in the above figure (fig. 69 - System Overview) the platform is divided in 3 main modules: the Java module, the Editor module and the Game module.

The Editor module is the actual program and is responsible for creating the model that will be used to make the games. This model is in a XML format and it describes everything that it is on the game.

The Java Module is basically a Command Proxy, a module that only receives commands from the Editor Module and it is responsible in creating a “bridge” between the Editor module and the Operative System. The most important task of the Java module is to create the final games. To do this the Editor module sends a model of the game to the Java module. Then the Java module calls the Flex Compiler using its java API compiling the Game Module with the model and assets that the Editor send, therefore creating a Flash file with the new Game.

The functionality of the Game Module is to provide the code to generate a game according to the specifications on model created by the Editor. Obviously it has to allow every option that the editor has.
5 Conclusion

In this chapter we reviewed the complete evolution of the prototype since the first paper prototype to a functional prototype able to create flash games.

It was shown several user interfaces, how they evolved, which user tests were made and how it was assured the prototype worked. Also shows how the prototype was adapted to the needs of the community of Ciberdúvidas.

Since the beginning that user tests were a constant in this project and while they took different forms (some task oriented, others in an exploratory mode and even giving constant feedback by email due distance problems) they helped tremendously making the project work.

Finally it was shown the architecture of the prototype, what are their modules and technologies involved as well as why Flex was chosen. And it was reviewed possible approaches made to connect flex and Operative System. Finally we end the Implementation with general overview of the platform.

The reactions in each user while playing the game proves that the games generated by the platform can be appealing to the target audience of the website.
Conclusion and Future Work

The preceding chapters have discussed the creation of a Model for creating making word games. It was showed the many steps to create such model since the motivation for creating word games (its recent popularity in the casual market and its possible use for education), the research to establish the model and the creation of LudoPor - a platform that creates games using that model. Unlike other platforms LudoPor has enough flexibility to enable anyone to create successful word games.

We started by establishing the reasons for successful word games, the mechanics that work and are so successful such as Multiple Choice, Matching or Word Forming among others. It was also seen how this mechanics can be simple but hard to master and how gameplay choices such as rewards or penalties help motivate persons to play these games.

It have been discussed the Conceptual Model for creating Word Games. The use of the game world for the basis for such games and why it should be used. Then we discussed the concepts and decisions in that Model such the world representation (the proposed was a Board representation), the decisions that have to be made to create a game, the player, its movement state and avatar, the layout of the challenges and the links between then, the rewards and penalties that challenges should enforce among many other. Finally it was discussed of how such choices influence gameplay and players.

Finally to demonstrate that the conceptual model can work, LudoPor was made. This platform was created in an iterative way using user test as the drive for evolving. There were many steps of this platform as two paper prototypes, a game prototype and two high fidelity prototypes. Also we had the help of the community of Ciberdúvidas that tested the prototype helping indentifying bugs, problems with the interface or problems with the process of creating games.

The result of the tests made to this implementation has shown that is possible to create a platform based on the model. Almost all of our users being able to create games with good average errors and a good average time spend by task. Our users also played the games that created and enjoyed them.

In the future it is planned that this platform could grow to use more concepts present in the conceptual model such as items, different links and goals as well as multiplayer mode to induce the
party games that was a reason of success reviewed in the Related Work. Also it was planned the implementation of more mechanics such as Word forming or Fill in the Gaps to support more and different games.

Also in the future it is very important to add tools and multimedia capabilities to better support story, setting and the environment of the game.
References


Appendix A

In this appendix is presented all the tables relating the statistics retrieved in the tasks presented in the user interface tests made to final prototype (section 3.6 of Implementation)

Following is presented two tables relating the success or failure of each user in each task

<table>
<thead>
<tr>
<th>Tasks/Users</th>
<th>Group 1 - Educators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maria José Mira</td>
</tr>
<tr>
<td>Create one challenge of multiple choice following an example available</td>
<td>1</td>
</tr>
<tr>
<td>Create one challenge of matching following an example available</td>
<td>0</td>
</tr>
<tr>
<td>Creating a path (choosing a starting and ending challenge and creating a link between them)</td>
<td>1</td>
</tr>
<tr>
<td>Add Time and Score</td>
<td>1</td>
</tr>
<tr>
<td>Create one comment to a challenge</td>
<td>1</td>
</tr>
<tr>
<td>Create rewards and penalties to a challenge</td>
<td>1</td>
</tr>
<tr>
<td>Customize images (character, board background and challenges)</td>
<td>1</td>
</tr>
<tr>
<td>Save project, create a game and play it</td>
<td>1</td>
</tr>
</tbody>
</table>

| Tasks/Users                                                                 | Group 2 - Adults 3-h | Group 3 - Young Adults +10 h |
|                                                                          | Marta | António | António | João |
| Create one challenge of multiple choice following an example available    | 1     | 1       | 1       | 1   |
| Create one challenge of matching following an example available           | 1     | 1       | 1       | 1   |
| Creating a path (choosing a starting and ending challenge and creating a link between them) | 1     | 1       | 1       | 1   |
| Add Time and Score                                                       | 1     | 1       | 1       | 1   |
| Create one comment to a challenge                                        | 1     | 1       | 1       | 1   |
| Create rewards and penalties to a challenge                              | 1     | 1       | 1       | 1   |
| Customize images (character, board background and challenges)            | 1     | 1       | 1       | 1   |
| Save project, create a game and play it                                  | 1     | 1       | 1       | 1   |

Following is presented two tables relating the time that each user took in completing each task
Following is presented two tables relating the number of mistakes that each user made in completing each task:

### Table 1: Mistakes Made by Educators

<table>
<thead>
<tr>
<th>Tasks / Users</th>
<th>Maria José Mira</th>
<th>Justina</th>
<th>Maria do Carmo</th>
<th>Ema</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create one challenge of multiple choice</td>
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<td>4</td>
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<td>2</td>
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<tr>
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<td>N.A.</td>
<td>3</td>
<td>4</td>
</tr>
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<td>N.A.</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
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<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Create one comment to a challenge</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Create rewards and penalties to a challenge</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Customize images (character, board background and challenges)</td>
<td>1</td>
<td>N.A.</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Save project, create a game and play it</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Task</td>
<td>Group 2 - Adults 3-6h</td>
<td>Group 3 - Young Adults +10 h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-----------------------</td>
<td>-----------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Create one challenge of multiple choice following an example available</td>
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<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Create one challenge of matching following an example available</td>
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<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Creating a path (choosing a starting and ending challenge and creating a link between them)</td>
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<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Add Time and Score</td>
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<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Create one comment to a challenge</td>
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<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Create rewards and penalties to a challenge</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Customize images (character, board background and challenges)</td>
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<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Save project, create a game and play it</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>