

# *Information system to promote reading literacy – Letrinhas*

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**Abstract —** The acquisition of reading skills is decisive for the academic achievement of elementary school students. However, unlike other domains of human development, learning to read is a complex process. With this in mind, several attempts have been made to find new educational strategies to foster students reading motivation. That is the context in which *Letrinhas* appears.

Considering the enormous potential of information and communication technologies for education and training, particularly mobile devices, we have developed a digital repository of teaching and learning materials and a multiplatform application that runs on mobile devices. This information system is designed to promote learning and the development of reading in students of the first and second cycles of elementary education and provide teachers with tools for monitoring and assessing reading skills against the curricular targets set by the Ministry of Education. This is no doubt a basic need that is not being met by the applications currently available in the market. The performance of *Letrinhas* was evaluated by specialists and users in a pilot group and a high level of satisfaction was observed among students and teachers as time and effort spent to consolidate reading is considerably reduced with this application.

**Keywords -** *Letrinhas; reading; m-learning; curricular targets; information system.*

## I. INTRODUCTION

Research literature on reading shows that there is a close relationship between students' reading proficiency and their academic performance and, therefore, it is of the utmost importance that reading plans should be made to identify and intervene effectively with students at risk of developing reading difficulties [1] [2] [3].

The acquisition of reading skills is therefore critical because it affects the ability to learn in all areas of the curriculum and is crucial to the students' academic performance. "The command of written language increases our communication potential and is simultaneously the great facilitator of learning as well as of the development of individual interests and the cognitive capacity of the subject/reader" (p.2013)[4].

Learning to read in the early stages of education is a complex task that is determinant for the development of fluent readers. Given its difficulty, for a significant number of students the initial process of learning to read is slow and time

consuming, often triggering frustration and low self-esteem [5]. This is the reason why several authors [6] [7] argue that research in the field of reading should focus on three aspects:

- (1) early identification;
- (2) prevention;
- (3) re-education;

Research studies show that the sooner the learning problems are identified, the bigger the success rate will be and therefore reading plans should be implemented in the first two years of schooling [8].

For this reason, it is crucial to identify children at risk of developing reading difficulties and that any system designed to assess reading literacy will be able to classify the students according to their performance level and apply appropriate solutions [5].

In the government guidelines for the teaching of Portuguese in basic education (*Programa e Metas Curriculares de Português do Ensino Básico*), which was enforced in the 2015/2016 school year, reading and writing aim at developing reading fluency (i.e. speed, accuracy and prosody), vocabulary, reading comprehension, gradual text production and comprehension.

It is clear from the curricular targets set by the government that the level of difficulty should increase gradually when it comes to reading. This is true for the reading targets set for the first four years of schooling.

"Read a text with a reasonably appropriate pronunciation and intonation and a speed per minute of at least:

- 1<sup>st</sup> grade: 55 words.
- 2<sup>nd</sup> grade: 90 words.
- 3<sup>rd</sup> grade: 110 words.
- 4<sup>th</sup> grade: 125 words" [9].

In this regard, there is an obvious need for resources to validate the results and create the necessary conditions to ensure improved outcomes for students with reading disabilities [5].

This is the context in which the libraries of the Artur Gonçalves cluster of schools (Torres Novas, Portugal), as the

innovative learning centres they are, created the project "Learning and Teaching in School Library Centres" in order to help the students develop the skills that will turn them into knowledgeable and engaged citizens ready to deal with the 21st century challenges, and also to find answers to some specific student problems which were previously identified in class council meetings.

Considered as an "Innovative Ideas Project" by the Rede de Bibliotecas Escolares (Portuguese Network of School Libraries), the project also includes a reading-related feature called "Ginásio de Leituras" (Gym of Reading). In order to create an innovative and adequate solution, the network of school libraries invited the Polytechnic Institute of Tomar (Portugal) to develop a solution based on information technologies that could help address the reading difficulties identified by the teachers. An urgent need since the analysis of students' performance reveals a substantial increase in cases marked with difficulties in learning to read, with a focus on school population in the first and second cycles of basic education.

The Polytechnic Institute of Tomar embraced the challenge with the involvement of faculty members and undergraduate students of the computer engineering degree and developed an information system - *Letrinhas*. This research project started in 2014 and its main objective is the creation of an information system that promotes the development of reading fluency in elementary school students and provides the teachers with tools for monitoring and assessing reading skills.

## II. PROMOTING READING THROUGH MOBILE DEVICES

The development and popularity of mobile devices has created enormous challenges and opportunities for education. Through them "we can learn anywhere, anytime and in many different ways. We can learn on our own and in groups, being together physically or remotely connected" (p. 30) [10].

The integration of mobile devices such as cell phones, smartphones or tablets in the process of teaching and learning has resulted in new educational landscapes and a new learning paradigm: the m-learning.

According to Salmon [11], this concept represents the fourth generation of electronic learning environments and an unavoidable part of the future of the teaching and learning process. Wagner [12] also argued that "the value of deploying mobile technologies in the service of learning and teaching seems to be both self-evident and unavoidable" (p. 42).

The use of mobile technologies places the student at the centre of the teaching-learning process and in turn the teacher will be playing the role of the mediator of learning and the organiser of more open and collaborative [10] processes strengthening learning theories related to constructivism and giving rise to new methodologies such as the Flipped Classroom [13] and the PBL – Problem-Based Learning [14].

"The potential of mobile technologies is even greater when it comes to language learning, since it contributes to the development of some or even all the basic skills" [15].

Therefore, we have witnessed the launch of various computer applications to promote reading literacy and learning, with many positive results both in terms of the mother tongue and in terms of foreign languages.

The GraphoGame developed by the University of Jyväskylä in partnership with the Niilo Mäki Institut is one of those applications. Available for PCs and mobile devices with Android operating system, it was developed for children with dyslexia but it can be used by any child with reading disabilities. This educational game makes learning to read easy and fun and, according to studies carried out, it makes the students "significantly better readers on most measures than the children [...] receiving only traditional remedial teaching "(p. 52) [16].

Lan, Sung and Chang [17] developed a learning system based on mobile devices for learning English as a second language and studies show that the "MPAL [mobile-device-supported peer-assisted learning] seemed to reduce anxiety in elementary EFL learners, promote motivation to learn, and enhance oral reading confidence" (p. 142).

Thoermer & Williams [18] argue that "reading instruction that incorporates digital texts can serve to motivate students to want to read and help increase students reading fluency in the classroom today" (p. 441), with a clear preference for mobile devices at the expense of notebooks or desktop computers due to size and portability [19].

We found no Portuguese studies in this area but computer applications have been used for learning to read for some time now in the country. If we look at PlayStore and Apple Store, offering applications for Android and IOS mobile devices respectively, we find that there are some applications to learn how to read Portuguese such as "Aprender a ler" from Blue Compass (iOS) and "ABC em PT" (Android). However, most of these applications are not Portuguese and are limited to basic functionality such as forming words, joining syllables or listening to reading demos.

Despite the success of computer applications to promote the learning of reading, it turns out that Portuguese market offer is very low and does not meet the needs identified by the teachers because in addition to not facilitating the assessment of the reading targets set in the government curricular targets for the teaching of Portuguese in basic education, they do not allow to choose texts according to students individual needs or to monitor their learning.

## III. THE LETRINHAS INFORMATION SYSTEM

In order to tackle the problems identified, an information system has been developed which aims mainly at providing educational resources to promote learning and the development of reading skills in elementary school students, especially those with greater disabilities.

In the project specification the following requirements were taken into account:

- Use of mobile devices;

- Operation in offline mode;
- Use of teaching materials chosen or created by teachers;
- Use of open source software.

Mobile devices have come to replace computers in performing various tasks and this trend will remain so because these devices have been gaining greater processing, storage and displaying capacity. We have witnessed a rapid development of these capacities which, together with portability and multimedia, outweigh the traditional PC advantage in performing certain tasks. Portability and multimedia capabilities are very important for teaching and learning and *Letrinhas* explores them to achieve its goal: promoting reading skills.

In functional terms, the offline mode is a fundamental requirement because learning can be made in locations where data are not available or, where they are available, the quality of service does not allow a good online experience. This is an inescapable reality in the school context, where data networks may not be available in all school locations; the information system must therefore be prepared to work properly in offline mode.

The use of open source software has to do with economic factors and the freedom to provide the system to end users without the need for installation of software licenses. The technologies chosen do not have any usage or operation costs, an important factor in the whole project, because thus the lifetime of the solution is higher and not dependent on external stakeholders.

The use of teaching materials selected or created by teachers facilitates the transition to the digital age as these can create materials adjusted to the specific needs of the students or use teaching materials available in the repository which have already proven to work and are adapted to the social and cultural reality of the students. This requirement was implemented through a digital content repository.

*Letrinhas* consists of three components:

- 1 Digital content repository: server that provides support to the backoffice and to the mobile device application;
- 2 backoffice: set of database management interfaces, including digital repository;
- 3 Application used on mobile devices;

### 1 - Digital content repository

Several studies [26] [27] show that the use of various elements simultaneously stimulating all the senses promotes learning. Melli [26], based on the work of Clark and Meyer [28], lays down the principle that visual information (text) accompanied by sound (audio) promotes an effective increase in learning by stimulating visual and auditory senses instead of just overloading the visual. Figure 1 shows the Cognitive

Theory of Multimedia Learning extracted from Clark and Meyer [28].

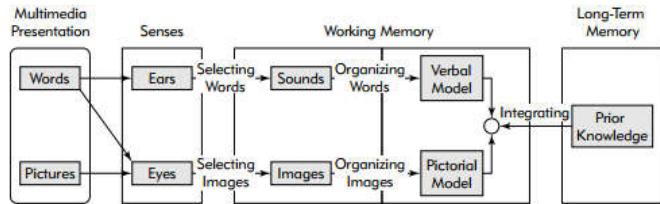


Fig. 1 - Cognitive Theory of Multimedia Learning

*Letrinhas* makes use of the multimedia capabilities of computer systems to display video, text, images and sound to promote reading.

The digital content repository, Figure 2, allows current educational content used by teachers to be enriched with multimedia resources to promote reading success. Another important feature of the repository is the sharing of educational content among teachers in an effort to improve its quality.

Fig. 2 - The Letrinhas digital repository

The repository enables the conduction of two tests to assess reading fluency:

1) *Text reading* – pronunciation, speech fluency, expressivity and number of words read per minute are assessed based on the reading of a full text.

2) *Word List* – A group of correlated words enables to assess pronunciation and the number of words read per minute.

These two tests assess the reading skills of students and require the intervention of the teacher for correction. They should not be carried out in a classroom setting, since the students need to be in a quiet environment for an effective recording.

In order to enlarge the scope of application of *Letrinhas*, two more tests have been developed to be used in classroom setting:

3) *Comprehension* – students are requested to identify specific words in a text. This test allows to assess other reading-related skills such as text comprehension or grammatical content.

4) *Multimedia* – a set of questions where questions and answers are multimedia elements. Text, pictures and sounds can be used in the questions and text and pictures can be used in the answers. These tests enable students to match sounds, pictures and words.

An advantage of this type of tests is that it comes with a self-correction feature included. When teachers build the question bank, they provide the system with the correct answers which are subsequently used to assess the students answers. This feature enables the tests to be used by a large number of students at a time. In addition, it allows them to practise and self-assess their knowledge without the support of teachers.

The repository is hosted on a server that provides support to the backoffice and to the mobile device application. In addition to host the repository, the server also provides services for managing the data from those involved in learning such as schools, classes, teachers and students; and authentication services to ensure the confidentiality and integrity of the information.

## 2 - Backoffice

Backoffice is an application that runs on a browser and is designed to maintain the system data.

The digital repository is managed by means of this application and enables teachers to create and update the educational content that is to be presented to students. Since the content will be presented through a mobile device application, the tool provides a rough picture of how the content will appear on the device (Figure 3).

Fig. 3 - Creation of a multimedia question and its layout preview on the mobile application

Sound is essential for learning to read and therefore tests are accompanied by text reading. The use of teacher-created audio recordings enables the students to listen to fluent reading including speed, accuracy and prosody and try to reproduce them.

Figure 4 shows the creation of a grammar test where the teacher can enter the text, record sound and select the right keywords that are requested to students.

Fig. 4 - Creation of the grammar test

Editing of reading tests using texts and word lists is similar to figure 4.

## 3 - Application for mobile devices

The students use the application to perform the tests and the teachers to correct them.

*Letrinhas* includes features that enable to record and reproduce sound of mobile devices to encourage reading. Audio reproduction is synchronised with text so that students may visually accompany reading (figure 5).

Fig. 5 - Synchronisation of text and audio

During the test, students can record their voice and listen to it as well as repeat the test if they wish so, thus being able to identify and self-correct their reading mistakes.

To assess students' reading fluency, teachers access their audio recordings, which allow an accurate assessment of readings and a better understanding of their difficulties. Figure 6 shows the assessment results of a reading test after correction by the teacher.

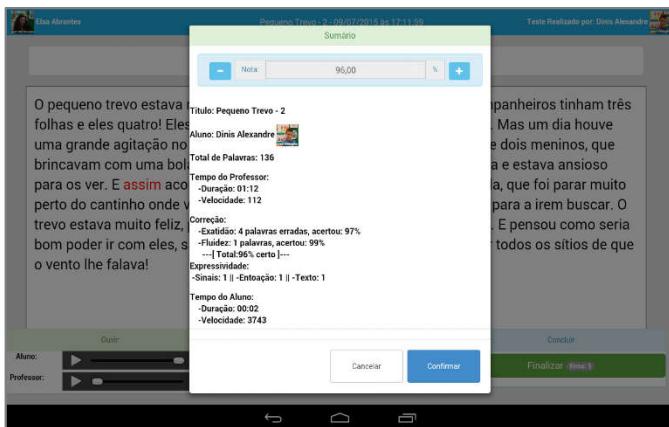


Fig. 6 - Assessment of a student's reading fluency.

Test correction is done on the tablet and the system is designed so as to use touch to select the mispronounced words and identify the mistakes. The system automatically calculates the reading time and the number of words read per minute. All assessment information is saved on databases that will be used by teachers to monitor the students learning progress.

#### IV. EVALUATION OF THE INFORMATION SYSTEM

The first version of *Letrinhas*, released in the academic year 2014/2015, has been tested by experts in the area and by future users, in order to evaluate its usability. The heuristic evaluation was used as the evaluation method, i.e. experts identified the problems based on the usability principles that it did not comply with. Tests involving users made it possible to identify some errors that were immediately corrected, in addition to some improvements based on the feedback of the users. In this way, there was the concern to create an information system that would meet the specific needs of their future users.

In the current academic year (2015/2016) a pilot study is underway at Centro Escolar dos Riachos, which involves two second-grade classes. The selection of students (6 from each class, in a total of 12) was the sole responsibility of the class teachers, the only selection criterion being that students should have shown reading disabilities at an early stage in their first grade. *Letrinhas* started to be used in the autumn, with students being monitored by a tutoring teacher and one of the researchers, in weekly sessions of a 60-minute duration. In order to evaluate the results in terms of reading fluency, the students took a pre-test in the first session, which made it possible to identify student difficulties and the same test will be used at the end of the school year to assess the progress achieved.

The results of this study will help us to assess the application's potential, not only in terms of learning results with an impact in all areas of the curriculum, but also the level of satisfaction of the students and teachers involved.

Although we don't have the results of this study yet, the evaluation carried out by the researchers and the tutoring teacher is very positive and the importance of *Letrinhas* to improve learning for the students involved was clear from the end-of-term assessment meetings. In fact, according to the teachers involved, it became clear that its use allows to

overcome reading difficulties in a shorter time-span when compared with previous years' data. Students and teachers also demonstrated high satisfaction and enthusiasm with the tool, which indicates that its use may be extended to other levels of schooling in the next school year given its potential, not only in terms of learning results, but also for the motivation it instilled in the students involved.

#### V. CONCLUSIONS

Learning to read is one of the biggest challenges faced by children at early stages of schooling [20] [1] [22] and the number of students identified with reading disabilities has been increasing [6] [23] [24]. According to Sousa [25], the introduction of curricular targets will place more than 85% of elementary school students far behind the targets set for reading.

To tackle this problem the library network of the Artur Gonçalves cluster of schools created the "Gym of Reading", an initiative involving design, implementation and evaluation of a computer solution to develop fluency in oral reading, a key indicator of reading proficiency.

Given the absence, in the national scene, of a software that could facilitate this work both in terms of assessment and improvement of reading skills, Polytechnic Institute of Tomar and the abovementioned cluster of schools have developed an information system to promote reading literacy among students in the first and second cycles of basic education and assess their performance in compliance with the targets set by the Ministry of Education.

*Letrinhas* not only facilitates the use of digital educational content created by the teachers but also helps sharing it with the school community through a digital repository. The content is used by students and teachers through a mobile device application that uses multimedia features incorporated in the devices to make the teaching/learning process more interesting and autonomous.

This information system also allows teachers to easily monitor their students' learning progress and to personalise content in order to meet the individual needs of each student.

The content that can be made available on *Letrinhas* is quite varied and comprehensive and can be used in different subjects and for different purposes.

Currently, *Letrinhas* is being used at Centro Escolar dos Riachos as part of a pilot study, with both its functionality and its usability being tested. However, the field notes that have already been collected show a high degree of satisfaction of students and teachers with this tool, as well as its positive impact on learning.

We expect to make the application available for download, free of charge, on mobile devices through Google PlayStore and Apple Store. Initially the digital repository will be available only for the network of technical and vocational training of the Médio Tejo (RFTPMT), which includes about 30 clusters of schools and vocational schools.

Although *Letrinhas* has been created to meet the reading literacy needs of students learning Portuguese, it is being prepared to be used with other languages.

#### ACKNOWLEDGEMENTS

We would like to thank Alexandre Carvalho, Artur Gomes, Cristiana Pereira, Renato Pestana and Tiago Fernandes, undergraduate students of the computer engineering degree from Polytechnic Institute of Tomar for their contribution to the project.

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