

Serious Game for reading and spelling skills

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Abstract—This work describes an interactive child-friendly application focused on spelling, intended to promote sensibility to Portuguese orthography. A description of the game and its particularities are given, as well as preliminary results obtained in school environment.

Keywords—serious games, reading skills, spelling skills, children reading difficulties

I. INTRODUCTION

Reading and spelling acquisition progress interactively. Indeed reading accuracy is potentiated by orthographic knowledge that benefits from reading experience [1, 2]. Those children who were once poor readers and at some point have compensated their difficulties usually continue to struggle with spelling which is characterized by orthographic errors.

Spelling acquisition consists on the development of the ability to map sounds that are heard in words onto phonologically appropriate letters [3]. This mapping may be more or less straightforward, depending on the phoneme-to-grapheme consistency. If there is a one-to-one consistency the spelling is unequivocal although if there is one-to-more-than-one mapping the spelling is inconsistent and thus error prone.

Research suggests that spelling acquisition benefits from explicit instruction [4]. A recent study suggests nonetheless that explicit instruction is not sufficient, particularly regarding inconsistent phoneme to grapheme conversion (PGC) that depend on implicit cues [5]. For the child to develop sensibility to implicit cues an explicit and systematic instruction is crucial. Spelling acquisition should not only include explicit statement of orthographic rules but also massive repetition of similar PGC, in order for the child to become implicitly aware of not only orthographic rules but most importantly orthographic statistical tendencies.

Educational software has been considered to be a highly valuable resource for children experiencing reading acquisition difficulties, as it has the potential to adapt to each individual learning rhythm. Indeed, education software has long been adopted and supported by research (e.g. [6-10]). Currently there persists the need for (i) more interactive software and (ii) more pronounced focus on spelling [11].

In this study, we present an interactive child-friendly

software application focused on spelling, intended to promote sensibility to Portuguese orthographic statistical tendencies.

THE GAME

The Piggy Bank is an Android game to be played by children by using both tablets and smartphones and making use of the hardware sensors embedded in those devices. The game development took into consideration the four design aspects referred by Schell [12] - aesthetics, story, technology and mechanics. Regarding the aesthetics, the game uses a scenario of a farm with animals, typically from children's entertainments. The story relates to a pig that has to be moved by the user in order to collect dropping coins with letters. These coins are part of a random word that is presented when the game is started using sound. The technology of the game is kept simple, with the movement of the pig in only one direction (left or right, on the bottom of the user interface) by tilting the device accordingly, using the device embedded accelerometer. The mechanics of the game generates a stimuli (word or pseudo word), from a database within the app, that is presented orally. Simultaneously, coins with random letters that compose the stimuli appear in pseudorandomized order. The child has to move the pig to collect them, by the correct order, in order to spell the listened stimuli

At any point, the child can move the pig to a loudspeaker sign to listen the word again. The game has a score scheme to register the progress of the game. The user starts with 100 points and, for each correct pick of a coin with the correct stimuli, one point is added, and the sound of a dropping coin is played. An incorrect pick reduces one point the score. The game proceeds (next stimuli is presented) if the answer is correct; the child is required to respell if the answer is incorrect. Fig. 1 shows the type of information the user sees for one random stimuli of its database (in the case "malha", PT version).

The game is built using the Unity game engine and can be played by different users on the same device, so it is necessary a user registration and login. With this functionality, the data from each user and his/her results when finishes playing the game, are stored in a cloud database (Firebase from Google). The stored data includes the user id, the date, the words played and the score. In case

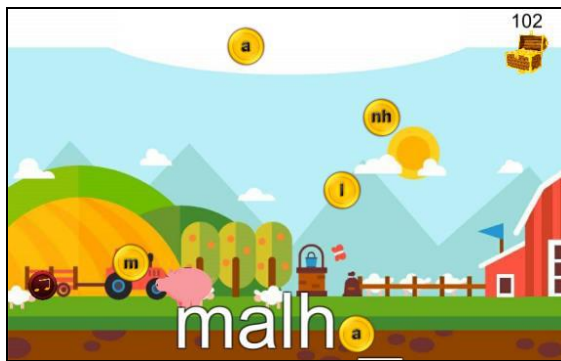


Fig. 1. Game screen shot for the stimuli “malha”.

Wi-Fi access is not available, a registered user can still login and play the game, but no data is recorded in the database. Each game has five levels, each one with a random word to be spelled. The rate and dropping velocity of the coins increases with each level. The user has the possibility to leave the game at any stage, but in this case no data is stored. A tutorial mode is also available, with four levels, just to familiarize the user with the game.

GDPR compliance is followed, namely regarding the anonymization for all data collected.

TESTING THE TOOL

The game was played by ten second graders (cf. Table 1) in school context using a smartphone in a quiet room under a speech therapist supervision.

The number of attempts until achieving the accurate spelling for each stimulus varies between 0 and 7. The interactive nature of this app seems to contribute to maintain children motivated to persist on the spelling practice until reaching the goal. Children's motivational assessment of the game was very high (average of 5 out of 5).

TABLE 1. NUMBER OF ATTEMPTS UNTIL ACCURATE SPELLING AND GAME ASSESSMENT PER CHILD.

Participant #	Sex	# attempts						game assess (1 out of 5)
		stim #1	stim #2	stim #3	stim #4	stim #5	stim #6	
1	F	4	4	0	3	6	3	5
2	M	7	2	1	4	1	1	4
3	F	1	2	1	1	1	4	5
4	F	1	0	1	0	0	2	5
5	M	0	3	2	1	1	1	5
6	M	0	0	1	1	0	0	5
7	M	5	3	0	2	1	1	5
8	F	4	5	1	3	5	3	5
9	M	5	0	0	1	0	1	5
10	M	5	7	6	5	5	5	5

CONCLUSION

In this work a serious game focused on spelling was presented and tested.

Preliminary tests indicate satisfactory results for the global learning outcomes of the game, each associated with a game mechanics [13]: (i) hypothesis – associated with experimentation (accurate capture of letters), repetition (by adopting levels that may be attained after a series of successful trials) and reflection (potentiated by immediate feedback) and (ii) motivation (by associating accuracy and fluency to rewards – coins). Indeed, all the children were highly motivated to play the game, manipulating it easily and the interactive interface clearly increased their level of interest. Therefore, the game evaluation factors as ease of use and interest/satisfaction proved to be very positive. Future work will focus on extending the stimuli database and applying the game to a wider group of children.

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