

Letrinhas: promoting reading through mobile devices

António Manuel Rodrigues Manso

Instituto Politécnico de Tomar
Campus Quinta do Contador – Estrada da Serra
2300-313 Tomar, Portugal
manso@ipt.pt

Pedro Miguel Aparício Dias

Instituto Politécnico de Tomar
Campus Quinta do Contador – Estrada da Serra
2300-313 Tomar, Portugal
pedrodias@ipt.pt

Célio Gonçalo Cardoso Marques

Instituto Politécnico de Tomar
Campus Quinta do Contador – Estrada da Serra
2300-313 Tomar, Portugal
celiomarques@ipt.pt

Ana Paula Faria Ferreira

Agrupamento de Escolas Artur Gonçalves
Avenida Sá Carneiro
2350-536 Torres Novas, Portugal
Investigadora do CESNOVA, FCSH
Universidade Nova de Lisboa
ana.ferreira@esagtn.com

Felisbela Maria Falcão Morgado

Agrupamento de Escolas Artur Gonçalves
Avenida Sá Carneiro
2350-536 Torres Novas, Portugal
felisbela.morgado@esagtn.com

Abstract

The acquisition of reading skills is a complex process, fundamental for creating fluent readers and, therefore, for the academic success of students. The use of mobile devices can contribute significantly to learning to read, not only for the enormous potential of m-learning technologies, but also because it places students at the centre of the teaching and learning process.

It is in this context that the *Letrinhas* information system arises. It consists of a digital repository of educational content and multi-platform software that runs on mobile devices. This information system is intended to promote learning and the development of reading in students of the 1st and 2nd cycles of basic education and provides teachers with tools for monitoring and assessing reading fluency. Its structure allows adaptation to the individual profile of each student as well as the choice of text or word lists by the teachers.

Keywords - *Letrinhas*; reading; education; learning; tablets; m-learning; curricular goals.

I. INTRODUCTION

The School Libraries of the Artur Gonçalves Cluster of Schools (Agrupamento de Escolas Artur Gonçalves) play a driving role in learning because of the work they have developed within the educational/pedagogical structures, assuming themselves as centres of learning capable of fostering collaborative work and contributing to achieve the goals and objectives of the Educational Project.

This work has been consolidated in the Cluster by the implementation of a wide range of projects aiming to meet specific student needs identified by the class council which, in most cases, are related to difficulties at the word reading level. In fact, there has been a substantial increase in cases of students with difficulties in learning to read, particularly in the first and second levels of basic education.

The acquisition of reading skills is critical because it affects the learning ability in all subject areas and is crucial to the academic success of students. Learning to read in the early stages of education is a complex task that is determinant for the development of fluent readers.

However, given its difficulty, for a significant number of students the initial process of learning to read is slow and time consuming, often causing feelings of frustration and low self-esteem. This is the reason why various authors [1] [2], argue that research in the field of reading should focus on three aspects:

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

In this context, it is crucial to identify students at risk of having difficulties in learning to read, therefore the development of a project with the aim of assessing students' reading literacy, on the one hand, and adopting appropriate measures, on the other, is paramount.

In the national guidelines for the teaching of Portuguese in basic education (Programa e Metas Curriculares de Português

do Ensino Básico), which will enter into force in the 2015/2016 school year, reading and writing are areas of content aimed at developing reading literacy (i.e. speed, accuracy and prosody), enlargement of vocabulary, reading comprehension, gradual text production and comprehension.

The goals associated with this area of content and more specifically with reading literacy include a progressive increase in degree of complexity. Take for example the goals concerning text reading in the four years of schooling:

"Read a text with a reasonably appropriate articulation and intonation and a speed of at least:

1st year: 55 words per minute.

2nd year: 90 words per minute.

3rd year: 110 words per minute.

4th year: 125 words per minute".

This example points to the need of using resources that enable this validation, on the one hand, and of creating the necessary conditions to ensure the improvement of this skill among students with reading difficulties, on the other.

It is in this context that the project "Gym of Reading" (Ginásio de Leituras) arises, a project involving the design, implementation and evaluation of a program to promote fluency in oral reading, essential indicator for reading literacy. Given the inexistence in Portugal of a software that would, on the one hand, facilitate this work and improve reading fluency, on the other, the Artur Gonçalves Cluster of Schools invited the Instituto Politécnico de Tomar (IPT) as a privileged partner to develop an information system that meets the real needs of teachers and students. This would give rise to *Letrinhas*.

II. TECHNOLOGY IN EDUCATION

After the democratisation of computers we have witnessed the popularisation of mobile devices such as tablets and smartphones and extraordinary developments in digital communications and information storage and processing [3]. Having in mind the enormous potential of these technologies, its introduction in teaching and learning process [3] was a natural progression, reinforcing the concept of mobile learning.

This concept reflects learning anytime anywhere with the help of mobile devices [4] and according to [5] it may:

- (1) help students develop basic literacy and math skills and identify their abilities;
- (2) encourage individual and collaborative learning experiences;
- (3) help students identify areas in which they need assistance and support;
- (4) help students combat resistance to the use of ICT;
- (5) help eliminate some learning formalities and engage more reticent students;
- (6) help students to focus for longer periods;
- (7) help increase self-confidence.

In Portugal there have been several projects designed to improve learning and school results with mobile devices, namely, tablets. Among them are: *TEA-Tablets in teaching and learning. The Gulbenkian classroom: understanding the present, preparing the future*¹; *Gulbenkian XXI School and Learning Communities*²; *EduLabs*³; *Creative Classrooms Lab*⁴ and *ManEEle*⁵.

Although the introduction of tablets in schools have gained greater visibility in recent times, its use in education has started several years ago, of which the following are examples: "Ordicollège 19" (France, 2010/2011), Use of iPad tablet devices in education (Lithuania, 2011/2012), The iPad pilot (Scotland, 2012), Ipad at Longfield Academy (United Kingdom (2009-2012) and FATIH Project (Turkey, 2011-2013) [6].

The use of these technologies places the student at the centre of the teaching-learning process, strengthening learning theories related to constructivism and, at the same time, gives rise to new methodologies, with emphasis to the flipped or inverted classroom [8] technique.

According to this methodology, students should begin by studying the new content outside of the classroom, usually through readings or videos; the class time being devoted to assimilate such content and convert it into knowledge by means of various strategies [9].

The fact of students bringing their devices to school and use them for educational purposes enables teachers to apply these new methodologies even when schools do not have the resources. On the one hand, this concept known as BYOD - Bring Your Own Device [10] or BYOT - Bring Your Own Technology [11] allows more effective learning results [12].

According to [13] we can no longer teach the way we have done so far, we need to look for a teaching technique that promotes an authentic learning that makes use of information and communication technologies. In this perspective, tablets are a great instrument due to its portability, accessibility and multiple features, promoting active student-centred learning. In this line Rotella [7] argues that "To get the most out of educational technology, teachers must combine the traditional classroom skills with new ones. And their repertoires will have to expand as the tablet's powers grow".

However, the analyses of reading apps available in the Portuguese market is very limited and does not meet the needs identified by the teachers of the Artur Gonçalves cluster of schools because, in addition to not facilitating the assessment of reading fluency according to the National Guidelines for the Teaching of Portuguese in Basic Education, they do not allow to select texts according to the individual profile of each student.

¹ <http://teagulbenkian.weebly.com>

² <http://tinyurl.com/ptbafpe>

³ <http://tinyurl.com/ozvygx7>

⁴ <http://creative.dge.mec.pt>

⁵ <http://tinyurl.com/okp9865>

It was based on these assumptions - adaptation to the individual profile of each student and text selection - that *Letrinhas* arose as an information system that allows individual training of reading skills.

III. LETRINHAS

Letrinhas is an information system consisting of a digital repository of educational content and multi-platform application (Android, iOS, Windows and others), which was designed to work on mobile devices using touch-screen interfaces. Its main purpose is to provide educational resources that promote learning and the development of reading skills in students of first and second cycles of basic education. The system also provides teachers with tools to assess reading fluency and information enabling the monitoring of learning.

The project started in 2014 and is being developed by faculty and students of the undergraduate degree in Computer Engineering from Escola Superior de Tecnologia de Tomar within IPT with the cooperation of teachers from the Artur Gonçalves cluster of schools - Torres Novas.

A. Assessment of Reading Literacy

Letrinhas includes features that allow to record and reproduce sound of mobile devices to promote reading. The system provides students with audio recordings of text read by the teachers. Audio reproduction is synchronised with text so that students may visually accompany reading (figure 1).

The reproduction of audio recordings enables the students to listen to fluent reading including speed, accuracy and prosody. The system also enables the students to control sound reproduction, namely the re-play of reading recordings.

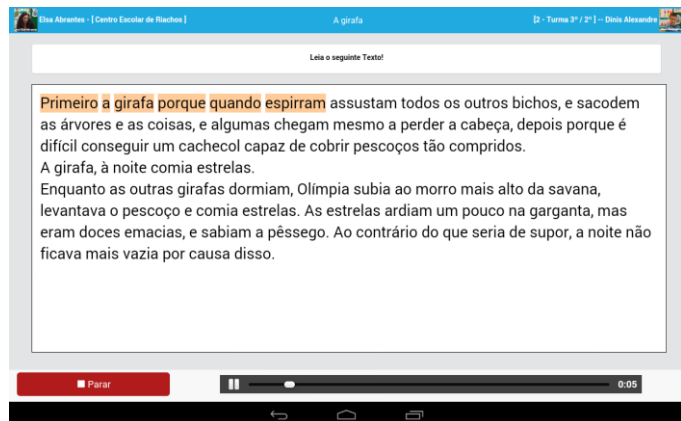


Fig. 1 - Synchronisation of text and audio recording

In 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 allows an accurate assessment of readings and a better understanding of students difficulties. Figure 2 shows the assessment results of a reading test after the teacher's correction.

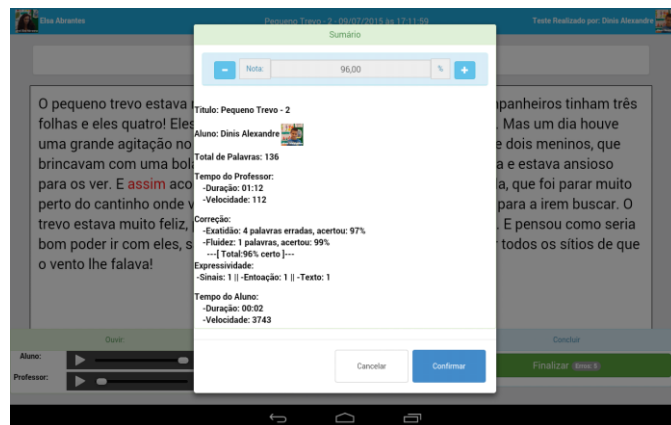


Fig. 2 - Assessment of a student's reading.

Test correction is done on the tablet and the system is designed so as to use touch to select the misspelled words and identify the spelling 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 progress of students' learning.

Figures 3 and 4 show the assessment results of a student's reading test. Figure 3 contains the chart of scores over time and figure 4 shows the assessment results for an individual test.



Fig. 3 - Overall reading progress results.



Fig. 4 - Results for an individual test.

B. Educational Resources

Letrinhas allows application of two tests to assess reading fluency:

1) *Text reading* – spelling, speech fluency, expressivity and number of words read per minute are assessed based on the reading of a full text. Figures 1 and 2 show two examples of this test.

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

These two tests assess students' reading skills and require the intervention from the teacher for correction. In addition, they should not be applied in classroom context since the student needs to be in complete silence 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 context:

3) *Comprehension* – the student is requested to identify specific words in a text. This test allows to assess other reading-related skills such as text comprehension or grammatical content. Figure 4 shows an example of this test.

4) *Multimedia* – a set of questions where questions and answers are multimedia elements. In questions text, pictures and sounds can be used and in answers text and pictures can be used. These tests allow students to link the sounds and pictures with the words. Figure 5 shows a question with text and Figure 6 with pictures.



Fig. 5 - Text comprehension questions making use of a multimedia test.

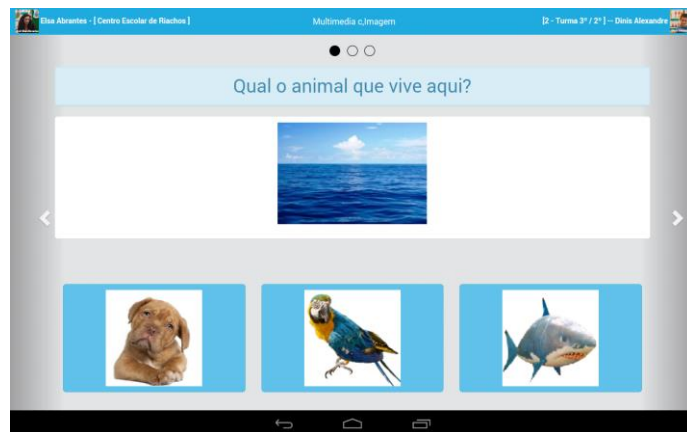


Fig. 6 - Questions with pictures making use of a multimedia test.

An advantage of this type of tests is that it has an auto-correct feature. 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 allows the tests to be used by a large number of students at a time. In addition, it allows the students to practice and self-assess their knowledge without the support of teachers.

Letrinhas has been originally designed to assess reading ability of Portuguese texts in students from the first and second cycles of basic education. After the first prototype has been developed and tested in real environment, the academic community was invited to contribute to the development of a final version. This contribution consisted in the critical analysis of the prototype features and proposal of new ones. This reflection revealed that the system could be used for teaching, learning and assessing foreign languages, similarly to what is done with Portuguese.

With the introduction of multimedia tests any content may be assessed provided that multiple-choice tests are used. Thus knowledge of mathematics, natural environment sciences or other subjects can be assessed with the aid of *Letrinhas*, i.e. the assessment platform.

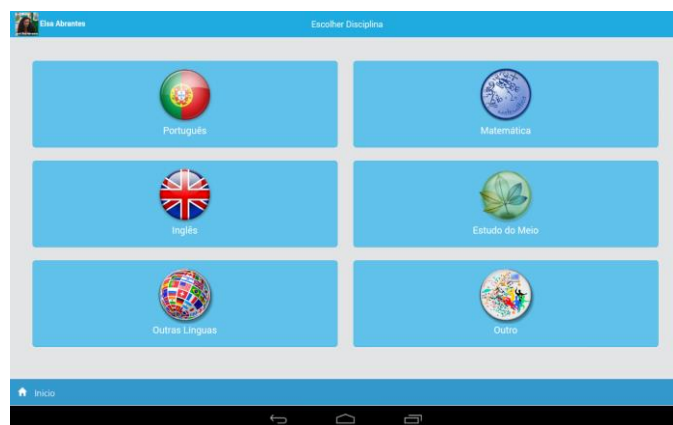


Fig. 7 - Subjects supported by Letrinhas.

Figure 7 shows the subjects available in *Letrinhas*. These subjects are divided into two groups according to the test types used:

- (1) Languages: All test types are available including those with voice recording. This category comprises subjects such as Portuguese, English and other languages;
- (2) Other subjects: Only multimedia tests are available. This category comprises such subjects as mathematics, natural environment sciences and others.

IV. INFORMATION SYSTEM

Letrinhas is composed by three components:

- (1) *Mobile App*: Application used by mobile devices;
- (2) *Backoffice*: Set of interfaces for managing system databases, including digital repository of educational content;
- (3) *Server*: Component that provides services to the backoffice and the mobile application.

Once the initial requirements have been identified, it became clear that Letrinhas would have a number of specific and technologically challenging requirements, of which two are crucial for the success of the target ecosystem: the need for introducing an interface for touch-screen devices that is independent from the operating system and the need for this application to work on environments with no connection to the data network. The first requirement aims at providing the learning software for the mobile systems that are most popular in the market, making the BYOD concept [10] viable. The second requirement is important because the mobile app should operate in environments where digital data networks may not be available. In order to overcome this problem, the data must be saved in a mobile device and then synchronise them with the server when the network is available.

These technologies have been chosen to meet the requirements above more effectively. Effectiveness is crucial to the success of the system since mobile devices have limited processing and storage capacity. Having in mind the above-mentioned, two important decisions have been made: the maximisation of software development among the three main components of the system (server, backoffice and mobile app) and the selection of a database system with some primitives for data synchronisation already embedded.

In order to maximise development among the various mobile platforms (the server and the backoffice) a JavaScript based architecture has been selected as this feature was common to all components. On the server, the JavaScript is used through Node.js in the mobile component through the Cordova framework which allows to reach multiple platforms simultaneously. For the backoffice JavaScript is used through the browser. Figure 8 shows the technologies used in each information system component.



Fig. 8 - Information system architecture of Letrinhas

The use of JavaScript language allowed us to re-use the source code developed for the several parts of the system, thus optimising the development time.

As the mobile component is going to operate in environments with no connectivity, a database system was selected that would support a synchronisation mechanism in a transparent way, and hence the use of the CouchDB and PouchDB combination. The main component (Couchdb) resides in the server and the secondary component (PouchDB) is inside the mobile device. All system data are permanently stored in a structured manner inside the CouchDB component, these being synchronised when necessary to the PouchDB that is inside the mobile device. Data synchronisation between the mobile application and the database system is transparent to the user: when the mobile device acquires connectivity with a data network, it automatically synchronises data with the server (CouchDB) and saves, in local databases (PouchDB), the elements required to operate in offline mode. Similarly, it transfers the students' tests and the teachers corrections performed in mobile devices to the central server.

At the level of the interaction of users with the system, the interface was designed taking into account the computer devices where they were to be used and respective users.

The mobile application interfaces are characterised by its simplicity and suitability to touch-screen interfaces, since they are used by beginners such as primary school students. The application that manages the data (the backoffice) has an adapted interface so as to be executed in the browser, controlled by the keyboard and the mouse, intended for experienced users, i.e. teachers and administrators. All the technologies selected have been developed using open source software and its use or integration are free of charge. This is an important factor for the success of the project as it is not dependent upon external entities.

V. CONCLUSIONS

Letrinhas is a digital tool created for students from the first and second cycles of basic education with the aim of promoting reading and help teachers to assess reading skills according to

the national guidelines for the teaching of Portuguese. In order to achieve this goal, the system makes use of current technologies that are user-friendly and popular among new student generations.

Learning to read is the greater challenge children have to face at the early stage of their school life. According to Sousa [14], "The results suggest that the introduction of the projected learning outcomes will lead to poor performance in reading of more than 85% of first-cycle students and that the use of rigid performance criteria in reading may compromise the diversity of learning processes" (p.ii).

Letrinhas aims to contribute to revert this scenario by providing digital pedagogical content created by teachers and shared across the school community through a digital repository. The content is used by the school community through a mobile device application that uses multimedia features incorporated in the devices to make the teaching/learning process more interesting and autonomous.

Letrinhas is at the development stage, and its functionality and usability have been tested in classroom setting by students and teachers during the 2014/2015 school year. Currently, corrections are being introduced in the information system based on the recommendations and errors encountered. The assessment of the system in terms of learning outcomes is projected for the 2015/2016 school year. This research will take place in the Artur Gonçalves cluster of schools in Torres Novas.

As the need for promotion and evaluation of reading skills is shared by all schools, we intend to expand the use of *Letrinhas* into the technological and professional training network of the Médio Tejo region, which includes more than 30 school clusters and professional schools.

ACKNOWLEDGEMENTS

We would like to thank Alexandre Carvalho, Artur Gomes and Tiago Fernandes, undergraduate students of the computer

engineering degree from ESTT-IPT for their contribution to the project.

BIBLIOGRAPHIC REFERENCES

- [1] V. Cruz, Uma abordagem filogenética e ontogenética à aprendizagem da leitura e escrita, *Sonhar*, 2, pp. 199-228, 2005.
- [2] S. Shaywitz, *Vencer a dislexia: Como dar resposta às perturbações da leitura em qualquer fase da vida*. Porto: Porto Editora, 2008.
- [3] C. G. Marques, Desenvolvimento e implementação de um modelo de blended-learning com objectos de aprendizagem no ensino superior. Tese de Doutoramento. Braga: Universidade do Minho, 2012.
- [4] M. F. Paulsen, E-learning – the state of the art. Work package one - The Delphi Project. NKI Distance Education. 2003, Consultado em 24 de setembro de 2006 em: <http://tinyurl.com/oncg9jq>
- [5] J. Attewell. Mobile technologies and learning: a technology update and m-learning project summary. London: Learning and Skills Development Agency. 2005, Consultado em 12 de abril de 2010 em <http://tinyurl.com/2agzz7>
- [6] A. Balanskat. Using mobile devices in education in European countries. In Encontro Nacional "Tablets na Educação". Aveiro: universidade de Aveiro, 2015.
- [7] C. Rotella, No Child Left Untabled. New York Times Magazine. 12 de setembro, 2013, Consultado em 18 de março de 2014 em <http://tinyurl.com/kjtg92p>
- [8] M. Hart, The expanding school day. T H E Journal. 39 (3), p. 6, 2012.
- [9] C. Brame, Flipping the classroom. Vanderbilt University Center for Teaching. 2013. Consultado em 17 de julho de 2014 em <http://cft.vanderbilt.edu/guides-sub-pages/flipping-the-classroom>.
- [10] C. Norris e E. Soloway, Tips for BYOD k12 programs. District Administration. 47 (7), p. 77, 2011.
- [11] C. Stanley, At one school district, the motto is BYOT - bring your own technology. 2012, Consultado em 24 de julho de 2014 em <http://tinyurl.com/oqrzf6d>
- [12] A. S. Ackerman e M. L. Krupp, Five components to consider for BYOT/BYOD. In IADIS International Conference on Cognition and Exploratory Learning in Digital Age (CELDA 2012), pp. 35-41, 2012.
- [13] H. H. Jacobs, Curriculum 21: Essential education for a changing world. Alexandria, VA: ASCD, 2010.
- [14] J. M. Sousa, Avaliação da fluência da leitura em alunos do 2º ciclo : metas curriculares para a velocidade da leitura. Tese de mestrado, Universidade de Lisboa, 2014.