

Development of virtual environment to help minimizing written expression disorder

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Abstract— Learning disorders are common in all social strata, but they are more severe in children without adequate care. This study aimed to develop a virtual environment to help the educator to stimulate children in early elementary grades in order to minimize the written expression disorder. This virtual environment is composed by ludic learning objects that address dysgraphia, considering the following aspects: floating lines, descendants and/or ascendants lines, irregular space between words, retouched letters, curvatures and angles of the arches. According to experts in Psychology, Pedagogy and Phonoaudiology, the virtual environment developed is attractive and can help children in acquiring language skills as well as can arouse curiosity, motivation, initiative and self-confidence, promoting interest in learning.

Keywords— virtual educational environment, dysgraphia, learning disability, written expression disorder.

I. INTRODUCTION

The process of knowledge acquisition is very complex and learning difficulties may be related to several factors, constituting specific disorders related to different levels of learning construction [1].

Dyslexia and dysgraphia are disorders or difficulties related to reading or writing [2]. According to Associação Brasileira de Dislexia (Brazilian Dyslexia Association) (ABD), the disorder is classified as difficulty with accurate recognition and/or fluency of the word and by poor decoding skills and spelling; dyslexia is the disorder more prevalent in classrooms and affects between 5% and 17% of the world population [3]. The Índice de Desenvolvimento da Educação Básica (Basic Education Development Index) (IDEB) confirmed that this problem may cause grade repetition or school evasion [4].

Writing is a complex mental activity that involves neuropsychological functions that depend on different interdependent processes [5]. The difficulty in written expression may be characterized as a learning disorder, which is defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-V – code 315.2) [2] as a combination of difficulties in the ability of the individuals to compose written texts, it is evidenced by illegible handwriting, poor organization of paragraphs, and by

spelling, grammatical and punctuation errors [6]. The International Statistical Classification of Diseases and Related Health Problems (ICD) of World Health Organization classifies on the category “Specific developmental disorders of scholastic skills”, F-81 diagnosis code [7].

However, these individuals are not incapable of learning. They understand the spoken word and just cannot learn by the traditional teaching methods used in textbooks, so it is necessary to develop a special teaching method that help them in conversion of hearing format of the word to its written or read format [6, 8].

According to Parâmetros Curriculares Nacionais (National Curriculum Parameters) (PCN) [9], different languages must be used to overcome these difficulties in teaching and learning - such as verbal, graphic, plastic and body languages - as a means to produce, express and communicate the ideas, which fit the different intentions and situations of communication; to know how to use different sources of information and technology to acquire and construct knowledge; to question the reality by formulating problems and trying to solve them, using the logical thinking, creativity, intuition, capacity for critical analysis, and by selecting procedures and verifying its suitability [10].

In this context, it is important to show the application of games in the literacy process as a tool that provides a pleasant way to learn in a detached context of formal learning [11]. It is through the games and by the appropriation of them by the child that the understanding of the world is built, widening gradually the social-range [12]. By playing, the child can experience behaviors, actions and perceptions without fear of reprisal or failures [10, 13, 14].

Educational computer games can be structured as virtual educational environments, which are benefited by advantages such as stimulating the enthusiasm and concentration, besides being motivators to arouse curiosity, fantasy and challenge [15, 16]. However, most existing educational computer games and virtual environments do not include writing disorders. Therefore, the aim of this study was to develop an interactive virtual environment to help children with written expression disorders in the process of learning.

II. MATERIALS AND METHODS

The virtual environment developed to help children overcome dysgraphia consists of learning objects that encompass through ludic form the concepts and content areas proposed in PCN for the early literacy stages. In order to embrace the ludic, entertaining games characteristics were implemented: 2D graphical interface, challenges, script structured in phases, feedback, colorful scenes, sounds, scores, bonuses for achievements, among others. To stimulate creativity and logical thinking strategies were inserted to the plot.

The theme, plot and script of this virtual environment have been developed with the help of psychologists and pedagogues who work with children with learning disorders. Literature on the subject, which helps the development of mental models that promote learning, were also consulted. The characters and their actions, scenes and other elements have been defined after developing the script. The scene is based on two cities in the state of São Paulo, Torre de Pedra and Dois Córregos, and the challenges were subdivided into phases, and after correct completion of each phase, a tower is built and more bonuses are added; if the child reports incorrectly what is required in one of the phases, the tower collapses and the character returns to the previous phase.

The virtual environment is designed for children in early school grades, regardless of gender, and it is characterized by the development of learning structures to interact with children through ludic form which encompass the following aspects of dysgraphia: floating lines, descendants and/or ascendants lines, irregular space between words, retouched letters, curvatures and angles of the arches. Issues related to the environment, that consider the age group 6-10 years, are also worked, including concepts of ecology as well as cultural and traditional aspects, such as food, entertainment and local festivities.

The main characters in the virtual environment are Quinzinho, Laurinha and Maroto, the puppy. For the definition of their bodily attributes, including characteristics of hair and clothing styles, we tried to escape from stereotypes "boy" and "girl" to facilitate the identification of players with the characters. Quinzinho, the protagonist of the story, has just arrived to Torre de Pedra city, and makes comparisons with his hometown, Dois Córregos.

Games programming languages like JAVA for Android, HTML 5 and Flash (ActionScript language) were used in the coding of the virtual environment. Resources from GIMP software enabled the creation and composition of landscapes as well as the treatment of images and texts. MorphVOX software was used for voices modeling, and the free software Inkscape (SVG format) and SVG - Edit for

web applications were used for vectorized elements (scenes and characters). The option for the Android platform was made because it allows its use on mobile devices, like tablets, with touchscreen technology.

The implemented virtual environment was evaluated by nine experts (two pedagogues, four psychologists, two educators and one phonoaudiologist), who provided their individual opinions according to their specialties. The pedagogues verified if the implemented educational content covered language skills according to criteria established by the Ministry of Education and Culture (MEC), the psychologists verified the implemented motivational factor, and whether or not it was able to maintain children's attention and concentration, and the phonoaudiologist checked if the developed software can aid in the phonological and alphabetic coding process.

III. RESULTS

The virtual environment starts with Quinzinho walking down a road from left to right, coming from Dois Córregos city and going to Torre de Pedra city where he meets Laurinha and Maroto, the puppy (Figures 1 and 2).



Fig. 1 Scene created with reference to Torre de Pedra and Dois Córregos cities, state of São Paulo



Fig. 2 Home screen with instructions to start the game (Exit, Instructions, Characters, Credits, Play)

The implemented phases enable the development of skills, as structured in Table 1.

Table 1 Skills to be developed in different phases

Steps	Theme	Skill
Write with your mouse over words in cursive form	Sights and geography	Motor development, differentiation between cursive letter and block letter
Crosswords	Typical dishes, cultural aspects	Reading and writing training
Complete the story with the correct word from audio and figure	Ecology	Perceptive development, text/image association
Complete words correctly	Adventure, fantasy	Recognizing letters, complete and recognize words

When Quinzinho goes through the road the child has two link options to access. In the option on the left, Quinzinho tells the story of Dois Córregos city, while in the option on the right Laurinha talks about Torre de Pedra city. When the option for Dois Córregos is accessed, a crossword puzzle about typical dishes of the city begins. If the choice is for Torre de Pedra, a game where the child is encouraged to write with the mouse over words in cursive form related to geography and tourist spots starts. If the answer is right, the word written in cursive letters turns into block letters. At each stage scores are presented.

Grouped scenes comprise different levels of learning support tool. The objective at Level 1 (easy) is the development of motor skills, focusing on cultural issues (typical dishes and sights). The objective at Level 2 (medium) is to develop perceptual skills, involving concepts of ecology from the interaction of the characters. This phase begins with the involvement of Maroto, the puppy, which is special because it has three hearts. An audio tells its story and the child is encouraged to complete the words of the story based on previously agreed terms. The word entered by the child is confronted to the database to check the spelling. After listening to the audio, the child selects the corresponding option. The activity is developed in a manner similar to a dictation in the classroom, but in a ludic way in order to help children to overcome their difficulties, at the same time that checks their hearing skills and the corresponding written words capacity.

At this same level, but in another scene, the character Maroto is in front of several trails that take to Torre de

Pedra. The puppy interacts with the child by winking and saying "It was good to find you here" "Let's have an adventure" "What is the best way to reach the top of the Tower?" "Every time I swing the tail, the game starts."

If the child takes more than 5 seconds to click on one of the paths (with the mouse or the keyboard), Maroto starts the greeting again. As the child clicks in the specified period, a new adventure begins. When the route of the trail starts, the child's goal is to reach the first tree, where the words must be complete correctly; other goals come successively until the top of the tower is reached.

The look of the virtual environment refers to comic book format by the dynamics and proximity to the target public (Figure 3). Both the structure of the plot and the challenges implemented in phases and scenes, as well as the interaction of the characters with the participants, promote an appropriate environment to the development of cognitive skills related to writing, fostering motivation, interest in learning and self-confidence since they promote the acquisition of skills in a ludic form, respecting the individual requirements of each child.



Fig. 3 One of the game screens with the interface characteristic that refers to the comic book format (Time to start! Click on the side documents or on the numbers below. Come with us! Click on the pictures or on the numbers below.)

Concerning the virtual environment assessment made by experts, they all agreed that this environment could aid the learning of written expression, stimulate logical thinking, memory and creativity in children. According to the pedagogues, educators and psychologists, the virtual environment includes ludic characteristics, and educational

content that addressed linguistic capacities according to criteria established by the Education and Culture Ministry (MEC) as well as situations that promote motivation and, consequently, contributes to the children's learning. They attested that the virtual environment will place the children in challenging situations in a delimited space where there is the possibility of making choices about shapes, letters and words that can be right or wrong (i.e. win-lose situations), being also necessary to follow rules to keep playing and reach a new stage, but also having a positive feedback for the frustration of losing. The phonaudiologist (who is expert in Otorhinolaryngology) also agreed that the developed software can aid as complementary therapy in the phonological and alphabetic coding process of phonaudiology area.

IV. CONCLUSION

The virtual environment developed has a friendly, interactive and functional interface. It addresses ludic features that are capable of enhancing the acquisition of fundamental contents and of motivating the learning of children with written expression disorders.

According to experts, it places the children in ludic situations that encompass knowledge on spelling and grammar which are necessary in the early cycles of learning, and it is also able to arouse curiosity, motivation, initiative and self-confidence in children, generating interest in learning.

This is a prototype, whose effectiveness as a teaching tool to help children with learning disability in written expression will be tested in future work.

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