# Pappagaio: User Centered Design for a second language vocabulary learning Android application

Caio César Santos de Resende<sup>1</sup>, André Pimenta Freire<sup>1</sup>, Patrícia Vasconcelos Almeida<sup>2</sup>

1Computer Science Department - Federal University of Lavras (UFLA) PO Box 3037 -37.200-000 - Lavras - MG - Brazil

<sup>2</sup>Human Sciences Department - Federal University of Lavras (UFLA) PO Box 3037 – 37.200-000 – Lavras – MG – Brazil.

kaio0500@gmail.com, apfreire@dcc.ufla.br, patricialmeida@dch.ufla.br

Abstract. The mobile devices usage has been growing ever since. This grow is linked to the hardware and software advance and the ability to do activities: such as learning a Second Language (L2), only possible before using other technologies. There is a variety of applications for second language vocabulary acquisition (Duolingo, Memrise, Livemocha, etc), most of them use self learning methodologies or limited number of games. Pappagaio is a user centered application focused on the communication between teachers and students while teaching/learning vocabulary in L2. Teachers will use mobile devices to create multimedia content (text, audio and images) and students will use this guided content throughout games as hangman, memory card or other associative games. In this paper, we will focus on the development of the user centered design for an Android application. The methods undertaken to build and test Pappagaio's prototype were online questionnaires, to understand the actual environment of teaching vocabulary in L2; Sketches, mockups and scenarios, to assist the prototype's interface design process; to test the prototype, a Collaborative Heuristic Evaluation followed by a User testing with Think-aloud method were conducted. The main goal of the project was to solve the extra-class vocabulary learning experience and, teachers, who tested it, they had shown low or inexistent resistance to use Pappagaio. For future work, there is a need for further testing, involving the whole application with a wider range of teachers and students for a long-term knowledge acquisition study.

#### **1. Introduction**

#### 1.1. Context

The mobile devices usage has been growing ever since. According to Gartner (2006), mobile devices sales grew 6.6% in the first quarter of 2006, compared to the same period of the year before, totaling approximately 3.65 millions devices.

The same trend is shown by eMarketer (2014). In 2012, the smartphone usage reached 1 billion mark worldwide and the expectation for 2014 is to hit 1.75 billions devices.

This growth is linked to technology advance, allowing mobile devices to have a similar or higher processing capacity compared to personal computers. Activities such as studying, playing, reading and communicating with others were only possible before with personal computers like desktops or laptops. The size and weight of smartphones has decreased, allowing more portability to them. Another interesting fact is that mobile devices can now have access to Internet by mobile network or via wireless access points.

In the beginning, technologies like books and dictionaries supported the vocabulary teaching in second language (L2) methodologies. As technology advanced and new methods were introduced on the market - tapes, CDs and computers - the educational system adapted its way of teaching to new and more interactive methods.

Currently, language schools are taking advantage of these new mobile technologies and students who do self-learning can also find a variety of applications (Duolingo<sup>1</sup>, Memrise<sup>2</sup> and Busuu<sup>3</sup>) and social networks (Livemocha<sup>4</sup>, Youtube<sup>5</sup> and blogs) to study by themselves.

This article presents the user-centered design to develop and test an Android application to help vocabulary acquisition in second language. This application can be used in education organizations (public, private and language schools) by their teachers, who will create the multimedia content and by their students who will learn while playing games.

#### **1.2. Motivation and Gap**

Vocabulary teaching in L2 has adapted to the new computer resources, providing new experiences that were not possible before. Among these experiences are game virtualization, communication between people across the world, and the possibility to practice activities by yourself or in a group at different places and time.

Currently, these new experiences are also been developed in mobile devices. Hence, organizations are focused in developing solutions for this new segment.

The free application known as Duolingo, available for the web and mobile platforms, allows users to practice vocabulary through games and different predefined levels, where can be developed the four linguistic abilities (listening, speaking, reading and writing) in a behaviorist methodology. Users can also follow their friends' activities and post questions to a Q&A forum.

Busuu is also a language learning application, but it differs from Duolingo. Busuu has a bigger language variety and other functionalities, such as, exercise revision and grammatical guiding. It is possible to chat via video with other users directly.

Another example of application is Memrise. It allows users to create multimedia content to practice skills related through its own developed method. This method is based on repetition and the Cambridge University Press initially developed it. In Memrise, users

<sup>&</sup>lt;sup>1</sup> http://www.duolingo.com

<sup>&</sup>lt;sup>2</sup> http://www.busuu.com

<sup>&</sup>lt;sup>3</sup> http://www.memrise.com

<sup>&</sup>lt;sup>4</sup> http://www.livemocha.com

<sup>&</sup>lt;sup>5</sup> http://www.youtube.com

can also add questions and the questions are answered by other students in the same class. Up to this moment, this platform has been totally free. The big difference is the possibility for content creation in different subjects not only on language acquisition. Most of these applications offer a self learning experience, where students change levels, execute tasks and interact with games based on a data base already populated when the application is installed (populated by the company who develops the application or by other users). However, there is a limited variety of games to practice the content and as the platform uses self learning methods, most of the time, the content does not fill completely the users need.

#### 1.3. Proposal

The work presented on this article is part of a bigger project called Pappagaio: a multi platform application to assist teachers while teaching second language vocabulary and their students to practice a directed multimedia content through games. It focus on the user centered design process undertaken in the development of Pappagaio.

The proposal of the application is to provide tools to enable teachers and students to extend their communication extra classroom, complementing the knowledge acquisition process.

Teachers from different types of institutions (public or private) and from different educational levels (primary, secondary, university) or even teachers at home can create multimedia content on Pappagaio. They can use resources as camera, microphone and media gallery to build collections of words, here called "decks". Each deck has a theme or a scope. Inside the theme, each deck will have multimedia "cards" (as in normal decks of cards) containing each, two terms along with two sounds and one image representing a specific word/expression. Since each teacher knows what it is best for their own students, they will choose which content will be created inside Pappagaio. After creating decks, teachers can share these decks inside theirs classes and their students will practice through games as memory card, hangman, cross words, associative games, pictionairy and so on.

To guarantee the application success, it is necessary to develop a good user experience for both students and teachers, making their communication as intuitive as possible. This would save teachers' time inside classrooms, and on Pappagaio, students can focus only on the tasks being performed.

#### **1.4.** Structure

This article is divided in 6 sections starting with a brief introduction about the mobile devices and vocabulary learning applications. Section 2 presents four interactive systems for second language vocabulary, their features and gaps. Section 3 describes the proposed system: Pappagaio, the User Centered Design (UCD) process, data collection and methodology to build the final prototype. Section 4 presents the first set of the user requirements' results based on the data collected through questionnaires. Section 5 shows the results from evaluations performed by means of inspections by usability experts and user testing. Finally, Section 6 discusses conclusions and future work.

#### 2. Interactive systems for second language vocabulary learning

This section aims to discuss 4 second language and vocabulary learning applications that offer similar features and experience as Pappagaio.

Duolingo is a web and mobile platform (iOs and Android) for second language acquisition that uses crowdsourcing as a word translation technique. Launched in 2012, the platform has until this moment courses in German, Spanish, French, English, Italian and Portuguese. It has approximately 12.5 mi users (Ong 2014).

The platform is divided in lessons from a given theme. Each lesson has a sequence of questions that tests the four linguistic abilities (speaking, listening, reading and writing). At the end of each lesson, the student receives a feedback about his/her performance. The more correct answers she/he gets, more points are added to his/her account.

In his study about the platform, Garcia (2013) demonstrated that the level of user satisfaction was higher to those who worked on the first levels and decreased as they advanced levels. Another fact observed by him, was that beginners noticed the difference from having no knowledge (before using the application) to some knowledge acquired while using Duolingo. However, their level of excitement decreased once they did not feel these advances at the same speed later on.

For the Duolingo future, Garcia (2013) concludes that to capture the whole market, it needs to take the good functionalities found in other applications such as audiovisual context from BCC Languages, advanced speech recognition to practice as in Rosetta Stone and the interaction with the crowd, natives and peer-to-peer users, as in Livemocha.

Livemocha is a worldwide web community where natives across the globe interact with learners through activities and conversation to inherence the four linguistic abilities.

According to Livemocha (2014) website, the service was born in 2007 and has more than 16 millions users in 195 countries, highlighting the worldwide demand for a collaborative and captivating language learning approach.

The available courses on Livemocha are mostly free (Basic Courses). But there are alternatives like Active Courses where users pay for additional features as official tutors or help files downloading.

Quadros (2011) explains how Livemocha lessons work and, according to him, are divided in 4 parts:

- Learn: the student has more than 30 lessons to read and listen;
- Revision: Random lessons exercises;
- Writing: Mostly, students are asked to describe items and to produce texts about a predefined theme;
- Speak: in this particular lesson, the student can record messages and receive feedback from the Livemocha community;

Silva (2013) states about the resources available at Livemocha. According to him, it is possible to build the four linguistic abilities efficiently. The author also highlights the fact that is not possible to build the fours linguistic abilities in most of public schools where there is a low workload and too many students per class. Besides this, across video resources and live interaction with native speakers, students can self motivate themselves to keep learning a second language.

The main disadvantages of Livemocha for Silva (2013) are that the community analysis and feedback are not instantaneous. Moreover, some users do not care about analyzing and end up giving a poor feedback, which can harm some beginners, discoura- ging them to keep using the platform. She also does an analogy with classroom teaching, where there is the need to monitor students' work guiding them to improvement and evolution.

Busuu is a social network centered in learning languages. Launched in 2008, it allows users to register in a course to have access to its content, and also practicing it with natives. Currently, Busuu has support to 12 languages and has more than 45 millions users, becoming the largest learning languages social network.

The available courses inside the network are based on the Common European Framework of Reference for Languages (CEFR), covering levels A1, A2, B1 and B2.

In each level there are different units, each containing a variety of vocabulary terms, grammar, reading and writing exercises, and tests performed throughout the levels. To perform the activities, the platform provides different resources as audio, dialogues, podcasts, images and PDF files. There is also a section where the student can chat on video with native or fluent speakers.

Besides being the largest learning languages social network, most of the features here exposed are paid. On the free license application, advertisements keep appearing on the screen, drawing users attention away from their tasks and disrupting the learning experience.

Memrise (2014) is web and mobile (iOS and Android) platform based on three principles: science, fun and community. Supported by Cambridge University Press, they developed a method that creates a fast, effective and funny vocabulary learning experience. This method is based on repetition, where students write, listen and read the same words/expressions many times.

To this date, it has one million users and a 30% monthly grow rate becoming one of the fastest growing learning tools in the world. It offers more than 200 different languages to vocabulary learning and support for different knowledge areas as Arts, Literature, Mathematics and Science (Memrise 2014).

Inside Memrise, as in Livemocha, any user can teach or learn. However, on Memrise, users interact with the platform differently because it gives content creation tools to users customize their courses. To create the content, firstly a course must be created, and levels are added to the course. In each level, multimedia terms are added to it. These terms are composed by a set of attributes defined by the user. For example, while teaching a language, the user will create items with two terms, one audio and if needed, an image. All of these attributes can be offered by the system automatically (if it exist inside the platform database).

After creating the content, the course can be shared and other users can practice it. This practice happens through a game based on the memorizing method. At the end, the users gets feedback about their performances winning points and advancing levels.

When users are practicing an activity, and suddenly a doubt comes up, they can consult "Mems". "Mems" are aids created by other users with text and image. The "Mems" can be rated by users and the best ones are shown first. Memrise also has social tools where users can follow each other's progress, visualize a ranking list inside courses and discuss the activities inside a Q&A forum.

Memrise has great features that support the learning experience, but there are some points to be improved. The suggestions feature, Mems, sometimes does not offer an accurate tip. Another feature to be improved is the learning game. There is only one game to practice the whole content. Another set of games can engage more users on the learning experience. Hence, users can check all the content available for them to study before they play it. Until this date, the platform does not offer tools to practice speaking, focusing only on three linguistic abilities (reading, writing and listening).

All of the platforms/applications here exposed have a large number of users and worldwide recognition, but there are some gaps that can be fixed in order to survive on this head-to-head competition. The new proposed platform described in this paper must use a unique approach, modifying the vocabulary learning and teaching techniques, putting teachers into the center of the process, which does not happen in most of the solutions available to this date. Furthermore, to be competitive against the already stable solutions, there is the need for a better pros and cons analysis.

#### 3. Pappagaio

This section describes the proposed system for this paper and its data collection, design process and methodology. Lastly, it discusses which methods were used to perform the usability evaluation.

#### 3.1 Proposed System

This paper proposes the design, developing and testing prototype for an Android application here called Pappagaio following the principles of User Centered Design. Pappagaio will offer an environment for teachers to create multimedia content and, later on, share this content with their students. Therefore, it will enable students to learn and practice this content through funny/interactive games, training three linguistic abilities (listening, reading and writing) in its first version.

Pappagaio will extend the already existing communication between students and teachers inside the classrooms, complementing the students learning process.

The platform has a larger scope than what we will show in this paper. This paper focuses on the content creation by teachers inside Pappagaio. It was developed first because without any content the platform would not be usable.

Teachers are the key users of Pappagaio and without an effective content creating workflow, students would have nothing to play with.

Pappagaio is divided in 4 parts: Classrooms, Decks, Games and Notifications. Decks represent the content and they are a collection of multimedia terms, here called cards. The use of this nomenclature aims to abstract and organize the platform vocabulary

collection. Teachers create cards representing each term they want to teach using the available mobile device's hardware (microphone to record, text input to write and gallery/camera to represent the term graphically).

After creating decks, teachers can share this decks inside their classrooms so they become available for their students, to learn through games.

Notifications keep teachers up to date from their students' performances inside the application. Reports showing how students performed which game or decks can help improve teachers' planning for future classes or even help them to know their students weakness.

#### **3.2. Development Process**

#### 3.2.1. Data collection and analysis

Data collection and analysis on this project happened in two occasions. First, data was collected to obtain an overview of the real situation about the teaching vocabulary methods and technologies in L2. Later on the development process, data was again collected by on usability evaluation.

The initial project research was an action research where the researcher tries to modify the environment that is being studied (Wainer 2007). Wainer also states that during the action research, it is expected an interaction between the researcher and the involved subjects, because solutions and definitions can emerge from this interaction.

Trying to understand the environment where the solutions are built, it is important for the project success. The data was collected from teachers who are involved on the teaching vocabulary in L2. A questionnaire containing a group of questions (objective and open-ended) about vocabulary teaching environment, technologies and methodologies was distributed via Google Forms.<sup>6</sup> A copy of the questionnaire is available at Appendix A.

Nielsen (2004) states that during usability testing, the user sample should relay between three to four users from each category. In this work, 11 teachers answered the questionnaire. Figure 1 represents an overview from the teachers' characteristics.



#### **3.2.2. Interface Design**

Building the user centered design for the development of applications implies the design of screens and graphic elements. That can be used as tools to show to how users to obtain their impressions and opinions. From the design techniques currently available

<sup>6</sup> http://www.forms.google.com

today, these project used sketching, mock-ups and prototyping. The wireframing technique was not used in this project due to schedule reasons. These techniques are used linearly in Figure 2, adapted from the article Concerning Fidelity in Design (Tate 2010):



Figure 2. Design techniques and the timeline curve

**Sketching:** Sketches are paper drawings created with a pen or a pencil to represent conceptual ideas about a design. Any person can build a sketch due to of its simple form. Bowles and Box (2011) define sketches as an efficient methodology to describe ideas.

They also state that sketches let a rapid idea revision that a digital tool would not allow. That is why it is used on the first moments of the design process, where brainstorming is recurrent. Another interesting aspect, sketches do not block users criticism because anyone can scribble them. From the 27 sketches drew for Pappagaio, Figure 3 illustrates three examples of them: the class and deck creation and which data is supposed to be filled by the users. Note that there is not enough details and the precision of the lines is not important. The importance here is to describe as simple as possible the raw idea of the interface design.



Figura 3. Pappagaio's sketches examples

**Mockuping:** Mockups are used to represent high fidelity screen designs and how they should be implemented (codified). Mockups add details and decorations like shadows, images, textures or another graphic effect inexistent in wireframes or sketches. According to Mathis (2011), when visual details are added to a mockup, aesthetic reasons are not the only concern, because beyond an eye-catching product, the design should give hints about application's workflow. This is affordance. The details are designed to communicate with users; for example, the color green represents correctness and red error messages. The mockups were created using the Adobe Illustrator<sup>7</sup> tool: a vector creating software that allows high fidelity screen designing. Figure 3 shows three mockups that illustrate the actions of creating a classroom and a card, respectively, on Pappagaio. It is important to reassure the use of different colors for different purposes and icons for real life assimilation.



Figure 4. Pappagaio's mock-ups examples

#### 3.2.3. Prototyping

A prototype is a form of implementation of an application interface that can be tested by target users and receive constructive feedback on early stages of product development. The goal of a prototype is to test a solution and its features before releasing to the market. A prototype has high or low fidelity, depending on the project's requirements/budget. A high fidelity prototype means it looks almost as exactly as the final product and the opposite represent the low fidelity. There are tools that help building prototypes and following are three tools analyzed considering strengths and weakness.

<sup>&</sup>lt;sup>7</sup> http://adobe.com/br/products/illustrator

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Figure 5. Pappagaio's prototype screenshots

**App Inventor**<sup>8</sup> is a blocks-based programming web tool to create Android applications. The tool makes it easier for novice programmers to build functional applications because of its easy-to-use drag and drop interface.

When creating a project, the developer works with drag and drop actions, dragging labels, buttons, and images into the phone screen. Later, there are some customizing tools available to better adapt your solution like changing color of buttons, text and their sizes.

After designing and positioning the elements on screen, the developer starts adding some connection between the elements, for example, if the user clicks on an image, there is an animation between screens. These actions are build using blocks-based programming, with logical statements placing inside each other (using drag and drop). When finishing the logical connecting between elements, it is possible to test the application on a real android device by just connecting it to the computer or using an android simulator environment.

#### Strengths

- Free;
- Easy to use;
- No coding for designing layouts and connecting elements actions;
- Simple interface;

<sup>&</sup>lt;sup>8</sup> http://appinventor.mit.edu/explore/

#### Weakness

- No Java code is exported, then, no customization after creating an app;
- Limited customization;
- Works only for Android;

**Axure**<sup>9</sup> is a desktop application to help creating sketches, wireframes and prototypes. Similar to App Inventor, Axure works with drag and drop elements into the workspace. Later, it is possible to add extra properties and connections between pages or page elements. Axure has more tools when it comes to create projects, allowing designers/developers to create more customizable projects. When publishing a project, Axure exports the project as a URL and it is viewed on any browser, mobile or not.

#### Strengths

- Variety of tools for flow diagrams, sketching, wire framing and prototyping;
- Familiar interface;
- No coding for designing layouts or connecting elements;
- The prototype works on any platform, web or mobile;

#### Weakness

- Free version has limitations;
- Final project, exported as a webpage, can limit experience on mobile phones;

Android Studio<sup>10</sup> is the official development environment that allows developers to build Android applications. It offers a layout editor, allowing drag and drop element creation, generating an XML file that can be edited later. There is an environment that simulates an Android device or a hooked phone is used for testing the application.

#### Strengths

- Design and code workspace view, easy to edit and customize projects and layouts;
- Extensive ability for hard coding customizations;
- Bigger range of native UI (User Interface) elements;
- Debugging tool with system logs;

#### Weakness

- Programming knowledge required;
- Only works for Android applications;

The Android SDK was the one used on this project because of two reasons. First, since the other part of the project mentioned in the proposal will be the development of the Android app, using the SDK for the prototype allows a better time management and code reuse in the future. The other reason is that the Android SDK allows the use of all

<sup>&</sup>lt;sup>9</sup> http://www.axure.com

<sup>&</sup>lt;sup>10</sup> https://developer.android.com/sdk/installing/studio.html

UI elements extending the possibilities while creating the screen designs. Thus, for a larger variety and less rework the Android SDK was chosen as the prototype tool.

#### 3.2.4. Methods for Usability Evaluation

According to Nielsen (1993), usability testing is the most accurate method when testing a solution, because it uses real users and concrete interface designs. Through user testing it is possible to obtain the necessary feedback to continue the design process or to discover errors to be reviewed.

While performing, it is important to reassure how the data is going to be recorded and analyzed. To guarantee a data collection completeness and allow for detailed analysis, the tests are recorded with a video camera or microphone. This ensures that the users' movements or reactions are recorded for later analyses. In this project, the "think-aloud" technique was used for the evaluation, along with recordings of the sessions. Think-aloud, as the name suggests, is a technique where users exposure their thoughts as they explore the application. Scenarios were given to simulate real life situations. Then, users were asked to perform a sequence of actions (tasks), and as they do, they were asked to keep saying out loud what they were thinking or willing to perform. Three people, two women and one man, lectures at Federal University of Lavras performed the user testing. Two of them teach at the English Language lab (one being a native north American) and the other is a current teacher at the Human Science Department. The average age between them is 30 years. They had sufficient computer and smartphone knowledge to performed the test.

Another technique used in this project was the Collaborative Heuristic Evaluation (HE) (Buykx 2009). This evaluation aims to recognize on the user interface some design principles and, as Nielsen (1993) said, it can also be used to explain design problems encountered in user interfaces. The Collaborative Evaluation involves more than one evaluator, performing the evaluation collaboratively as a group at the same time, and not separately as in the traditional approach to heuristic evaluations. This helps to improve the productivity of the evaluation and avoid spending extra times in discussions. A single list of problems is produced, but each evaluator is allowed to assign his/her individual severity rating to each problem. Four evaluators performed the evaluation of this project. Salgado and Freire (2014) perform a mapping study and found that from 13 HE studies, 5 of them used 4 evaluators.

To be able to recognize errors or design principles during a HE, there is a list of heuristics to follow. Nielsen (1993) defined a set of 10 heuristics and Salgado and Freire (2014), through their mapping study, also discovered which heuristics were most used in mobile usability testing. In this project, during the usability evaluation, it was used a set of 15 heuristics - a combination of the Nielsen and Molich's plus 5 most used heuristics from Salgado and Freire's mapping study as reported in literature. The complete list is available on the Appendix B. The evaluation in this study involved 4 evaluators with previous experience performing heuristic evaluations and with experience in user centered design.

#### 4. Results - User Requirements

This section demonstrates the first set of results obtained from this work, consisting of the analysis of the questionnaire applied with teachers. The main goal of this data collection was to obtain an overview of the real situation about the vocabulary teaching in second language and to gain insights about user requirements, interface design and Pappagaio's features. Eleven teachers answered the questionnaire and a copy is available at Appendix A. To categorize the data, a content analysis was performed, coding the main points identifying and assigning categories to them ("tagging" items). From teacher's answers, the main keywords were extracted and, later, the words were counted and the most used were listed below according to each question.

- **Teacher smartphone usage:** The majority of teachers (73%) own a smartphone. 45% own a android phone while only 28% an iOS phone. This could help our project to launch first an Android beta version for testing and feedback while later on an iOS version would be released.
- **Teaching vocabulary methods:** The methods that were mentioned most frequently were vocabulary in context and the use of multimedia files. Other answers included online gaming, CD-ROMs and flashcards. The project will create context with the interrelation between multimedia files (image, sound and text) all combined in a specific group of words/expressions where teachers will create as they wish.

"I work with figures, synonyms, always teaching in the studied language, in this case English. I ask my students to insert on their sheets, new studied words and I give exercise to connect these new words, in context, with the words' definitions." (Free translated by the author)

Tags	Count
Contextualization	4x
Images	4x
Real life situations	3x
Texts	3x

• Vocabulary homework: The teachers said they assign homework that involves exercising the ability to learn new vocabulary such as reading, watching short movies, creating new sentences and making lists of new words and their use in sentences. Again, it shows teachers are concerned about context and the use of multimedia platforms to learn new words.

	"Yes,	I do.	Many	of the	exercises	involve	images	and soun	ds."
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Tags	Count
Finding new words	4x
Vocabulary exercises	2x
Reading, Games, Images, Sounds, Movies	1x

• Challenges while teaching vocabulary: This question aimed to recognize what were the biggest challenges while teaching vocabulary. Teachers reported that memorizing was their students' main challenge. Pappagaio will train memorizing by offering games that can be played anytime or as many times as the students want.

Tags	Count
Memorizing	5x
Contextualization	3x
Teach only in L2, Adult feeling childish, pronunciation, practicing	1x

• **Technologies used while teaching vocabulary:** The main type of media used to teach vocabulary is still CD-ROMs with sounds. However, some teachers are using some mobile applications, the internet and other multimedia alternatives like movies, videos or podcasts. Hence, there is a gap that could be filled by a mobile platform in which teachers could create their own content and try new ways of interaction with multimedia files and games.

"Since I only have private students I can easily adapt activities. I use my iPad a lot to download talks, cartoons, songs and games. Nevertheless these are all adapted activities, so I don't have a file..."

Tags	Count
Audio	5x
CD-ROMs, Internet, Games, Dictionaries, Movies, Projections	2x
Cartoons, Podcasts, Skype	1x

• **Introducing a new app to help students learn vocabulary:** Some teachers said they already use vocabulary mobile applications such as Duolingo. Others said that students like new methods and technology. And they also contributed with interesting information that is relevant to Pappagaio: the importance of obtaining feedback from students and supporting an offline mode in a tool.

"I think a mobile app is a good way to make practicing vocab more interesting and fun. It's good to have a variety of teaching strategies, and a mobile app may have visual appeal for students."

Tags	Count
Practicing anywhere	4x

Appealing technology	3x
New teaching strategies	3x
Interesting, fun, better timing to learn, multimedia, give feed to teacher, collaboration, offline mode, context	1x

• Suggestions of activities or games that could be implemented in the mobile platform: The suggestions are related to our proposed model: associative games and others can be implement with multimedia content. The multimedia content helps these type of games to be more interactive and fun.

Tags	Count
Associative Games	4x
Crosswords, videos, listening, Context, Quizzes	1x

#### 5. Usability Evaluation

#### **5.1. Heuristic Evaluation**

The Heuristic Evaluation (HE) evaluation reported in this study was performed in a room where the application prototype was projected onto a wall and the evaluators were given a set of actions inside a scenario to analyze. Since teachers are the most important users, the scenarios were focused on the content creation inside Pappagaio. Evaluators provided with 2 scenarios to be performed by an operator and the evaluators analyzed potential problems that could occur to users while using the application.

**Scenario 1:** You are a public school teacher and you currently you 4 Portuguese classrooms at secondary school. You teach on Tuesdays and Thursdays during the morning. Your classrooms have an average of 30 students per class. You want to login into Pappagaio and create a classroom that represents one of your school classrooms.

**Scenario 2:** Your students are really interested in learning new words and mostly how to contextualize them. Nothing better than creating a multimedia deck, so they could interact at any moment playing games inside Pappagaio. Imagine you are teaching about colors this week. Please create a deck that would represent a combination of colors and add 1 card representing the color "black".

Based on the list of heuristics, the evaluators set for each design or usability problem a severity rate according to Nielsen (1993). The severity goes from 0 - not a problem; 1 - cosmetic problem - fix only if there is extra time on the project; 2 - minor usability problem - low priority fixing; 3 - major usability problem - high priority fixing; and 4 - usability catastrophe - must be fixed before product release.

From the 65 usability problems encountered during the HE, 15 received a 3 or higher severity rate, meaning that they have to be fixed, otherwise users would take too long to finish the actions. The list of the most critical problems is presented in Table 1.

Screens	Problem's description	Applicable heuristics	Average Severity Rate
Initial Screen	There is no feedback if Create Account is implemented	H1, H5, H9	3
Classrooms	Empty Screen - Explain why is it empty	H6, H1, H9, H5	3,25
Create Classroom	Fill the obligate fields, which are obligate?	H6, H5, H9	3,25
Create Classroom	Interaction order is not clear - can I finish a class even without adding a deck?	Н6, Н5	3
Create Classroom	There is no confirmation message after concluding the action	H1	3
Create Classroom	When clicking in "add deck" takes to another screen	Нб	3
Create Classroom and other creating content screens	If the user clicks in go back,there is no warning that he might lost his/her work	H5	3,25
Create Deck	Add Deck button is not clear about adding an existing deck already	H2	3,5
Create Deck	The process is too complex	Н7	3,5

Create Deck	If creating a card, there is no information about the deck if it was saved	H7	3
Add Deck	On the adding screen, there is no option to create another deck if necessary	H7, H5, H10	3,5
Add Deck	Text Label Add/create deck is too confusing	Нб	3
Creating Card	There is no instruction about what is necessary to fill	H5, H1	3
Creating Card	Too much information	H13	3,25
Creating Card	There is a play button without a file to play	H1	3
Creating Card	It lacks instructions about how to record a term	Нб	3



The data collected while performing the heuristic evaluation demonstrates a need to redesign some screens/functionalities. Most of the errors were related to appropriate error messages, affordance, lack of help or tips for users to perform actions and lack of proper positioning of relevant information on the screen.

#### 5.2. User Tests

Three teachers at University level performed the Usability Tests. They teach English for Federal University of Lavras' students. Nielsen (2004) says that the number of users to test an design should be about 3 to 4 in each group. They performed the same scenarios presented to the HE evaluators. All of their actions were recorded with a camera and the videos were analyzed. The usability problems were tracked and Table 2 shows an example of the compilation of the results from User 1.

USER 1		
Time and application's screens	User actions	
01:36 (Create class)	She mistake the languages (taught language and spoken language)	
01:45 (Create class)	The keyboard did not hide after completing the fields, hiding the bottom buttons to finish creating class action	
01:59 (Create class)	She asked "Should I add decks"	
03:02 (Create card)	She clicked again on creating a deck.	
03:12 (Create card)	She understood after seeing the button "add cards" on the create deckscreen and went back. But the back screen went to the classes not decks that confused her.	
03:20 (Classes)	While trying to create cards she clicked on the shortcut to show all the decks inside a classroom	
03:28 (Classrooms)	She clicked on the flags trying to enter a classroom.	
03:29 ("ISF" classroom)	She clicked on the "add deck" trying to creating a card.	
03:35 (Add Deck screen)	She clicked on the deck available to importand nothing happen because it was not implemented.	
03:38 (Add Deck screen)	She selected the deck to import into "ISF" classroom. It was not implemented	
03:50 (Deck tab)	She again tried to enter a deck clicking on the flags	
03:53 (Deck tab)	She clicked on the classrooms shortcut inside colors deck	
04:14 (Create deck)	She created another deck named "Colors" because she could not find the add card option	
04:22 (Decks)	She mistake the back button and went to	

	the login screen
04:28 (Classroom)	She again clicked on the flags trying to enter a classroom while trying to add a card to the Colors deck
05:13 (Create card)	She was going to click on the play button beforerecording it because it is placed on the left side of the screen
05:14 (Create card)	When she clicked on the record button for thetaught term the application crashed and simply said "Pappagaio stopped"
05:18 (Colors deck)	The application went back to the deck screen
05:20 (Classrooms)	She clicked on the back button trying to go back to the creating card screen
05:21 (Classrooms)	She clicked on the shortcut trying to enter the decks tab
05:29 (Decks)	Trying to enter the Colors deck, she again clicked on the flags
05:38 (Create card)	She clicked on the "plus one" button because she thought she already had one card created
06:08 (Create card)	She asked "check" to finish the action before taking or uploading a picture
06:12 (Create card)	The keyboard was hiding the upload/take picture buttons
06:19 (Create card)	She was doubt about which button to press the "camera icon" or the "folder" icon
07:04 (Create card)	It took 4 seconds to her to find the "check" button and conclude the action
07:10 (Colors deck)	Without any feedback on the card she just created, she said, "I think I did it?"
07:16 (Colors deck)	She started to explore the deck fields pressing them waiting for a feedback from

	the application.
07:25 (Colors deck)	She said after touching the screen a few times more "Yes, I think that is it."

#### Table 2: List of User 1 actions performed on tape during the Usability Test

During the usability test, 81 problems were encountered. The problems encountered by the users were similar to the problems found on the heuristic evaluations. Users after performing the content creation, did not know where to find it. The lack of affordance affected users too. They clicked on icons thinking they were clickable. One major problem they also faced was creating a card. For them, it was a complex process. Buttons were too close to each other and there were no tips or help to guide them through the process.

After the test, they answered a questionnaire The System Usability Scale about their performance and how they felt using Pappagaio. Table 3 shows the form they used to inform their impressions on the satisfaction while using the system and the average for each topic given by users.

The System Usability Scale Standard version	Average opinion 1 (Strongly disagree) to 5 (Strongly Agree)	
I think that I would like to use this system	4	
I found the system unnecessarily complex	2	
I thought the system was easy to use	3,5	
I think that I would need the support of a technical person to be able to use this system	2	
I found the various functions in the system were well integrated	2,5	
I thought there was too much inconsistence in this system	2	
I would imagine that most people would learn to use this system very quickly	3,5	
I found the system very cumbersome to use	2	
I felt very confident using the system	2,5	
I needed to learn a lot of things before I could get going with this system	2	

#### Table 3: Users' impression after using Pappagaio

From the feedback participants gave after the tests, an analysis was made on the main strenghts and weaknesses of the prototype pointed out by them. Those are listed as follows.

#### Strengths:

- •"Very attractive";
- •"I think with time I could easily get used to the app";
- •"Intuitive login screen";
- •"Plus sign on screens are intuitive, but far from its finality";

#### **Suggestions:**

- "The term 'spoken language' is imprecise";
- "A tutorial would be nice";
- "Some starter decks could be useful";
- "A built in pictures library";

#### 6. Conclusion and future work

This last section presents the highlights and most important results from the requirements, design and user evaluations. It also presents the redesign after the usability evaluation and future work.

#### 6.1. User requirements

The data collected and analyzed before, provided important insights to the project design. Teachers stated that contextualization is as important as the use of multimedia content, while memorizing is the first challenge when learning second language vocabulary. Plus the mobility and appealing technology is strength for an application, which can lead to an interactive experience combining all these elements with gamification.

#### 6.2. Evaluation and Redesign

The evaluation executed either by experts or users have shown that even following the Android design1 guiding and mobile design principles, both encountered issues while performing/analyzing Pappagaio. The main problems were related to the process of giving poor feedback to users when they had made mistakes and users were not able to complete tasks or took too much time because of the lack of on-spot assistance/tutorials.

In Figure 4 are shown some mockup redesigns based on the feedback given by users

and evaluators. Help assistance on every screen on the app was added to minimize errors and help users if they need. The other example shows the new interface design for creating a card. The interface (in Portuguese) was aiming to make it cleaner and easier to identify the workflow when compared to the old design.

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AJUDA SOBRE BARALHOS	Termo em francês:	
No <b>Pappagaio.</b> BARALHOS são coleções criadas para melhor organizar seu conteúdo multi- mídia.	DD:10	
Como na vida real, baralhos aqui contêm CARTAS. Aqui elas são multimidias, cu seja, contêm palavras, sons e imagem. Com esta es- trutura, os seus alunos podem jiogar jogos inter- ativos, melhorando o processo de aprendiza- gem.	Aperte e segure para gravar ENTENDI Termo em holandês:	TIRAR FOTO 🗎 IMPORTAR
Digamos que queira ensinar seus alunos termos usados em um supermercado. Para isso, você poderia criar um baralho chamado "Termos en- contrados no supermercado".	00.00	
Com isso, você garante uma contextualização dos termos e seus alunos podem praticar o baralho inserido em um contexto.	Adicionar imagem:	CRIAR CARTA
FECHAR ENTENDI		

Figure 6. Redesign proposition for creating a card

#### 6.3. Future work

The results presented on this paper are just the beginning of the user centered design of Pappagaio. The focus of work presented in the paper was to test the possibility to create content on mobile devices and the results shown that it was possible. Future work will involve, for the short term, test the redesign for content creating, and after that there are changes to be made about on the interface design and functionalities, such as, sharing decks between teachers, designing and implementing games to be played by students and the development of the students' interface of Pappagaio.

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#### Appendix A

#### Questionnaire 001 - Teaching vocabulary in foreign languages

- 1. In which level do you teach vocabulary?
- 2. Which methods do you use to teach vocabulary?
- 3. Do you give vocabulary homework to your students? How?
- 4. What is the biggest challenge while teaching vocabulary?
- 5. Do you use technology resources while teaching vocabulary? What?
- 6. Do you believe that students can learn better vocabulary from a mobile app? How?
- 7. Would you like to give some activity examples you may had success teaching vocabulary? (games, books, CDs)
- 8. Could you leave your email so we can contact you in a near future to put you ahead of our project development?
- 9. Would you add a question to this questionnaire, or would you like to leave a comment?
- 10. How did you know about the project?

#### **Appendix B**

#	Heuristic
1	Visibility of system status
2	Match between system and the real world
3	User control and freedom
4	Consistency and standards
5	Error prevention
6	Recognition rather than recall
7	Flexibility and efficiency of use
8	Aesthetic and minimalist design
9	Help users recognize, diagnose, and recover from errors
10	Help and documentation
11	Pleasurable and Respectful Interaction with the User
12	Constant and appropriate feedback
13	Ease of input, screen readability and glanceability
14	Aesthetic, privacy and social conventions
15	Every round trip counts

Table 4: List	of Heuristics	used on eval	luation
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### CAIO CÉSAR SANTOS DE RESENDE

## PAPPAGAIO: USER CENTERED DESIGN FOR A SECOND LANGUAGE VOCABULARY LEARNING ANDROID APPLICATION

Trabalho de Conclusão de Curso de Graduação apresentado ao Colegiado do Curso de Bacharelado em Sistemas de Informação, para obtenção do título de Bacharel.

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Dr. José Monserrat Neto

Dr<sup>a</sup> Ana Paula Piovesan Melchiori

Dr. André Pimenta Freire (Orientador) Dr<sup>a</sup> Patricia Vasconcelos Almeida (Coorientadora)

> LAVRAS-MG Novembro/2014