

# Luz, Câmera, Libras!: How a Mobile Game Can Improve the Learning of Sign Languages

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**Abstract.** There is a natural communication barrier between hearing and non-hearing people, and one of the reasons is the lack of knowledge about sign languages. This paper presents a study about a mobile application for learning and practicing the Brazilian sign language (Libras). The application consists of a guessing game in which two players must guess each other's signs. For two months, the data collected from the game server and from the user gaming experience was analyzed with regard to the user interaction, engagement, fun and learning. The obtained results indicate that due to the mobile nature of the application, the drop rate was higher than expected. However, the user information demonstrated that learning tools can benefit from the mobile and ubiquitous nature of such devices. Despite the many drawbacks found, users confirmed the game was fun and effective for learning a sign language.

**Keywords:** Mobile, Sign Language, User Experience, Games.

## 1 Introduction

Deafness, or hearing loss, is defined by the IDEA (Individuals with Disabilities Education Act) as a hearing impairment so severe that the person is unable to process linguistic information through hearing. According to the World Health Organization, in 2004, 275 million people had moderate-to-profound hearing impairment.

Although deafness does not affect a person's intellectual capacity or ability to learn, it directly affects how a person interacts with the world and can lead to difficult challenges in some situations, including learning. The communication gap between hearing and non-hearing people is aggravated by the fact that the major percentage of the population does not know any kind of sign language. In this scenario, every deaf person would need an interpreter in order to communicate without issues.

Concerning the Brazilian context, there are about two million people with moderate-to-profound hearing impairment, according to the 2010 census. In 1857, within the first Brazilian School for Deaf People, a sign language was developed in order to ease communication between hearing-impaired people. The Brazilian Sign Language (Libras) is derived from the French Sign Language.

However, nowadays only a small percentage of the Brazilian population actually knows Libras. In addition, the Brazilian Federation for Education and Integration of Deaf People (Prodeaf) estimates that only 7% of the deaf population in the country are capable of properly understanding Portuguese written language, because they were not alphabetized [1].

Observing this communication barrier, it is clear that a better understanding of sign languages can facilitate the interaction between hearing and deaf people. But learning Libras requires as much effort as any spoken language, and unless the students have a strong motivation or objective, they tend to give up along the way. One method to engage students in the learning process is to create a ludic tool that keeps their attention while it continuously presents the signs and vocabulary contents.

The recent growth on the use of smartphones and other mobile devices has made it an interesting field to tackle some of these communication issues. A game called Luz, Câmera, Libras! (LCL) was developed for iOS and Android devices with the objective of creating an interaction between the users, using sign language to communicate. The LCL is a turn-based guessing game, which main objective is to create on the players some interest about sign languages and diminish the existing communication barrier.

In such way, this work presents an alternative for learning and practicing sign languages, and intends to help the interpersonal interaction mediated by digital devices. At the same time, this paper aims to analyze the LCL gaming experience, by examining the user engagement with the game, the users' interaction during gameplay and the application's ability to teach basic Libras vocabulary.

## 2 Digital Interfaces and Tools for Learning Aid

Along with the advances in electronic computing, the digital revolution has affected several human activities. For instance, education is facing many changes due to the new technologies. Digital learning environments afford dynamicity and flexibility to the act of acquiring information, updating content and adopting specific practices according to each one's needs. However, easy to reach content and digital tools do not guarantee one of the most important education factors: motivation. When applied to the educational context, digital games have proven to be quite efficient in approaching this issue. In sequence, a few digital tools or games for aiding education are presented.

The LVILibras [10] is a digital tool for teaching Libras, developed for both Android and iOS platforms. The process is based on videos, animations and images in which general Libras concepts are presented. This tool does not present any innovation regarding didactics, since its focus is to bring digital resources into a traditional class procedure.

The AutoVerbal Talking Soundboard [14] (Figure 1A) is an application designed for Apple mobile devices, which purpose is to help a deaf or mute person communicate with other people that do not know a sign language. The system has several images by default for which user can assign words individually. This way, whenever that

icon is touched, the word is reproduced aloud. The program has a Text-to-Speech feature as well, which verbalizes any written text typed.

The Ldn Access [17] was designed for multiple purposes. It stores routes, obstacles, ramps and several adapted toilets throughout the city of London. The system is based on GPS for a more accurate guidance. Users can also filter establishments by category, like when looking for Indian food. According to the developers, the application was made simple for users with deficient motor skills. Thus, instead of typing long words, such users may simply touch icons on screen (Figure 1B). It does not depend on internet, which guarantees autonomy for most of the system features.



Fig. 1. A: AutoVerbal Pro screen (iPhone version); B: London Access screen

Also, some analogic games have adapted versions for teaching sign languages, commonly meant for children [3]. Figure 2 shows two different games. The first one is a lotto-like game, in which alphabet letters are drawn and the user must fulfill cards with the correspondent Libras letter. The second follows a dominoes mechanics. Each piece has both an object picture and a letter from the Libras alphabet. Users must match the Libras letter with the first letter of the object.



Fig. 2. Libras adapted Board games

### 3 Ludic Learning

The use of ludic approaches for learning is not a new phenomenon, especially regarding children's education. From the early decades of the twentieth century, teaching methods like the Montessori [13] use, among other resources, ludic activities in order to teach children basic concepts such as mathematical operations, reading and writing abilities. More recently, there is a wide range of digital games designed to be used as additional pedagogical material in classroom environments.

The idea of using games for learning purposes fits well with the constructivist approach to the process of acquiring knowledge. The widely accepted theory, proposed by Jean Piaget in the 60's, applies the concepts of cognitivism – a field of Psychology that focuses on mental processes such as perception, problem-solving and decision-making – to learning processes. The basic premise of constructivism is the idea that an individual is capable of building his own knowledge by gathering information and resources provided by the environment and/or a facilitator, whose role is assumed by a teacher, in the most traditional learning contexts. [8]

Leont'ev [9] added a social component to the constructivist learning dynamics. He states that the cognitive development cannot be held apart from the social and cultural context in which it happens. Being so, the superior mental processes (thought, language and willful behavior), are originated by social interactions, through activities that take place in specific environments, and are mediated by instruments. Such instruments can be as diverse as a notebook and pencil, a movie, an electronic device, or even a game.

Being the game an environment, as well as a mediating tool, part of the information that will become knowledge on the subject's mind already exists; ready to be combined with the player's experiences and mental connections.

One of the concepts bounded to games is the idea of flow, defined by Csikszentmihályi [2] as “the satisfying, exhilarating feeling of creative accomplishment and heightened functioning.” It happens when an individual is completely focused on the task being performed, and there is a good balance between the challenges, the player's skills and the rewards from doing the task. A person can experience flow in various activities, but playing a well-designed game has proved to be one of the quickest ways of achieving it.

The major objective in the realm of educational games is to introduce flow into learning activities, thus engaging the players/learners into a pleasing task that has embedded in it the content that is expected to be learned.

The LCL game helps learning and practicing sign languages by adopting game characteristics, as well as a constructivist knowledge-acquiring approach. This way, it creates an environment for learning sign languages that aims to attract and motivate players to improve their abilities in game and, consequently, to increase their sign language abilities.

## 4 Usability, Accessibility and Interaction in Games

Usability is a measure composed by three metrics: effectiveness, efficiency and user satisfaction, where each of these can assume different measures as desirable system's properties. However, the LCL has hybrid characteristics since it aims to teach sign language as a distance learning tool, besides entertaining by incorporating competitive elements from games. Thus, it becomes a challenge to define a design methodology capable of covering both characteristics. As explained by [7], user-centered design methods, usually applied to production software, can be adapted for evaluating certain aspects of games. Among usability methods, the ones that focus on user satisfaction evaluation become more suitable for evaluating games thus enable the extrapolation of this feature to achieve answers about how fun the game actually is, thereby obtaining a more reliable overview of user experience.

Some researches approach usability of systems for people with disabilities such as the ones performed by [16], who employed the Think Aloud Protocol for individuals who are deaf or [18], who worked on the development of an educational game for deaf and hearing children. There are efforts in adapting traditional methods of usability evaluation for games, as it is observed in [12], the RITE method; an adaptation of Usability Testing. Similarly, [6] analyzes the contribution of inspection methods with experts. However, it could not be found any research focused on developing a game to teach sign language to normal people and its respective usability evaluation.

Starting from these concepts, we must select from among several usability evaluation methods those that will be able to extract better qualitative information from users. We can find in HCI literature various evaluation methods that can be used in different scenarios. In turn, [5] describes the Self Reporting Log method as a diary in which the volunteer can make notes about his/her interactions with the system. It is recommended applying Self Reporting Log when the user is at distance, factor that favors the LCL's evaluation because it is a mobile application, and therefore cannot set a specific location for its use. In addition to this method, the Server Log was also analyzed in order to gather information about the rate of voluntary use and some patterns in usage behavior. After the testing period, the users had also answered a survey about their experiences with the game, which will be presented further along.

## 5 The Luz, Câmera, Libras! Application

The game was built around the guessing word mechanics, (e.g. Pictionary [4], Draw Something [15]). The main goal of the game is to create a learning session between two players, where basic sign language gestures can be assimilated during the leisure activity. One of the main attractions for the user engagement is the limitation to play only among the user's Facebook friends. The familiarity with the other player creates an additional layer of entertainment which relies on watching your friends mimic a sign language gesture in front of the camera, which is funnier than watching a strange person in the same situation.

The application was developed for the iOS platform, being available for iPhones, iPods and iPads. An Android version was also developed alongside the iOS version, but for the current evaluation, only the iOS version was used. In addition to the client application being executed in the players' device, a server application was created to receive the players' responses, coordinate the matches and store the game statistics.

## 5.1 Game Mechanics

Currently, each match is playable by exactly two people, but the players can hold many concurrent matches. At each round the player must watch a video recorded by his friend and guess which word was signed. Next, the player must record his own video, based on three given options. Then, the recorded video is sent to the server, the round restarts, and the other player receives a notification to guess the new word.

When asked to choose between the three options, in fact three videos are shown, and the user can play them repeatedly as many times as wanted, until he feels comfortable to mimic the sign in front of the camera (Figure 3A). In the next step, the chosen video is still available to be played again, while the player is recording his own version. This way, the learning by repetition process takes place while the player tries to memorize the sequence of gestures that must be reproduced.

The words available for choosing were manually classified in three difficulty levels by the development team. Using this criterion, it was possible to initiate beginner users in the sign language, by showing them some signs that they might have used before, and then presenting some other options that required more memory effort.

In the first version of the application, the player had to choose the correct answer among four options presented on the screen. However, after initial tests, this implementation was considered inadequate for the gameplay for it was too easy to rule out the incorrect. Thus, the guessing mechanics was changed into a modified keyboard, containing a random set of possible letters mixed with the correct set of letters for the given word (Figure 3B and 3C).

The keyboard was designed to allow the user freedom to experiment with different possible answers. There is no penalty in wrong attempts, as the only way to fail this stage is to give up. In addition to manually rearranging the letters, the possibility to shuffle them is also given. To aid the user in the guessing stage there is a 'Help' feature, which puts some word letters in their right place, giving a glimpse of what the answer might be.

Once the whole gameplay is asynchronous, the two players do not have to be using the application at the same time. A normal play session would involve a player recording multiple videos for different rounds and guessing words for others. When the player is done, he/she should be comfortable to leave the application without having to wait for answers from other players. This comfortably fits the mobile nature of the platform, where players do not always have time to wait for other people's answers.



**Fig. 3.** A: The reference video to be memorized and mimicked; B and C: The evolution of the word guessing mechanics

## 6 Analyzing the Luz, Câmera, Libras! Experience

The LCL evaluation process is described next. After a testing and debugging stage, the beta version of the game was made available online (through Apple Store). The release was shared in Facebook for its quick spreading, reach and ease of regular instant updates. The user evaluation period comprehends the months of December of 2012 and January of 2013. The game was hosted on a cloud application platform, so it was possible to analyze both server and user information. Server data may provide user engagement information, whereas user answers deal with the playing experience.

### 6.1 Server Data Analysis

A total of 230 players were registered in the game server starting from December the 10th, from which 47 people did not play any match afterwards. From the actual 183 players, 12 of them were regular players (group A) and 30 played between 1 and 10 days (group B). The other 141 players had just about 24 hours of gaming experience (group C), which represents a rejection rate of about 77%.

During the evaluation time, 479 matches were created and 827 rounds were played. It represents approximately 1.7 rounds per match. Players from group A had a total of 139 matches they created or joined, whereas the number of rounds played was 304. As the duration of the gaming experience decreases, the number of rounds per matches behaves accordingly. Group B had 78 matches in which they played 142 rounds and group C – the larger group – had 262 matches to 381 rounds.

Regarding the number of correct answers, the longer the players kept on playing the higher was their accuracy rate. The players from the group A correctly guessed their partner's sign 56 times against 21 mistakes, which represents approximately a ratio of 2.6 for correct/incorrect answers. On the other hand, both groups B and C presented a much higher error rate than correct answers.

### 6.2 User Data Analysis

During the testing period, the users were asked to maintain a Self Reporting Log in order to keep track of any strange behavior the application could present, as well as ideas to improve the player experience by criticizing the game interface. This information is condensed and further explained in Figure 4A and 4B.

After the testing period, the users were asked to answer an online survey so they could provide feedback as regards several aspects, such as the interaction with the application, in game interaction, and learning and practicing issues.

About 15 users were actual respondents on the evaluation phase. Although the server data provided all user information, such as name, email or Facebook account, it was decided to do not ask for any personal information on the survey, so users could answer completely anonymously, therefore avoiding any influence on the answers.

Again, to reinforce the information gathered with the Self Reporting Log results, the users were asked to comment any problem found on the application functioning (Figure 4A), as well as interface issues (Figure 4B).

		I couldn't move back to the last screen	
It unexpectedly terminated		I couldn't find an specific button	
It crashed and I got stuck		An existing match vanished	
It didn't show one of the videos		I was not able to record a video	
It didn't show my partner's video		I recorded a video but it cut some frames	
It didn't recognize the right word		The 'Help' button didn't help much	
It took too long to load matches		I didn't understand a button's meaning	
It took too long to send my video		I didn't know how many seconds	
I wasn't notified about new matches		I had to record my video	
I couldn't start matches		I wanted feedback for wrong attempts	
Other issues		Other issues	

Fig. 4. A: User list of reported errors; B: User list of interface complaints

Some of the other issues reported as functioning problems were actually game features, like the guessing order when choosing a random match; other referred to server and pop-up errors. Regarding the interface issues found, one user complained about the video execution speed, which was said to be too fast, and another commented that it wasn't clear that it was possible to choose among 3 videos.

When asked if they faced difficulties in order to record videos, only 27% of the players answered negatively. About 13% reported high difficulty, 33% medium, and 27% said it was somewhat difficult. These results probably reflect the need of using both hands and face to perform some signs.

The game was randomly published at one time, aiming to replicate a real market context. In such way, only 27% of the players answered they found enough friends with whom they could play. However, it did not prevent people from playing the game. About half of the players informed they mostly interacted with unknown people.



It is important to notice that, while similar games like Draw Something also encourage the interaction with strangers, the LCL game requires users to show themselves when recording the videos. It was expected that players could feel uncomfortable or shy when playing with unknown people, which could be confirmed by 33% of the respondents. Moreover, 40% of the players reported feeling ashamed to play in public environments and 13% indicated inconvenience or intrusion in some situations.

Finally, despite the drawbacks discussed previously, 87% of the respondents said they enjoyed playing the game and had fun. Concerning the sign practice, 93% of the players indicated the game helped them learn Libras (60% reported some help and 33% said it was very helpful). In order to reinforce these results, 27% of the users informed they remembered ten or more words in Libras, 40% said they remembered around 6 words, and 20% answered about 2 words. Only 13% admitted that they did not remember a single word.

## 7 Conclusions and Future Work

This work introduced an innovative opportunity for learning and practicing sign languages while having fun and promoting accessibility. It also described the data acquisition procedure of a 2-month evaluation for the Luz, Câmera, Libras! first release.

Regarding this beta version, although the server data indicated a high abandonment rate, it can be considered common on mobile applications due to the fact that users download many of them just for testing. Also, early rejection is common in the game market, and free games are even more likely to be abandoned [11]. In addition to it, as observed in [19], games with educational purposes tend to be less engaging than purely commercial ones.

Due to the game's collaborative approach (i.e. both players only earn points when the words are guessed right), it might have been the case that players didn't feel stimulated to continue the rounds while their partners failed to guess words correctly. Together with this factor, the interest in learning demonstrated by group A made these players the ones who played the longest.

Concerning the user feedback, it is clear the need of several improvements. Users reported shyness as a relevant problem when playing with strangers. However, it is hard to work around this aspect, once facial expressions are crucial for sign languages. Perhaps adopting a feature for presentation or socialization could mitigate this complaint (e.g. a built-in chat feature).

Despite the drawbacks found on this first real user contact, the game achieved its main objectives: it has proven to be fun, and people also confirmed that it helped learning Libras, being possible to make use of language databases of other countries in order to develop a multilanguage solution.

As future work, the application must be continuously developed and improved to fix the many problems reported by the users and to implement some new features to promote more engagement. More than using only Libras, other sign languages are already being integrated into the system. Finally, the Android version of the game was recently finalized, so it can be integrated and distributed alongside with the iOS version, reaching a wider public this way.

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