Bacurau Game - A Learning Object to Child Education

Alexandre Soares da Silva*

a* Celeny Fernandes Alves José Vicente Júnior Re

es Márcio Osshiro Gabi Rodrigo Costa Silva de Oliveira

shiro Gabriel Braga Zamproni Lima Iva de Oliveira

Instituto Federal de Educação, Ciência e Tecnologia de Mato Grosso do Sul, Brazil



Figure 1: Bacurau Game - Learning Object to Child Education

ABSTRACT

Lately, the idea behind using digital games in order to teach - or support teaching - some concepts have became natural. The role of a digital game can go from a simple objective which exercises memory or cognitive thinking in a playful way, up to a task that incorporates a learning object or a laboral assignment masked as one of the game's tasks. Due to this trend, this work proposes an educational configurable web game where teachers can easily define game content or theme. Through a web site, the educator or teacher can register the required words according to their pedagogical objectives. The game mechanics remains the same for all themes, but the content can be defined through a web site, just like a form. This flexibility allows the game to be used in several areas rather than a unique subject. Moreover, to run the game it's not necessary to install any dedicated plugin or program, it runs in any HTML5/CSS3 compatible web browser, providing mobility and compatibility suitable for schools.

Keywords: HTML5 game, custom web game, education, learning object.

1 INTRODUCTION

In the technology and information access era in which information is each day more accessible, there is a vast amount of data around and not so much time left to consume it. What is even worse, in education, some lessons may not appeal to the students like before, hence some of them have serious difficulties in understanding a few basic concepts. In the end, this situation leads up to lack of motivation in a vicious circle. Going on the opposite direction is entertainment, not so long ago if you were having fun your not learning, but things have changed. This paper addresses one particular category of entertainment, digital games, a model of entertainment that can demand, or even require, knowledge and some cognitive skills in order to advance. The role of a digital game can go from a simple objective which exercises memory or cognitive thinking in a playful way up to a task that incorporates a learning object or a laboral assignment masked as one of the game 's tasks. According to Brazilian's federal law n^{0} 11274/2006 [3], it is mandatory to the children enroll school in the first year of elementary school. In this period, the alphabetization process begins. Fantacholi[7] emphasizes the importance of playing (not referring only to digital games in his context) for the integral growth of children physical, social, cultural, affective, emotional and cognitive aspects.

Through play the child reveals their cognitive, visual, auditory, tactile and motion state as well as their way of learning and entering into a cognitive relationship with the world of events, people, things and symbols [15]. Due to this observation, the act of playing is, in fact, part of the learning process of a child, and asks for tools to support these activities. The work addressed in this paper describes a digital game called Bacurau that can back up teachers and educators of elementary schools on the alphabetization process of their students.

The game symbol is a bird known in Brazil as Bacurau whose habits includes flying with its large mouth wide open to capture insects. The game concept creates an analogy with children in alphabetization age. Like these birds, they are eager for something, but in this case, the knowledge. Yet, the Bacurau concept is not limited to a simple game created with some of the available game engines or frameworks. Its usability is similar to that of a form from a web site, since it is natural to think that teachers of basic education are not expert game designers and sometimes not even familiarized with technology. The project is divided into two main modules:

- A dynamic web site where the teacher can access or register the intended activities. The interface is just like a regular simple form fill where the teacher or educator can post an activity, its words, the letters allowed, velocity of the game, among others game features.
- The game The game runs on any modern web browser with no need of plugins or installations. It automatically reads the desired activity from the web site and set up the game matching the information provided. Students just need to be notified about the URL (uniform resource locator - the resource address) where the game is hosted.

This approach allows teachers and educators to design the game theme seamless using already known technology; and students can interact with the game without the need of a special hardware or program. As Pagela [13] stated, the modern web browsers endue

^{*}e-mail: alexandre.silva@ifms.edu.br

the majority of the technologies needed to develop an interactive application or even a complete digital game. The codification of the game interface relies solely on HTML5 and CSS3 features, terms widely used in order to refer to modern web technologies [16] [14]. The HTML5 and CSS3 allows to implement the graphics and mechanics of the game natively for the web browser.

The present article is organized as follows: section 2 gives an overview about related work and main contribution of this project. On section 3, the adopted methodology is described as well as some important technical implementation details. Section 4 argue about perceived results and influence of the game on the students, and finally, section 5 briefly talks about achieved goals and future expectations.

2 RELATED WORK

Alphabet Matching [1] is a game whose gameplay tries to relate object's name first letter with the corresponding character or sounds. It has nice graphics, but is solely in English and the words are not configurable. The website where it resides hosts some other games and classifies them, depending on the child age.

The website *learninggamesforkids.com* [12] put together several alphabet related games. They require an old popular browser plugin to run and although there is a great quantity of games, some of then lacks explanation on how to play it. Again, the words or letters utilized in the games are not customizable and covers only English language.

In Brazil, works related with common features are the following software: Alfagame [6] and Chuva de Letras [11]. Alfagame describes three challenges:

- Alphabet challenge: letters from alphabet start to fall and the player must type the corresponding letter on the keyboard before the letter reaches the ground (bottom of the screen). The game ends when all letters are correctly typed.
- Letters challenge: Based on a specific letter, several pictures are showed and the player must click on a picture whose first letter of its name is the same as the base letter defined.
- Mathematical operations challenge: Introduces mathematical operation problems like addition or subtraction whose result is represented through fruits pictures; obviously, the player must match the fruits with the correct result

On Chuva de Letras game a picture is shown to the player and some letters start to fall down. The player goal is to take all the letters that make up for the representation of the picture at hand. Just like in this project, it is not mandatory to take the letters in sequential order, as long as it is part of the word represented by the picture. If the player takes a wrong letter, a point is discounted; the game ends if the player looses all five points.

As a work emerged from an initiative of the research group NIJOD (interdisciplinary research center for digital games) from IFMS - Instituto Federal de Educação, Ciência e Tecnologia de Mato Grosso do Sul, the Bacurau game has some similarities with Chuva de Letras. However, Bacurau challenges are defined by the teacher or educator according his pedagogical teaching system, in other words, the challenges are configurable to fit the class learning objective and theme, making the game also a collaborative learning object. Being customizable allows not only to define the direction or theme, but also do not constraint its use to a single language: the registered words can be diversified and in any cultural language allowed by the system character set.

3 METHODOLOGY AND DEVELOPMENT

Through known literature about alphabetization using digital games and also aided by the support of graduation teachers who also work in primary schools, the first step consisted in documentation of ideas from authors experience for further analyses. Later, these ideas were the base to define requisites of the system. The project turned up to be a two module system: a web site to customize the activities and the game itself which reads the custom options and words defined in the web site to create the levels. A brief description of the basic features of the system can be seen in the UML(*unified modeling language*) use case diagram on figure 2.



Figure 2: Use case main diagram.

Teachers and educators were questioned about the game mechanics and if it could be used as a complement and learning reinforcement to regular activities. Also, related bibliography was visited and a prototype defined. It became clear that the project should have an acquainted environment for the teacher. Surely, an important aspect also considered was the running environment; in many zones in the country, lots of schools have only popular computers available and no dedicated expert. Therefore, the game configuration and non functional requisites should be designed as simple as possible.

Moreover, to standardize and facilitate the communication between the web site and the game the developers decided to adopt the JSON format. JSON or JavaScript Object Notation is a lightweight data-interchange format widely adopted in the internet. JSON format it is not complex to read, write, parse, generate and have some other properties ideal data-interchange language [10]. Here, the web site generates data on JSON format to the game module. As the game is executed in the browser - that natively runs JavaScript -, it can readily consume the data.

On functional requisites side, it is important to note that the teacher can register the words he intends the student to identify and train, according to the desired stage of the the educational process. There is already an implementation that allows the teacher to upload a figure as a complement to the meaning of the word. It is up to the teacher to define how many and which are the letters of the game; he can use the letters that make up for the word or any other set. In addition to the words and letters configuration, there are others customizable features of a registered task: speed of the falling letters, if the game should exhibit the uploaded image and how many wrong answers are allowed (by default there is no limit).

Once defined the basic requisites, the next step consisted on the designing of the educator's configuration web pages. Several wire-frame (screen prototypes) models were built to be validated with stakeholders. The most appropriated wire-frame chosen is shown in figure 3.

Actually, the register is a website page and on current development stage is hosted in a server inside the institution where it has been implemented. As told in section 1, in order to play the game the students just need to access the reported URL. This client/server approach allows to modify or increment the game in such a way that changes will be immediately available. On the other hand, for being dynamic, the website needs a web server and a programming language able to create dynamic web pages. This is not a prob-

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Figure 3: Wireframe Prototype - Words register form.



Figure 4: Bacurau Game - We site page to query the already registered tasks.

lem, because the website is lightweight and ought to be hosted in one machine, without the need to be in players(client) computer. In practice, it is hosted in an external server and can be used by all game instances regardless of where they are located. Among technologies adopted to accomplish the task are: the Apache server[8] to work as a web server, PHP language [9] as the scripting language especially suited to web development and MySQL SGBD [2] for data persistence and query.

To prevent some nuisances on the game like a predictable and repetitive gameplay, even with the falling speed informed by educator or teacher, the letters will not fall at the same velocity. There is a minimum velocity, let's say 4 seconds, to each letter fall from top to bottom of the screen; beyond that, a random multiplier factor is applied to the speed given by teacher and summed up to the minimum velocity. This action gives the falling letters arbitrary but somehow controlled falling speeds.

Another design choice is relative to the sound effects. There is a sound for word complete, wrong letter, right letter and Bacurau swallow. At least for now, there is no background music due the fact that each level, depending on various factors, can be a little long and the music can distract or pall the student. All sound effects utilized in the game are free to use under creative commons license [4].

To guide the player, the desired word is shown in the top of the screen with a big font size. All letters are yellow colored and as they are collect they change to green. On the left of the screen it is possible to see if the collected letter was accepted or not; if it is the correct one, the counter near the green check will increase, otherwise the counter near the red x is the increased one.

In gameplay area, it is possible do move the Bacurau pawn using keyboard directional keys and open its mouth to eat letters using the space bar. The motivation behind the decision to use a key to open Bacurauś mouth and not just touch the letters, is that this action promotes immersion with the game engaging the players. Furthermore, to facilitate the children identification of the valid region to eat the letters is slightly marked in red around Bacurau's head, as figure 5 shows.



Figure 5: Bacurau game screen.

4 DISCUSSION

The defined architecture allows any school with a modest computer and a network to release the game to the students. As the content and cognitive difficult is customizable by the teacher taking into account the learning stage of each class, the project is not summed up to a generic alphabetic game.

On the practical side, at least in this first version, a game with background music did not appeal to the players who tried it. Even if the music was pleasant, sometimes depending on the word length, random appearance sequence among other factors, the level may linger a little bit longer to finish and the music gets tedious in addition to distract the player and stray from learning reinforcement objective. Even if this game is educational, empirically the team responsible for development tried to reach the flow expectations providing a somehow challenging task for children, with a little uncertain result (the player do not know which word comes next and at least initially, do not know how is the impact of wrong or right decisions) that needs a little bit of skill. At the same time the design tried not to disappoint children, giving a next letter at all times. The flow is not so easy to achieve, but the adjustable features are clear [5]. A future idea is separate the game creating levels for several child life stages, adapting each level to a specific age.

The students in this project helped with programming, scenario art (figure 6) and ideas. It is early to say what's the real fun-factor or flow of the game. In these first tests, the impressions were positive, but the game still needs to be applied to schools and their students. Thereto, during development cycles, the students that take par in implementation suggest changes to the game, design or mechanics. This conduct is other aspect of game development that can be availed in the future: use game development (not only play the game, but also implement it) to motivate student engagement with the chosen theme. The Bacurau sprite (animated character) was designed by a team member as well.

5 CONCLUSION AND FUTURE WORKS

The designed architecture, composed by a web site to define the tasks and a game that reads them, worked well internally with some students in the executed tests. Naturally, the next step is provide access to the game for more classes and schools; this also is going to materialize a concrete opinion about the game. To do this, the website needs a more robust administration policy. The website login system is not yet allowing and administrator and users registration, although it is not a hard implementation to do, it is in line for future work. The main objective of the project was achieved: implement



Figure 6: One of the background art created by the students involved with the project

teacher customizable game to help learning reinforcement in alphabetization on primary schools. Yet, the gameplay does not change a lot, so as a future work it is planned to add gameplay variations using the same data. The adopted format for the data facilitates the creation of another games like memory, matching figures and words, among others like the existing examples in cited in [12], using the same registered data on the web site.

REFERENCES

- abcya.com. Alphabet matching: Monster mansion match alphabet. http://www.abcya.com/alphabet_matching_game.htm, august 2017.
- [2] O. C. and/or its affiliates. Mysql. https://www.mysql.com, octuber 2017.
- [3] Brasil. Lei nº 11.274/06, de 06 de fevereiro de 2006. altera a redação dos artigos. 29, 30, 32 e 87 da lei no 9.394, de 20 de dezembro de 1996, que estabelece as diretrizes e bases da educação nacional, dispondo sobre a duração de 9 (nove) anos para o ensino fundamental, com matrícula obrigatória a partir dos 6 (seis) anos de idade. Standard, Feb. 2006.
- [4] C. Commons. Creative commons: Sobre as licenças. https://creativecommons.org/licenses/, octuber 2017.
- [5] M. Csikszentmihalyi. Flow: The Psychology of Optimal Experience. Harper Perennial, first edition, 1990.
- [6] D. P. da Silva Netto and M. W. A. dos Santos. Alfagame: Um jogo para auxílio no processo de alfabetização. In *Brazilian Symposium* on Computers in Education (Simpósio Brasileiro de Informática na Educação-SBIE), volume 23, 2012.
- [7] F. d. N. Fantacholi. O brincar na educação infantil: jogos, brinquedos e brincadeiras-um olhar psicopedagógico. *Revista Científica Aprender*, 5, 2011.
- [8] T. A. S. Foundation. Apache: Http server project. https://httpd.apache.org, octuber 2017.
- [9] P. Group and P. Authors. Php: Hypertext preprocessor. https://www.php.net, octuber 2017.
- [10] E. international. The json data interchange format. http://www.ecmainternational.org/publications/files/ECMA-ST/ECMA-404.pdf, octuber 2013.
- [11] Jogosdaescola. Chuva de letras, 2017.
- [12] L. G. F. Kids. Learning games for kids. http://www.learninggamesforkids.com/, august 2017.
- [13] M. A. Pagella. Making Isometric Social Real-Time Games With HTML5, CSS3, and JavaScript. Oreilly Media, first edition, 2011.
- [14] M. S. Silva. HTML5 a linguagem de marcação que revolucionou a web. Novatec, first edition, 2012.
- [15] L. S. Vygotsky. A formação social da mente. trad. josé cipolla neto, luis silveira menna barreto e solange castro afeche, 1998.

[16] WHATWG. Html living status: 1.2 is this html5? http://www.whatwg.org/specs/web-apps/currentwork/multipage/introduction.html, august 2017.