

Implementing an Online Sign Language Dictionary

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Abstract

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Introduction

Sign language dictionaries are an essential tool that facilitates the communication and understanding between people who have a hearing impediment and between people who have and do not have that condition. In addition, sign language dictionaries are useful because work as indicators of the current state of a country's sign language (Haualand & Allen, 2009). According to World Health Organization, 360 million people worldwide have a hearing impediment. This population includes people who have deafness (70 million) (World Health Organization, 2015). They usually use sign language as their first language, so they depend on it to communicate and live the day by day.

According to the project Ethnologue, there are around 137 sign languages worldwide (this number does not include dialects) and 10,622,816 users of those languages. The reason of such a small number of users is mainly because the users of those sign languages are in a vast majority people with a hearing impediment. (Lewis, Simons, & Fenning, 2015).

Even though the number of people who use sign language reaches millions worldwide, they represent a small population, which makes them a marginal society. Because of that condition they usually do not receive the support and recognition they need and deserve (Haualand & Allen, 2009).

The margination has promoted the emergence of misunderstandings, myths and above all, segregation (Retana, 2011). That segregation is palpable in the scarce information available regarding this population, a situation that is common worldwide (Haualand & Allen, 2009).

{Justification (Has to do with the motivation to do this investigation)}

Having a hearing impediment has serious social, cultural and linguistic implications given that it affects the way people relate and interact with each other. Furthermore, there are fundamental life aspects like access to the information, which is limited or inexistent to them, that needs immediate improvement given that it causes people with a hearing impediment to have a significant ignorance of the society around them and even the whole world (Haualand & Allen, 2009).

An online signs language dictionary is a marvelous tool that can have a tremendous repercussion because it can promote the inclusion of this population into the society, reducing the impact of having a hearing

impediment. Dictionaries are an perfect gadget to learn and expand knowledge, according to the Oxford Online English Dictionary, a dictionary is a mean that classifies and presents words of a language with its meaning; either in its own language or the equal in another language, and also provides other useful information about it (Oxford, 2016). Sign language fits perfectly in the definition, especially when taking account the advantage of the digital era, where multimedia allows the optimal transmission of the visual channel.

Nevertheless, the fact that an artifact fits the formal definition does not mean that it will work right away as magic. In order to deliver a good final product everything has to be considered: from the computers we have to understand their limitations, capacities, tools and platforms and from the users we have to understand their psychology, social factors, errors, among others (Alan, Janet, Gregory, & Russell, 2005). That is why is important to review what makes a dictionary effective. The two main components of the effectiveness of a dictionary are the user and the dictionary itself. If those factors do their part properly, the interaction will be successful. ¿Why is that? Well according to Lew, a user has to have the appropriate set of skills needed use a dictionary and the dictionary as a tool has to provide a favorable user experience (Lew, 2013). There has been a disparity in the development of those two factors.

In recent years most efforts to better develop user's skill to interact with the dictionaries have been scarce. The reason is not absolutely clear but one can think that the development of the user's skills is something that is hard to support, because it depends on a great portion on the user itself, it is their self-commitment what makes them get better. Most efforts have gone to the improvement of the tools, the dictionaries (Lew, 2013). That is precisely the target of this piece of work, the improvement of online sign language dictionaries, through a better user experience, as defined by the norm ISO 9241 as the *"person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service"* (International Organization for Standardization (ISO), 2015) .

A fundamental component, that deserves special attention when improving the user experience, is the inclusion of the already studied and established concepts from the human-computer interaction discipline. Thanks to it, users can be provided users with products of great quality, usability which at the same time will increase productivity and security; delivering at the end a product that fully meets its purpose. (Narciso & Taniana, 2001).

{Motivation}

To fulfill the purpose of a dictionary, it is ideal that the transmission of knowledge is done in an intuitive and user friendly manner. Sadly, this is not the case. There is an extensive heterogeneity among online sign's dictionaries, which affects the user experience, from the visual and the functional point of view.

Having proper means is very rare in most countries. Thus there are few tools available, like online sign's dictionaries, and the ones that exist have a wide number of problems, starting with the mentioned issue that all very different.

This very important social matter can lead to a better life especially for the population who has a hearing impediment. But it has to be acknowledged that in order to get a maximum exploitation of an online sign language dictionary the user experience has to be as optimal and standardized as possible. That improvement surely promotes their inclusion into the society.

The current work will be focused on dictionaries, specifically online sign language dictionaries.

{Objectives}

{General}

The main goal of this paper is to propose a template for an online sign language dictionary that enhances the user experience.

{Especific}

For that purpose, there are certain things that need to be done:

- Select the most relevant online sign language dictionaries available.
- Identify functional and visual features already existing in those online sign language dictionaries.
- Analyze those identified features to see if they provide any real contribution to the final user experience.
- Select the fundamental, functional and visual, features that must compose an online sign language dictionary.
- Create a template for an online language dictionary based on the previously selected features.
- Evaluate the final template.

{d. Estructura del documento}

For the development of the present investigation, in section 2 there will be a review of some related work. Next on section 3 there will be the methodology followed to the template creation. Then in section 4 the template proposal is exposed. After that in section 5 the evaluation of the template is examined. Finally, on section 6 the conclusions of the present work can be found.

2. Background

{b. Qué cosas se han hecho respecto a implementación de diccionarios para SL.}

Historically there have been efforts to produce sign language dictionaries, but there has been a major problem with those efforts and it is the conception of those dictionaries as an inventory of signs, which only proves that the little recognition sign languages have had implied a deep ignorance and carelessness on everything around the language (Tovar, 2001). This serious misunderstanding, widely spread, has severe consequences, being the most worrying that there is the notion that there is equivalence between any oral language and a sign language, that both share common characteristics that make it easily understandable for people with hearing impediment. This clearly favors oralism and limits the utility of the dictionaries as tools to understand and learn the language properly. This tendency is not new at all, as an example it can be mentioned the famous congress celebrated in Milán in 1880 where a group of international experts dictated that the best solution for the deaf was the oralism (Tovar, 2001). Is quite common to find sign inventories referred as sign language dictionaries, where the usual word has been to place a draw of a sign along it possible translation to an oral language, making them just bilingual inventories. This kind of work has been developed by different people, but rarely by the deaf community itself. It examined closely, the formal transcription just tries to reproduce the constitutive features of signs and does not evidence the description of the making of the sign, the movement of the hands nor the articulation points, excluding basic and must-have information for the sign. The linguistic as well as the lexicographic analysis, which are the pillars to the construction of dictionaries of all kinds, are left behind. This has been the case for many years and the worrying fact is that today is still happening quite a lot. (Massone & Druetta, 2010)

There are two elements that are vital to produce better results. One is the fact that the work has to be done by linguistics, because of their knowledge on the field. Two, those linguistic in order to obtain a full picture of the situation have to become themselves ethnographers, so they can be able to deeply understand their people and culture with their customs, habits and differences (Oxford, 2016).

Monolingual sign language dictionaries are the true sign language dictionaries, given that those are pure and stick to the truth of the language. Bilingual are just informative, they do not provide all the information that

the language has. One wonders ¿Why is it that the deaf community does not produce their own monolingual dictionaries? The answer is unknown at this moment, but a few possible reasons could be: a strong influence and dominance of the oral forces, ignorance or simply a lack of maturity or preparation in social and political matters as a group. All kind of sign writing lacks validity, because it is developed and imposed by listeners whom obviously do not come from the deaf community (Massone & Druetta, 2010).

There is evidence that the study of sign languages started long time ago, with the work started by L'Épée and its team with deaf children in Paris around the XVIII century for example. This work had its ups and downs, having an important lose strength in the XIX century. Then after a few years later a good impulse came to the study of sign languages with the publication of William Stokoe in 1960 called "*Sign language Structure: An Outline of the Visual Communication Systems of the American Deaf*", this came along with another publication called "*A Dictionary of American Sign Language on Linguistic Principles*" (Tovar, 2001). All this made the foundation and the pillars of consequent efforts on sign languages.

There have been many initiatives after the ones mentioned, but there hasn't been a big enthusiasm and progress in the area. Lately, there has been a resurgence of interest on the development of sign language dictionaries because of the possibilities brought by the new multimedia technologies, where the visual channel can be well represented. With this kind of technology, monolingual dictionaries can be possible. But special attention has to be put when creating a digital sign language dictionary, because the process is not just simply copying the results and already existing data from the traditional dictionaries to the new format (That would make it an inventory as it has been previously mentioned). As a matter of reference, first attempts to develop computerized dictionaries are registered by two groups in the 90's, one the team of W.C Stokoe from the United States and then other team from Germany composed by S.Prillwitz and R. Schulmeister. Both thought with the purpose of helping people with hearing impediments in their jobs, to help interpreters and also students in their learning process. There are other registered efforts from teams of Japan, Finland and Spain. There are many, of different languages, but most still are signs inventories (Massone & Druetta, 2010).

Governments, private organizations and even single individuals have made the main actors on the creation of tools like online sign language dictionaries. There is one major problem: everyone has had its one particular approach. The features in each site have been put there randomly, based on the site owner consideration, not necessarily considering the user's needs, which causes the dictionaries to have little value and exploitation.

2.1 Diccionarios de lenguajes de señas y sus características (De manera muy general)

As mentioned before, mostly by unknown, sign languages have been treated as pseudo-languages. This conception is peculiar, because the big difference between an oral language and a sign language is basically the channel. Sing languages use a visual-gestural channel, while oral languages use the audio-vocal channel (Tovar, 2001). To legitimize the language there is got to be a process, in which linguistics are vital (Massone & Druetta, 2010). Many decision and aspects have to be taken into account when a linguist is working this matter. The acceptance of sign languages by the society implies a big step on the assurance of their cultural identity and the destruction of harmful stigmas.

2.2 Podría ser porque los lenguajes de señas y su importancia. Además de la importancia de tener un diccionario para lenguajes de señas. Incluir falta de homogeneidad de los lenguajes de señas.

According to Massone and Druetta, the study of any sign language is valuable due the following reasons:

1. Adds information to the sign language structure and to the language itself. This analysis helps getting a better understanding of the language, resulting in the correction of wrong judgements.
2. Results in instruments like dictionaries and grammars, which help to legitimate and preserve its valuable cultural patrimony, their language.
3. Those instruments are also beneficial to linguists of other sign languages.
4. It opens up a diverse and wide range of possibilities to other investigation fields.

Linguists are in a key position when it comes to the development of sign language and the culture of their users. They can, directly or indirectly, help to break or maintain the dominance over the language used by people with a hearing impediment. Thus the representation of the deaf culture and language plays a crucial role. Researches have to be careful, to avoid promoting inequality by constructing sign language inventories, instead of dictionaries. Sign language can't be based on oral languages, because most people with a hearing impediment have basic knowledge on the oral language, which causes the written language to be useless for them (Massone & Druetta, 2010).

3. Methodology

To come up with the final proposed template for online sign languages dictionaries, the process was as follows.

{What was done}

3.1 Selection of already existing online sign language dictionaries

The first step was a study of 16 online sign language dictionaries. The search was done with the keywords *sign language dictionary*, *diccionario de lengua de señas*, *diccionario de señas* and *diccionario de language de señas*. As can be seen, the searches were done in english and Spanish. The selection of those dictionaries was done based on Google Search Engine most relevant results. Google does that by using a functionality called pageRank, which is basically a family of algorithms that assign particular numbered importance ranks to each of their documents indexed by their search engine (Google, 1998). The following is the complete list of selected sites.

1. **American sign language University:** <http://www.lifeprint.com/>
2. **Aprendiendo la Lengua de Señas:** <http://senas.spm.uach.cl/sites/baner/front.aspx>
3. **ASLPro:** <http://www.aslpro.com/cgi-bin/aslpro/aslpro.cgi>
4. **British Sign Language Dictionary:** <http://www.british-sign.co.uk/>
5. **British Sign Language Dictionary:** <http://www.signbsl.com/>
6. **Dicci Señas:** <http://diccisenas.cedeti.cl/>
7. **Diccionario Bilingüe Lengua de Señas Chilena:** <http://diccionariodesenas.umce.cl/>
8. **Diccionario de Lengua de Señas Ecuatoriana:** <http://plataformaconadis.gob.ec/diccionario/>
9. **Diccionario de Señas Argentina:** <http://manosquehablan.com.ar/diccionario/>
10. **Diccionario LESCO CENAREC:** <http://cenarec-lesco.org/DiccionarioLESCO.php>
11. **Handspeak:** <http://www.handspeak.com/>
12. **Lenguaje de Señas indio:** <http://indiansignlanguage.org/dictionary/>
13. **Lengua de Signos Española:** <http://www.sematos.eu/lse.html>
14. **New Zealand Sign Language:** <http://nzsl.vuw.ac.nz/>
15. **Spread the Sign:** <http://www.spreadthesign.com/>
16. **Wikisigns:** <http://www.wikisigns.org>

3.2 Feature's Identification

Next step was the identification features. The identification of the features was a manual process, the sites were visited one by one, and using the observation and utilization those were identified. There were 15 visual and 31 functional features identified for online sign language dictionaries.

Functional features

Anonymous users can brow/use the site	There can be variations of the same term	User is able to create its own terms list
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User can search terms using a textbox	There is a section with the most common/used terms	Translation of terms to other language(s) available
Terms can be filtered by categories	There are learning tools, like showing a “term of the day” in the home page.	Selection between right and left handed is available
Video, if available, has controls	There can be examples of usage of the term	User can add terms to the site
Terms can be filtered by their first letter	There can be written explanations of the term	There is audio available for the terms
Upon search, the site suggests similar terms	The site is multi-language ready	Term images, if available, can be downloaded
A definition of the term is available	Terms can be filtered by form, for example the number of fingers used	Term images, if available, can be printed
There is autocomplete/suggestion of terms as the user types letters	Terms can be rated by users	Term video, if available, can be downloaded
There can be multiple results from a search	User are able to create its own profile	There is a counter of the number of times each term has been consulted
User can search using phrases	There is a counter of total terms available	Site has terms and conditions in place
User can upload multiple files, to specify the term, its definition, explanation and examples.		

Visual Features

The terms are ordered in some fashion	Terms list is always available	The user is able to modify the playing video speed
The term has a video associated	Term has an image associated	The site does not reload the page entirely when a term is selected
Search results are always available	The site does not reload the page entirely when doing a term search	The term has a thumbnail associated in the general terms list
Terms list is in its own assigned container, which determines its size	The web design is responsive	The term, its definition, explanation and examples have a sign language video associated.
Video, if available, has auto-start	Search bar is always available	Icons are associated with the different site actions and responses

3.3 Feature evaluation

Then the most relevant features were selected. The criterion used to select those features was a two steps process: first, was the evaluation of the presence of each feature in each site which was measured with the number of times that feature appeared in the analyzed sites and then a further analysis was done to all features, so the ones that did not show many times had a chance to be selected. Each feature was evaluated in order to see how valuable that feature could be, the main question was ¿Did it bring any contribution? Because the fact that a feature was not found in most sites does not mean that is not useful (as a matter of fact could be a revolutionary feature). Therefore, all of them were reviewed.

Functional features - Number of many times each feature showed in each site

Feature	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
Anonymous users can brow/use the site	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	16
User can search terms using a textbox	X	X		X	X		X	X		X	X	X	X	X	X	X	13
Terms can be filtered by categories		X			X	X	X	X	X	X	X	X	X	X	X		12
Video, if available, has controls	X	X	X		X	X	X	X		X		X	X	X		X	12
Terms can be filtered by their first letter	X	X	X			X	X	X	X		X	X			X		10
Upon search, the site suggests similar terms	X		X	X	X		X		X		X	X	X	X			10
A definition of the term is available	X			X			X	X	X	X	X			X	X		9

Then there are features that are not shared by most sites. The following is the complete decomposition by number of matches:

- 8: There is autocomplete/suggestion of terms as the user types letters and there can be multiple results from a search.
- 7: User can search using phrases and there can be variations of the same term.
- 6: There is a section with the most common/used terms, there are learning tools, like showing a “term of the day” in the home page, and there can be examples of usage of the term.
- 5: There can be written explanations of the term, the site is multi-language ready.
- 3: Terms can be filtered by form, for example the number of fingers used, terms can be rated by users, and users are able to create its own profile.
- 2: There is a counter of total terms available, user is able to create its own terms list and translation of terms to other language(s) available.
- 1: Selection between right and left handed is available, user can add terms to the site, there is audio available for the terms, term images, if available, can be downloaded and term images, if available, can be printed.
- 0: Term video, if available, can be downloaded, there is a counter of the number of times each term has been consulted, site has terms and conditions in place and User can upload multiple files, to specify the term, its definition, explanation and examples.

Visual features - Number of many times each feature showed in each site

Feature	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
The terms are ordered in some fashion	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	15
The term has a video associated	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	15
Search results are always available		X		X	X		X	X	X	X	X	X	X	X	X		12
Terms list is in its own assigned container, which determines its	X		X	X		X	X		X	X	X	X		X	X		11

size																
Video, if available, has auto-start	X		X			X	X		X	X	X	X	X			9
Terms list is always available	X		X			X	X		X	X	X				X	8

Then there are features that are not shared by most sites. The following is the complete decomposition by number of matches:

- 6: Term has an image associated and the site does not reload the page entirely when doing a term search.
- 4: The web design is responsive, search bar is always available.
- 3: The user is able to modify the playing video speed.
- 2: The site does not reload the page entirely when a term is selected and the term has a thumbnail associated in the general terms list.
- 0: The term, its definition, explanation and examples have a sign language video associated and Icons are associated with the different site actions and responses

Analysis of features

Having the precedent information in place, was time to do an individual analysis each feature, which had the intention of measuring its value, regardless the number of times it appeared in each site.

The objective here is to determine if a feature adds value to the site or not. As it was mentioned before, a well design functionality uses the best of users and dictionaries to get optimal results, it puts the machine to do the work not the user (Ricardo, Cuauhtémoc, & Javier, 2004).

For that purpose user experience is a central topic in this paper, but ¿What does provide a good user experience? Well one essential element is usability, because when it is taken into account it manages to adequately satisfy the needs of the users. Usability according to the norm ISO 9241, is the “*extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.*” (International Organization for Standardization (ISO), 2015). Hence it becomes the perception of how consistent, standardized, productive, simple, effective and intuitive a process is to perform a function in a particular system. (Ricardo, Cuauhtémoc, & Javier, 2004)

One does not have to reinvent the wheel. There are already investigations and guidelines available. There is one regarding design that is worth checking, it was made by a group from the North Carolina State University. According to them, there are seven principles of universal design that should be taken into account when developing an interactive system, those are: (1) Equitable use. All users are treated the same, as far as possible. The system aims for a high rate of user’s inclusion. (2) Flexibility in use. The design is made so the user can choose it preferred way to interact with it, based on its skills and desires. (3) Simple and intuitive. The user should feel comfortable when using it, even when it’s the first time. The use has to be obvious and effortless. (4) Perceptive information. The information presented has to be presented in a clear manner. (5) Tolerance of error. Mistakes and unexpected actions should not have a huge impact or in the system. (6) Low Physical effort. In every computer based system, the idea as stated before, is that the machine has to do the work, not the user. (7) Size and space for approach and use. The system has to be accessible, usable and reachable to any user. (Alan, Janet, Gregory, & Russell, 2005).

It’s quite hard to fulfil all of them completely. The idea is to accomplish an integral work, where those principles are included, so the system complies its purpose in the best possible manner, regardless the user’s particular condition. The center of any design and functionality should be the final users; all efforts should be focused on them (Ricardo, Cuauhtémoc, & Javier, 2004).

The main goal of these features is that they can provide value to the user experience by providing accessibility, simplicity and usability to the site. Said so, the features will be analyzed in those aspects. The order of the appearance of the features is based on the times they appeared in the selected sites.

The complete analysis of features can be found at: <http://lesco-mcarmona.rhcloud.com/DiccionarioLesco/resources/papers/Implementing-an-Online-Sign-Language-Dictionary.pdf>

Analysis of the functional features

- 1) **Anonymous users can brow/use the site.** This is a key function of the dictionary. The main idea is that it brings a global accessibility to all kinds of users, so the sign language can be known, learned, shared and scattered across the population.
- 2) **User can search terms using a textbox.** Searching is the main skill a user has to find the words/terms needed. Been able to search using keywords and wildcards is crucial from a usability standpoint.
- 3) **Terms can be filtered by categories.** Searching is the main skill a user has to find the words/terms needed. Been able to narrow the search is a key functionality.
- 4) **Video, if available, has controls.** The user has to be the owner of the content been presented in the screen for an optimal experience. Been able to manipulate the video is fundamental to be in control.
- 5) **Terms can be filtered by their first letter.** As stated above, searching is the main skill a user has to find the words/terms needed. Been able to filter by their first letter improves the searching experience.
- 6) **Upon search, the site suggests similar terms.** The capacity of the site to link different terms brings the user the ability to learn and relate more than it would with a simple return of the required term.
- 7) **A definition of the term is available.** The term itself is not enough to transfer knowledge of it. Having the definition, it also a vital part of the main functionality of a dictionary.
- 8) **There is autocomplete/suggestion of terms as the user type letters.** Provides the user the power of searching based on the unknown, expanding its searching possibilities.
- 9) **There can be multiple results from a search.** The user will not only be able to know and relate similar terms, but also select the most appropriate based on the available choices.
- 10) **User can search using phrases.** The possibilities open up to a countless number of terms and phrases, with this kind of feature there are fewer limitations.
- 11) **There can be variations of the same term.** Regionalisms or even different way of expressing the same thing will be available.
- 12) **There is a section with the most common/used terms.** Tells much about the sign language itself, because shows a statistic data, giving hints of the most common and used terms. This information is valuable and could also be used for new learners for example to know the most 'common and basic' terms people look for.
- 13) **There are learning tools, like showing a "term of the day" in the home page.** Engaging users into learning can potentiate not only the knowledge of the language itself but their main population.
- 14) **There can be examples of usage of the term.** The most, the better. In this case having examples of the usage gives the users a broader understanding of the term been consulted.
- 15) **There can be written explanations of the term.** The purpose is to make a global site, where users with or without any hearing impediment can make the most of the tool. Having written explanations enabled, brings an inclusion factor to all literate people with the oral language the sign language interacts with.
- 16) **Terms can be rated by users.** The fact that the users are the owners of the content makes the site a target to low quality/offensive things. The idea, as it happens with most of the user generated content sites, is that the users themselves can evaluate it. Also the evaluation can be positive, so this will give recognition when it is deserved and encourage people to keep up the good work, plus it will give that kind of content more visibility.

- 17) **Users are able to create a profile.** Being a site mostly owned by its users requires them to have a profile in order to add content; otherwise there will be impossible to control the content addition to the site.
- 18) **There is a counter of total terms available.** Brings contribution to the site and the language itself, as stated before there is little to none information regarding the sign language. Statistics can contribute in many ways to its knowledge and development.
- 19) **User is able to create its own terms list.** Having a profile, make the users able to create their own list of term, based on their personal interests and needs.
- 20) **There is a counter of the number of times each term has been consulted.** Brings contribution to the site and the language itself, as stated before there is little to none information regarding the sign language. Statistics can contribute in many ways to its knowledge and development.
- 21) **Site has terms and conditions in place.** Since the site is design to allow the upload and presentation of content owned by its users from an external platform, there is mandatory to have terms and conditions of the site, and have the users agree with those in order to avoid legal issues.
- 22) **User can add terms to the site.** This will empower people to create, share and grow in an unlimited way. This erases the limitation imposed in most sites, where there is an organization or persona in charge of adding, editing and updating the content.
- 23) **User can upload multiple files, to specify the term, its definition, explanation and examples.** This feature will be revolutionary to the community that uses sign language as their primary language because it will allow them to express and explain the terms in their own language. This will give them ownership and will facilitate their interaction among the people who share their condition. Studies show that when people interact in environments where the share with other people who have aspects in common they are more likely to get engaged (Claros-Kartchner, 2009).

The following is the list of features that were not selected as part of the template.

- 24) **The site is multi-language ready.** Even when having a multi-language site provides a broader access to more people, it adds complexity to the development. There is no doubt that this is a feature with great significance, but due the complications it could imply it is not considered in the template. There are already services only like Google Translate, which accomplish the mission of translating different types of text and media to more than 100 languages (Google).
- 25) **Terms can be filtered by form, for example the number of fingers used.** This ability does not provide any sort of improvement on the evaluated areas. As a matter of fact, given the type of inputs a computer system has evaluated by form adds complexity to the search.
- 26) **Translation of terms to other language(s).** This site is thought to be bilingual, using the oral language and the sign language of the local culture where it is developed for better use. Translate to other sign languages is complex and it is out of the scope of this paper, because of that it will not considered in the template.
- 27) **Selection between right and left handed is available.** Having the distinction does not bring value to the site. As a matter of fact, it can lead to confusion in some cases.
- 28) **There is audio available for the terms.** Audio is not part of the study by any means given that the vast majority of users of sign language dictionaries have a hearing impediment and even for those who don't, this feature does not bring any tangible value.
- 29) **Term images, if available, can be downloaded.** Video are the proper multimedia typo sign language because they allow the users to properly describe a term. Said so, the site will not be associating images to the term, so been able to download this type of content does not make sense in this context.
- 30) **Term images, if available, can be printed.** Video are the proper multimedia typo sign language because they allow the users to properly describe a term. Said so, the site will not be associating images to the term, so been able to download this type of content does not make sense in this context.

- 31) **Term video, if available, can be downloaded.** The idea is that the user will be the owners of their video. So, been able to download content of others won't be taken as a main feature because it can be a potential violation to others copyrights.

Analysis of the visual features

"In an ideal design, the interface is both usable and aesthetically pleasing. However, the looks of the interface should never come to the disadvantage of the usability." (Alan, Janet, Gregory, & Russell, 2005).

- 1) **The terms are ordered in some fashion.** Order improves the search capability, which as it has been mentioned before, is the key aspect of a dictionary.
- 2) **The term has a video associated.** Sign languages are a visual-spatial communication; they use the visual channel to transmit. Everything matters, facial expressions, speed, movements of the arms, fingers and etcetera (Massone & Druetta, 2010). Said so, video is the proper media to use in this kind of dictionary, is the feature that better accomplish their purpose, based on the kind of content it serves.
- 3) **Search bar is always available.** Having the search bar always available provides the users the ability to navigate the site and get results with only a few interactions.
- 4) **Search results are always available.** Simplicity is fundamental. Having the results always available improves user's navigation because reduces the required number of interactions with the site in order to get results.
- 5) **Terms list is in its own assigned container, which determines its size.** Standardization improves consistency. Defined sized sections will make it easier to use, given that without caring about the number of terms it contains it will remain the same.
- 6) **Terms list is always available.** As stated before, functionality like this one improves the user experience by bringing easy access to the relevant content.
- 7) **The site does not reload the page entirely when doing a term search.** This provides two advantages, reduces the bandwidth, which increases the response time and also keep the user in the same place, which eases the utilization of the site and its familiarization with it.
- 8) **The site does not reload the page entirely when a term is selected.** This provides two advantages, reduces the bandwidth, which increases the response time and also keep the user in the same place, which eases the utilization of the site and its familiarization with it.
- 9) **The web design is responsive.** This feature is essential in a site where users can upload content, because it allows them to share content easily, given that today most users own a mobile device. ¿Why responsive design is so important? Due the enormous growth on the number of mobile devices in the market, each of those with its own characteristics, a new challenge arrived, how to be able to display the content in a good manner in most of them (Kailashkumar V, 2013).

Designing a responsive site allows the user to access it in any device they have or have access to. It is an approach where a single website is developed and designed with the intention that it can enhance the user experience by providing a simple and user-friendly use (Rogatnev, 2015), incorporating the ability to readjust the layout and the content to a specific contexts given from all the wide range of different devices (Gardner, 2011).

- 10) **The term, its definition, explanation and examples have a sign language video associated.** As explained in the functional features. This feature will be revolutionary to the community that uses sign language as their primary language because it will allow them to express and explain the terms in their own language. This will give them ownership and will facilitate their interaction among the people who share their condition.

- 11) **Icons are associated with the different site actions and responses.** The site has to focus on user experience, and given that it is expected that some users of the site are not used to read or write, icons help in the use of the site immensely.

The following is the list of features that were not selected as part of the template.

- 12) **Video, if available, has auto-start.** Having auto-start is a nice feature, but it takes again control from the user. Given that the site is for the user and they are the owners of it, they should be able to decide when they are ready to watch the content of the site.
- 13) **Term has an image associated.** Images do not bring enough information to the users regarding the term, so this feature does not provide any value. Besides it creates complexity to the user adding a new term to the site, given that he/she will have to come up with an image in some fashion.
- 14) **The term has a thumbnail associated in the general terms list.** As the images associated with the terms, same thing happens with thumbnail associated with terms. They do not provide any value. Besides it creates complexity to the user, it complicates adding a new term to the site given that he/she will have to come up with a thumbnail for the term.
- 15) **The user is able to modify the playing video speed.** When learning, this feature could be valuable, because it will allow the users to better understand a term execution. But due the technical difficulties this could mean, it will not be considered a basic feature.

4. Template proposal

After the analysis, the template had to be composed based on the results. This dictionary template contains the most relevant functional and visual features a site must have to comply with the objective of providing an optimal user experience of an online sign's language dictionary.

An important factor to take into account is that even when the objective is to provide the highest level of accessibility, the fact that the dictionary is aimed to all kinds of users and that is digital, some features require some skill from the users. There has to be a minimum level of literacy and also there has to be a set of skills to use a computer-mediated mean, a *digital literacy* (Lew, 2013). This means that it will be necessary to know how to use a computer in order to navigate and also understand at some level a written language (most probably the one that coexists with the particular sign language of the dictionary) in order to perform other actions like creating a user profile for example.

a. Proposal description

The final template is composed of 23 functional features and 11 visual features. All of them selected to fulfill all the possible basic needs of an online sign's language dictionary.

Final list of functional features

1) Anonymous users can brow/use the site.	13) There are learning tools, like showing a "term of the day" in the home page.
2) User can search terms using a textbox.	14) There can be examples of usage of the term.
3) Terms can be filtered by categories.	15) There can be written explanations of the term.
4) Video, if available, has controls.	16) Terms can be rated by users.
5) Terms can be filtered by their first letter.	17) Users are able to create a profile.
6) Upon search, the site suggests similar terms.	18) There is a counter of total terms available.
7) A definition of the term is available.	19) User is able to create its own terms list.
8) There is autocomplete/suggestion of terms as the user types letters.	20) There is a counter of the number of times each term has been consulted
9) There can be multiple results from a search.	21) Site has terms and conditions in place.
10) User can search using phrases.	22) User can add terms to the site.
11) There can be variations of the same term.	
12) There is a section with the most	

common/used terms.	23) User can upload multiple files, to specify the term, its definition, explanation and examples.
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Final list of visual features

1) The terms are ordered in some fashion. 2) The term has a video associated. 3) Search bar is always available. 4) Search results are always available. 5) Terms list is in its own assigned container, which determines its size. 6) Terms list is always available.	7) The site does not reload the page entirely when doing a term search. 8) The site does not reload the page entirely when a term is selected. 9) The web design is responsive. 10) The term, its definition, explanation and examples have a sign language video associated. 11) Icons are associated with the different site actions and responses.
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b. Pantallazos/figuras de descripción.

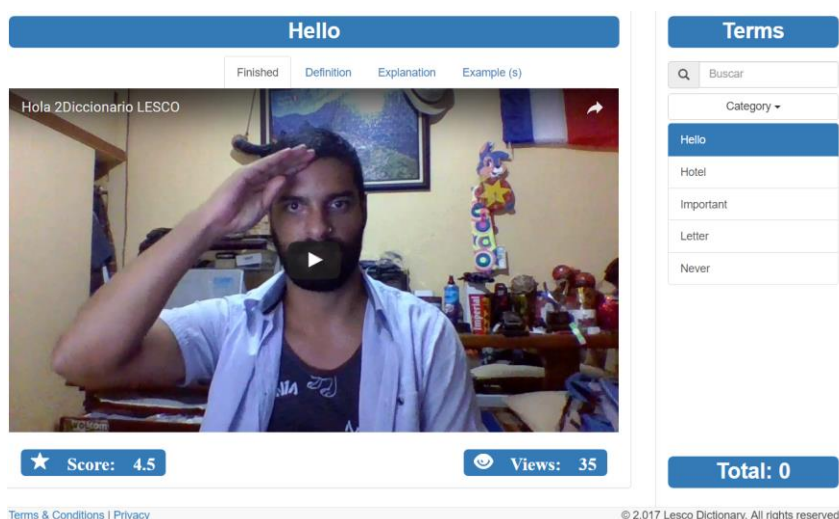


Figure 1. One single page has it all, no reload necessary. {Final image has to be modified}

c. Justification.

{Why there the features in the table elected}

The Internet has had a huge impact in humanity. It has become indispensable and the main source of information for most people. Part of its success has been the ease of publishing content as well as consulting it. (Ricardo, Cuauhtémoc, & Javier, 2004). An Online digital dictionary with a well-designed interface will provide the user with the tools necessary to make the most of it, with little effort from its part (Lew, 2013). All the selected features were picked with that motto in mind.

From all the features, there are two that are crucial to the proposal. One is the fact that the site has to adhere to the law by having terms and conditions, given that it gives users the power of being the owner of its own videos. Two, users can now upload videos not only of the term itself but of the different components of a term in a dictionary like its explanation, its description and examples, which bring a richer experience to users with a hearing impediment.

5. Evaluation

The final step was the dictionary template evaluation. This was done with users that have and do not have a hearing impairment.

{a. Cómo se evaluó }

{b. Evaluación como tal }

{c. Results }

When the design is made with its users as the center of all, the operation comes automatically. If there are problems to use something, it usually means that it was designed taking into account their final users and their needs. (Ricardo, Cuauhtémoc, & Javier, 2004)

6. Conclusion and Discussion

These skills may overlap with those involved in using other digital tools, in particular those having to do with internet search strategies. The question to ask next is how these skills should be taught, and by whom. The obvious candidates, schools as traditional educational institutions, find it very hard to keep up with the pace (Langegard 2011).

{a. Discusión de los resultados }

{b. Contribution of this work }

This research provides several contributions: (1) an inventory of the better ranked available online sign language dictionaries; (2) an analysis of the visual and functional features of those online sign language dictionaries; and (3) a proposal of a template based on the analysis that was done. This template will consider visual and functional features.

{Future Work }

It would be ideal to get feedback on the template from more users, who use it in many more sign languages.

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References

- Alan, D., Janet, F., Gregory, D. A., & Russell, B. (2005). Human-Computer Interaction.
- Claros-Kartchner, R. (2009). La inclusión de las personas sordas, como grupo étnico, en los sistemas educativos. *Revista Latinoamericana de Educación Inclusiva*, 3(1).
- Gardner, B. (2011, October). Inside The Digital Ecosystem. *Sigma* Σ , 11(1).
- Google. (1998). Patent No. US6285999 B1. United States.
- Google. (n.d.). Google Translate. Retrieved October 10, 2016, from https://translate.google.com/about/intl/en_ALL/languages/
- Haualand, H., & Allen, C. (2009). *Personas Sordas y Derechos Humanos*. Federación Mundial de Sordos y Asociación Nacional de Sordos de Suecia.
- International Organization for Standardization (ISO). (2015). ISO 9241-210:2010. Ergonomics of Human System Interaction.
- Kailashkumar V, N. (2013). Responsive Web Design. Om Vindhyavasini College of Information Technology & Management .
- Lew, R. (2013). From paper to electronic dictionaries: Evolving dictionary skills. From the Selected Works of Robert Lew. Adam Mickiewicz University.
- Lewis, M. P., Simons, G. F., & Fenning, C. D. (2015). *Ethnologue: Languages of the World*, Eighteenth edition. Dallas, Texs: SIL International.
- Massone, M. G., & Druetta, J. C. (2010, May-August). Dictionaries on sign language: lexicographic questions. (C. d.-C.-y. CONICET, Ed.) 34(70).
- Narciso, F. E., & Taniana, R. J. (2001). La Interacción Humano-Computadora (MODIHC). XXVII Conferencia Latinoamericana de Informática CLEI2001.
- Oxford. (2016, October 22). Oxford Dictionaries. Retrieved October 22, 2016, from English Oxford Living Dictionaries: <https://en.oxforddictionaries.com/definition/dictionary>
- Oxford. (2016, December 12). Oxford Dictionaries. Retrieved December 12, 2016, from English Oxford Living Dictionaries: <https://en.oxforddictionaries.com/definition/>
- Retana, P. (2011). Aproximación a la Lengua de Señas Costarricense (LESCO). *Filología y Lingüística de la Universidad de Costa Rica*, 37(2), 137-146.
- Ricardo, B.-Y., Cuauhtémoc, R. L., & Javier, V. M. (2004). Information architecture and usability on the web. *El profesional de la información*, 168-178.
- Rogatnev, N. (2015). Responsive Web Design. Bachelor's Thesis Information Technology. University of Applied Science.
- Tovar, L. A. (2001, Noviembre). La Importancia del Estudio De Las Lenguas de Señas. (U. D. Valle, Ed.) *Lenguaje*(28).
- World Health Organization. (2015, March). Deafness and Hearing Loss. Retrieved June 2015, 15, from Fact Sheet N°300: www.who.int/mediacentre/factsheets/fs300/en/