

# Signbank 2.0 of Sign Languages: Easy to Administer, Easy to Use, Easy to Share

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## Abstract

Signbank 2.0 integrates sign language documentation to identify signs with their specifications in the context of a large sign language corpus. Signbank 2.0 is inspired by Global Signbank, especially with respect to the integration of the general linguistic structure, and by developments from the earlier Libras Sign Identification platform, with search systems organized by sign language parameters. The current proposal presents several advances, especially regarding the administration panel with a simple dashboard. In addition, the current Signbank 2.0 implements [and at least one more instance] more sophisticated search systems from a linguistic and technological point of view. The tools developed include more possibilities for sign searches categorized based on linguistic and visual criteria. Finally, the search system presents the frequency of signs linked to the EAF files, listing the occurrences in the integrated corpus and giving the exact video timing of the sign.

**Keywords:** Signbank, Sign language documentation, Sign language visualization, Visual design

## 1. Introduction

Signbank 2.0 is a database of signs from different sign languages associated with corpora. It is the result of previous sign databases developed with the aim of providing descriptions of each sign as a list of signs extracted from a specific sign language corpus. Johnston (1989) created the first lexical database for sign language. His work aimed to provide a dictionary of Australian Sign Language (Auslan) based on the Auslan corpus. Johnston's work led to the establishment of the Global Signbank (Cassidy et al., 2018; Crasborn et al., 2012, 2018). The Global Signbank was an initiative to create a global database of different sign languages. In parallel, Brazil created the first Sign ID for Brazilian Sign Language (Libras) in 2008 (Quadros, 2016; Quadros et al., 2020). This specific Sign ID had the basic goal of listing the signs associated with the gloss identification words from Portuguese for utility purposes only; the glosses allowed annotators to be consistent in their Libras annotations. Each sign had an associated ID gloss to feed the annotations of the Libras corpus. The Sign ID system also developed a search tool based on sign parameters such as handshapes, and locations. However, this system was not user-friendly. In 2014, the proposal was replaced by the Libras Signbank, inspired by the Global Signbank and used as an open-access system. However, some sign language tools were lost, and the management platform was not accessible to the sign researchers. In 2019, we decided to improve the Signbank with a different system, with new open access software, to include again sign language search tools inspired by the Sign ID system, combined with new developments, subsequently published by Scolari (2022) and Quadros et al. (2022). These new search tools

offer different ways to locate the signs, taking into account general users and users who do not know the glosses that identify the signs. This was done by integrating a sign language-based search tool that starts from the handshapes and includes the hands involved in the sign (one-handed signs or two-handed symmetrical/asymmetrical signs) and the location of the sign (head, torso, limbs).

Moreover, the dashboard has been developed to be accessible to sign language researchers. It is designed for sign language communities, especially deaf communities. The main approach is to decentralize the management of the system, giving the users the right to manage it. The basic idea is “*they can do it themselves*”. This dashboard contains tools that are sophisticated but easy to use and accessible to every member with different roles in the system. The roles created include (i) ‘Administrator’, (ii) ‘Data Publisher’, and (iii) ‘Data Publication Approver’. The administrators can manage the organization, the data and the categories integrated in the Signbank 2.0. This design was done by the developers, who reviewed the users' workflow and fed it into the creation of the solutions.

Signbank 2.0 is currently being tested for Brazilian Sign Language (Libras) (<https://signbank.libras.ufsc.br/en>) and will soon be available for other sign languages (International Sign Lg., IntSL), German Sign Language, DGS), Hungarian Sign Language, Austrian SL, and Estonian SL, with the possibility to be applied to other sign languages over the world for parallel analysis through a next step development that will possibility the network among all signbanks 2.0. As an example, the Libras Signbank contains 3,067 signs with image,

video, and phonological descriptions that allow searching by handshape, location, and handedness (one-handed signs, symmetrical/asymmetrical two-handed signs). The information about phonological features is inserted with codes and handshape images. The option for handshape images is preferred by users because it is known to them and easily identifiable. Both administrator and general users have access to the handshape images for both hands. The codes associated with the handshapes follow the Global Signbank with some adjustments. The handshape search tool accessed by general users can be associated with either HamNoSys or SignWriting in the next stages of the database. Currently, the search tools are based on linguistic descriptions selected from lists using the written form and images of the handshapes and icons/symbols. These choices are related to previous experience with older versions of the Signbank where we used SignWriting. Users, including deaf users, did not use it as a reference for their search. In fact, they used various guesses of possible written words to try to find the sign, or they signed in specific groups using social media tools to find out what the gloss was for the particular sign they needed to annotate. This user experience/feedback led to the development of the handshape slider by the design student at the Universidade Federal de Santa Catarina. This slider was incorporated in Signbank 2.0 (Scolari, 2022; Scolari et al. 2022).

Signbank 2.0 is a technology-mediated collaborative environment that meets Davidson's (2008) definition of a generation of tools called Humanities 2.0, in which participation is based on different sets of theoretical assumptions that decenter knowledge and authority. The foundation of the Signbank's current structure is based on a community of practice that benefits from technologies to amplify the networks of relationships, making learning and social construction of knowledge possible through creative techniques and the use of tools (Wenger et al., 2002, see also Quadros et al., 2022 for Libras).

The technical architecture of the Signbank consists of a systematic and structured approach to designing and defining the structure, components, and interactions of a complex system. The requirements for the development were meticulously carried out through a series of immersion phases derived from the participatory design methodology (Camargo & Fazani, 2014). This collaborative approach involved stakeholders and end users actively involved in the development process, ensuring that their perspectives and needs were thoroughly considered. Through meetings, interviews, and iterative feedback loops, we gained valuable insights that shaped the project's direction, resulting in a user-centered and highly effective

solution that precisely meets the expectations and requirements of its intended users. This project, focused on the coexistence of sign language and deaf communities, has led to the development of Signbank 2.0.

Understanding the needs of the users, the niche and the public is the first step in this process. This was done by interviewing stakeholders, conducting scenario and user research, and defining and systematizing common platform requirements. The next step was to analyze and synthesize the results and draw some conclusions. This was done by drawing conclusions and synthesizing the research, developing personas and a User Journey Strategy as a procedural strategy for Thinking Design. The next step was to create, prototype, and test. With well-defined strategies in place, the path was clear to create all the necessary pieces to execute the project. Our focus was on designing the ideal solution, using collaborative creation (co-creation) and evaluation tools to help with this process. Then we have the style guide, site map, prototyping (low, medium and high fidelity) and usability tests. Once the tests had been completed, the development of the scripts began. The prototype was mature enough to be implemented, allowing programmers to code and give materiality to the project.

User feedback was collected in a system designed for interaction between users and developers along the process. It was designed as a collaborative form where users review each step of development and add suggestions when needed. The basic idea was to make the communication between users and developers very efficient, because in previous experiences with the development of previous versions of the signature bank, we learned that this is a key step in the process.

The evolution of Signbank 2.0 allows users to have autonomy to manage the system. It removes the barriers imposed by the limitation of language specificity and allows the modification of sign-related features. Thus, Signbank 2.0 has a structure that can be replicated by different institutions and adapted to different sign languages and countries. Our goal was to provide a sign language documentation tool that could be used by sign language communities and research communities, creating opportunities to create a Signbank in their own countries, especially those with limited financial resources.

Considering the target audience of the Signbank and the needs of sign language communities and research communities (including deaf and non-deaf researchers), Signbank 2.0 was designed to include aspects related to web accessibility, usability, and visual organization. The main goal was to have a platform that was friendly to signers

(i.e., not only to computer technicians) and easy to manage, use, and share. A complete set of signed videos explaining each page was created. The administrators can edit these videos of the pages at any time. The organization uses videos available in sign language corpora associated with EAF files from ELAN Eudico Annotator (Crasborn et al., 2012). These sign language corpora feed the Signbank, which complement the signs with specific linguistic information. Another important aspect is that the current Signbank 2.0 is designed to be sustainable considering its technological lifetime and version developments. The main sustainable goal is that the community of users at universities and research institutes worldwide will continue to improve it technically by implementing a multicenter Signbank 2.0. network.

The development of this research and the resources for accessibility are described in this article.

The architectural basis of Signbank 2.0 allows its application to sign languages in other countries. As a result, documentation is available for Brazilian Sign Language (Libras), German Sign Language (DGS), International Sign Language (IntSL), Hungarian Sign Language (MJNY) and Austrian Sign Language (ÖGS). It is open-source software with the goal of making it sustainable through network platforms to be implemented in the next steps connecting all the signbanks of the sign languages that have implemented it.

Signbank 2.0 is a linguistic corpus-based tool, not a bilingual dictionary. The motivation for the first versions of signbanks around the world was related to the need to have standard glosses to identify signs, so we refer to the glosses as ID-gloss or ID-sign. However, considering the development of sign language corpora all over the world, the signbank started to include corpus-related information that identifies each sign based on linguistic information (such as phonological, morphological, syntactic and semantic, and more recently iconicity), expanding the original concept. Signbank 2.0 contains all this technical information and possible translations for each sign. The possible translations also serve sign language annotation purposes, as annotation can include the translation of sign production into another language.

## 2. Resources to Signbank 2.0

Signbank 2.0. has two basic interfaces available to its users: (a) the portal and (b) the dashboard. The portal is available to all users who want to access the database for various purposes, e.g. to find a specific sign, to view the occurrences of the sign in the available corpus, to identify the glosses associated with a sign, and to research signs for various linguistic and translation purposes. The

dashboard is intended for users with specific roles in Signbank 2.0 (administrators, publishers, and approvers of specific changes). This development gives more control to the end users, as it was built to give them autonomy, independent of the developers.

The tools developed for this new version of Signbank allow the management of resources, including an accessible structure based on sign languages. The background idea is to have a simple but robust platform that can accommodate all the requirements of the Signbank. This follows Rosenfeld, Morville, and Arango's (2015) proposal for building platforms based on the organization of tools that prioritize a layout based on clarity with an architecture using a distribution of information with little depth. That is, only a few clicks are required to access any content of the Signbank 2.0.

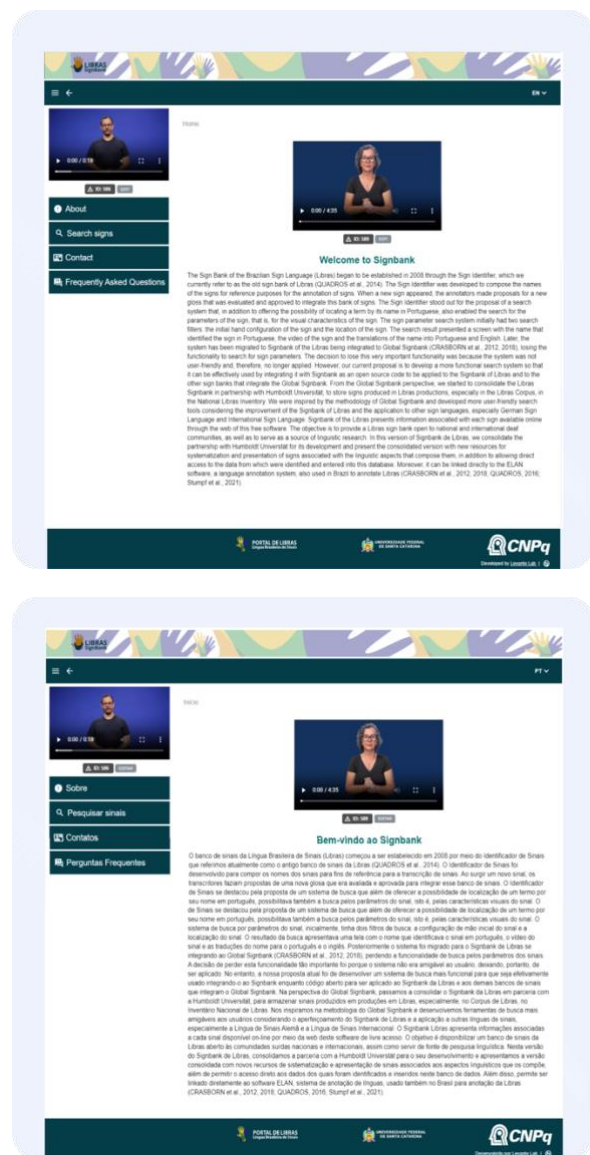


Figure 1: Libras Signbank Landing Page in Portuguese and English.

Source: <https://signbank.libras.ufsc.br/pt/about>

## 2.1 Signbank 2.0 Portal<sup>1</sup>

The Signbank 2.0 Portal contains the following resources:

- A landing page which includes general information about the system and the general layout of the sign bank.
- Search tools with features including handshapes, locations, words, linguistic information and visual network
- Frequency of signs in the sign language corpus
- A list of sign occurrences in the current corpus
- Language contact with sign language(s) and/or written systems
- Frequently Asked Questions (FAQ)
- Terms of Use
- Privacy Policy

The Signbank 2.0 Portal has the information available in the sign language of each country. It can also be accessed in the written language of the respective country and/or in English. The portal layout includes the menu to access the general information on the 'About' page, search tools, contact information and FAQ. Each menu item is accompanied by a signed explanation (see figure 1).

The FAQ, the Terms of Service and the Privacy Policy can be edited in the dashboard as often as necessary, according to legal requirements of the respective country.

The search tools are an innovative part of Signbank 2.0. Despite their complexity, they are designed to be intuitive and comprehensible and to be used in different ways. Figure 2 shows the options to search for signs:

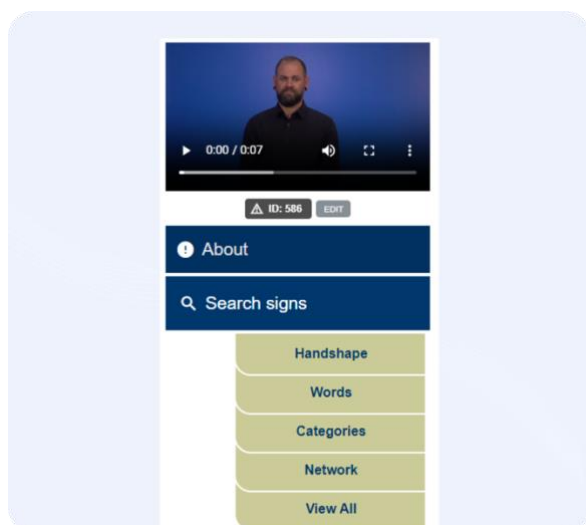


Figure 2: Signbank search tools menu

The sign search by handshape is the result of research by Scolari et al. (2022). This is a new design which is considered a novel solution to the problem identified in the Sign ID search system. The order of the handshapes is organized based on similarity organization. This search tool allows the users to scroll easily through all the handshapes listed in each sign language, as illustrated in Figure 3, using a scroll bar.

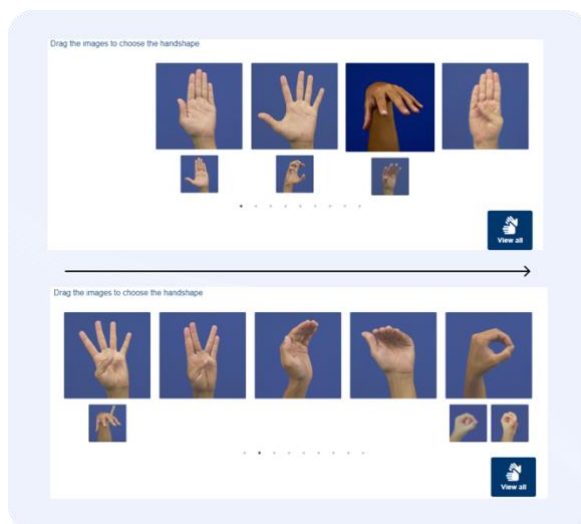


Figure 3: Visualization of the handshape scroller

A major improvement over the previous systems, which was/were not user friendly, is that the search tool in Signbank 2.0. allows users to scroll quickly through all the options on the same page. The previous system grouped handshapes and changed pages for each group. User would become lost among all the options, and it was complicated to reload the pages to find the option to select. Signbank 2.0 has all the handshapes on the same line, so users can scroll forward and back easily to find the exact option that fits the sign they are searching for.

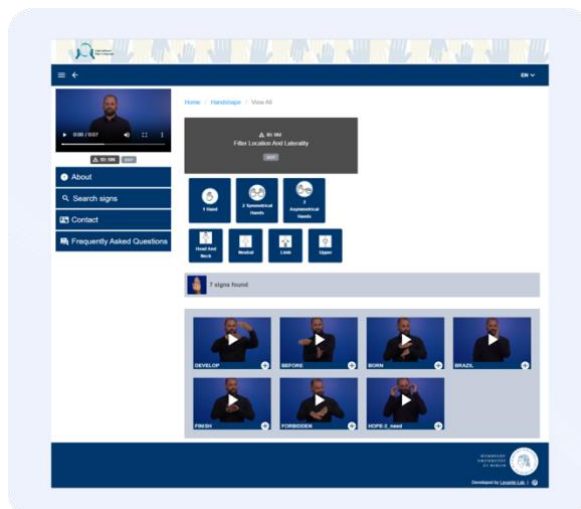


Figure 4: Additional Filters for Searching Signs

<sup>1</sup> Signbank 2.0 functionalities are listed in the appendix.

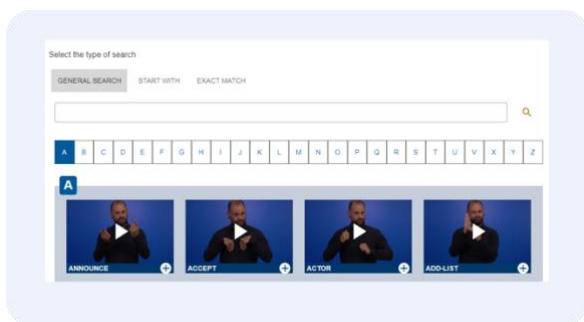


Figure 5: Word-based search for signs

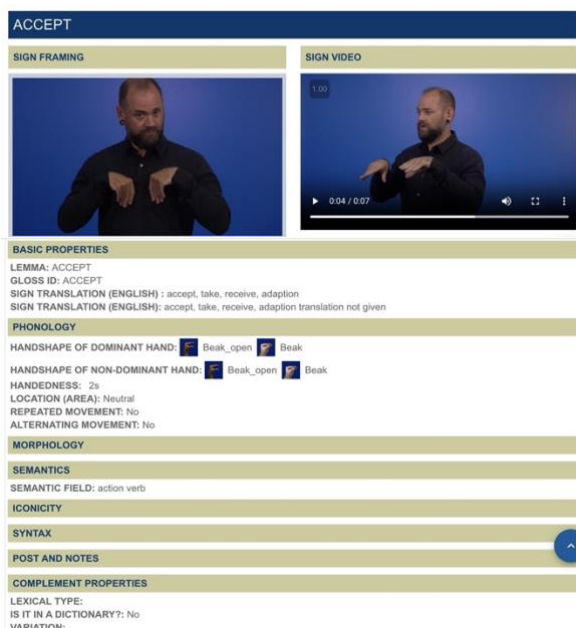


Figure 6: Results of the exact sign with a list of properties if available

In addition, the less common variants of the handshape are located directly below the main handshape, so that all handshapes can be displayed in an easily recognizable visual size. Usability tests were conducted with users of the Libras Signbank. The results indicate that users take advantage of finding the signs using this new search tool. The search tool has additional filters that include the number of hands and their arrangement involved in the sign and the location where the sign is typically produced. Figure 4 illustrates these additional filters.

These filters include options to restrict the search by the number of hands involved in the sign (one-handed signs vs. two-handed symmetrical signs and/or two-handed asymmetrical signs). The features of location in the search tool are a) around the head, b) neutral space, c) limbs and d) upper torso. Another search tool is word-based, as shown in Figure 5.

In this case, it is possible to use an initial letter that the gloss ID starts with. Alternatively, it is possible to search by choosing from the options: general search, start with an exact word. These options

are designed to serve different purposes. Annotators usually do not know the gloss ID when they are looking for it to follow the standard annotation of a particular sign. Thus, they may have clues about possible words and use a general search to get a list of all the tags that use a possible word, and then look at the tag listed. Sometimes they remember the first letters of the word and choose the second option. If we know the exact gloss ID for a sign, we may want to search for it directly to get the list of occurrences for research purposes. In this case, it is possible to look at each occurrence directly in the corpus with the full list of places where it appears (see Figures 6 and 7).

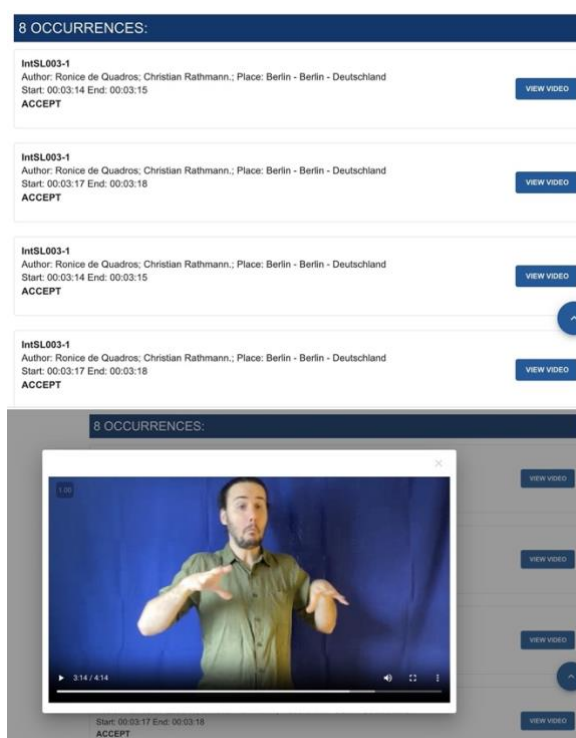


Figure 7: List of occurrences of the sign ACCEPT in the current corpus & visualization of one of the available occurrences

Each occurrence can be accessed directly at the exact time in the video where it occurs. This is made possible by the EAF files associated with the videos in the corpus. In the case of the International Sign Language (IntSL) Signbank shown as an example in these figures, the EAF files are annotated in English, which is the only language available to date. However, for national Signbanks, such as for Libras, for DGS, for MUNY, for ÖGS, there are two ways to search for signs: by gloss ID in the national language, such as Portuguese, German or Hungarian in these respective Signbanks, or by English gloss ID. For these two options, we have EAF files annotated in both written languages.

The other search tool is based on linguistic categories: phonology (dominant hand, weak hand, location, movement, orientation, relationship between manual articulators), morphosyntax (word classes), semantics (semantic fields), and complementary properties (variation). These categories can be listed to show all the information about the sign, as shown in Figure 8. The user can choose what to compare between signs in this search option. It is also possible to download the search result in an Excel file.

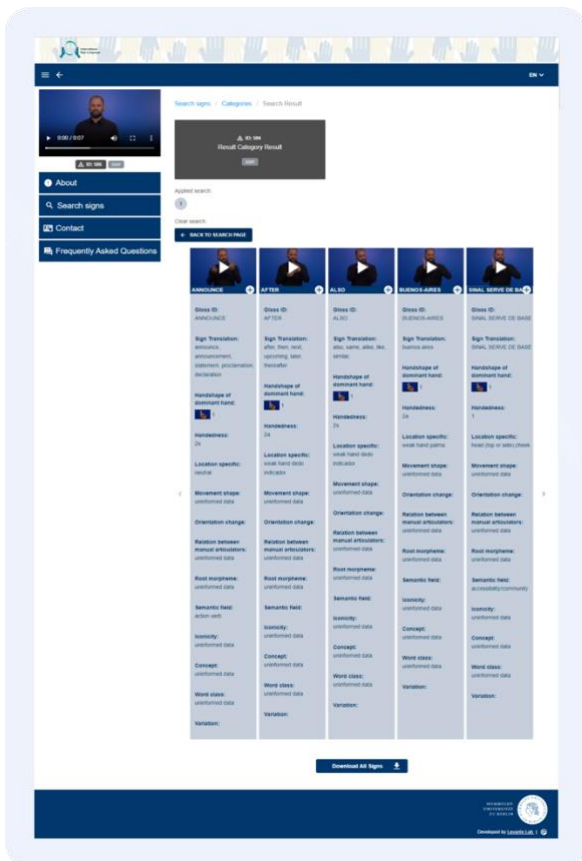


Figure 8: Sign with linguistic information filtered by category of 'dominant handshape'

The network search in turn generates results that include all signs or select linguistic categories in the form of a word cloud. The result of all signs available in Signbank 2.0 shows the signs with more occurrences in larger letters than those with fewer occurrences, as illustrated in Figure 9 for signs in the International Sign Language Signbank.

The network search generates results that show all signs or selected linguistic categories. The result of all signs available in Signbank 2.0 shows the signs with more occurrences larger than those with fewer occurrences, as illustrated in Figure 9 for signs in the IntSL Signbank.

In Figure 9, the signs such as ACQUIRE, BUT-2, and ALREADY show a high frequency of occurrences in the IntSL corpus, which is

associated with the IntSL Signbank. On the other hand, the signs with smaller word sizes placed in the network visualization are the ones with lower frequency of occurrences. For example, CURRICULUM has 2 occurrences. ACQUIRE has 140 occurrences and BUT-2 has 116 occurrences in the IntSL corpus. A slightly larger word, such as BOOK, has 16 occurrences, and the other word even larger than BOOK, such as CLEAR, has 42 occurrences in this corpus.

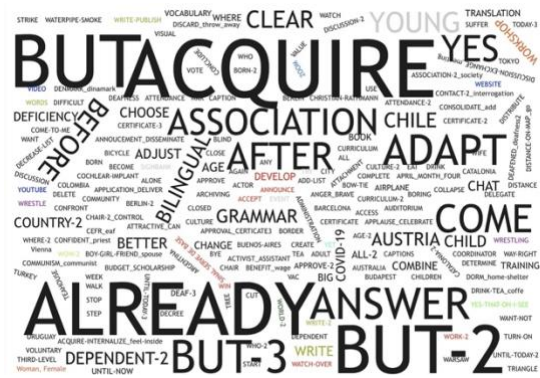


Figure 9: Network search results in the IntSL Signbank

The last option is to display all the signs. This is useful because annotators sometimes want to look at the whole set of signs. It was noticed in the Sign ID system that deaf annotators used to ask for administrative access in order to access all signs in the Sign ID. Based on this experience, this option has been added to the Signbank 2.0, as shown in Figure 10.

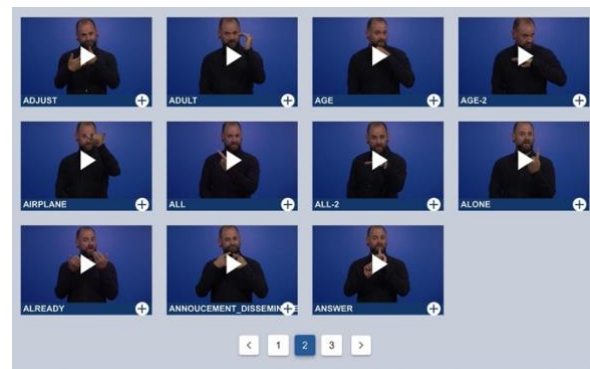


Figure 10: Paged display of available signs with the scroll to see the next signs



Figure 11: Options for searching signs

Users can also search by the Roman alphabet system or by handshapes on the general sign search page (see Figure 11).

Additionally, the portal contains the section of FAQs about Signbank 2.0 in sign languages and written languages. There is also a contact section where users can send direct messages to the system administrators, either in sign language or in written language.

Overall, the creation of Signbank 2.0 is the result of research in the field of design for the development of a visual identity project that values visuality, visual sign language(s) and the forms of visual orientation of sign language users. In addition to adopting the guidelines of web accessibility, it follows the recommendations of studies which analyzed the use of web environments by deaf people, (Flor, 2016 and Fajardo, Parra, and Cañas, 2010), see also the design of the Libras portal in Quadros et al. 2022). The basis of these recommendations always considers the use of visual sign language(s) and contextualized visual resources. These designs privilege the use of familiar and iconic images inspired by specific sign languages to facilitate the understanding of sign language users. The interface has been produced from a deaf perspective, relying on deaf sign language users and sign language researchers throughout its development. Signbank 2.0 takes into account these requirements and includes navigation tools with visual and sign orientation. It is relevant to address that these visual tools are among the top results for accessibility and friendly database use by general users. The possible addition of notation systems, such as HamNoSys and SignWriting, would be for more technical users, for translation purposes, and for the inclusion of avatars in the system, which we are leading for future developments.

## 2.2 Signbank 2.0 Dashboard

The Signbank 2.0 Dashboard is designed to empower the administrative users who manage this portal. It is designed for users to adapt and customize the information needed in each research institution, according to the respective sign language, visual identity of the platform, about, terms of use and privacy requirements of each country. The administrators of the research institution can manage all this specific information in their Signbank of the respective sign language. They can also customize the specific information about the sign language, such as the sign language categories, including handshapes. The basic idea was to have the ability to feed Signbank 2.0 at any time and make adjustments as needed, without developer involvement. The proposal was to create a dashboard in a simple way for the managers who are allowed to make changes in this portal. This required the definition of “persons”, which includes manager roles with

different tasks. It is also necessary to use the sign language of each country as one of the main languages of the portal to provide all the dashboard information. This makes the Signbank accessible for sign language users.

The Signbank 2.0 Dashboard includes all the settings that can be managed by the users, as shown in Figure 12.

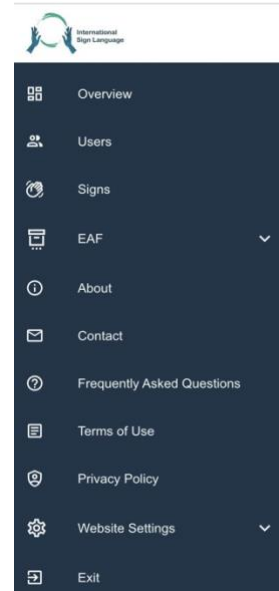


Figure 12: Signbank 2.0 Dashboard general menu

From here, it is possible to manage the whole of Signbank 2.0. People with different roles can make changes or updates in this dashboard. The dashboard can have users with different permissions. They can be administrators, data publishers and data approvers. Administrators can enable or disable approvers or publishers. Approvers can also publish signs, in addition to approving what the publisher has uploaded and filling out any sign included in Signbank 2.0.

In the Sign menu, the administrator can edit the linguistic specifications and there is a list of sign items. Also, publishers can download a new sign and add its specific information, and approvers can approve the signs published by the publisher. Figure 13 shows the view of this area:

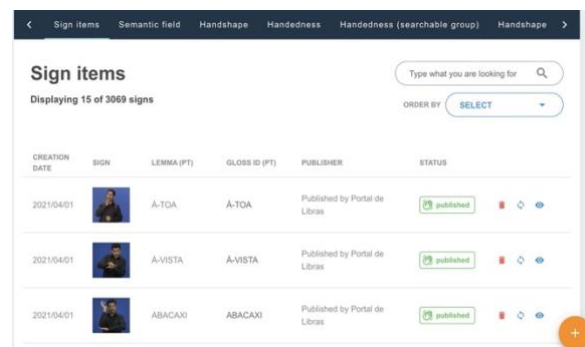


Figure 13: Sign items and linguistic specifications

The top row contains the linguistic specifications that the administrator can edit. The 'Sign Items' list contains all the published signs and their status: they can be approved or pending. Approvers need to check them to approve or to label as 'pending'. To publish a new sign, users click on the + sign at the bottom right of the page. This will open the form to be filled in. This is where the publisher or user with a higher level of access adds all the required and available information, as well as additional information, adding the video signing the sign and the cover with the frame that can better identify the sign. The first page contains the required information that the search tools will use. The following pages contain additional information that is optional and may or may not be used for search purposes, depending on its availability.

The next item on the menu is 'EAF', where the publisher adds EAF files and corresponding movies from the available corpus. When the EAF files and the videos have been included, it shows the list of published EAF files and the list of occurrences of each sign. Figure 15 shows the latter list. Dashboard managers can then visualize all published materials.

CREATION DATE	VIDEO	GLOSS ID	TIME	LANGUAGE
2023/07/04	FLN_GR_F06_entrevista_cam03 translation not given (Florianoópolis - Santa Catarina) Ronice Müller de Quadros	GOOD	00:00:04 - 00:00:04	en
2023/07/04	FLN_GR_F06_entrevista_cam03 translation not given (Florianoópolis - Santa Catarina) Ronice Müller de Quadros	E(POSITIVE)	00:00:04 - 00:00:05	en
2023/07/04	FLN_GR_F06_entrevista_cam03 translation not given (Florianoópolis - Santa Catarina) Ronice Müller de Quadros	LIKE	00:00:05 - 00:00:06	en
2023/07/04	FLN_GR_F06_entrevista_cam03 translation not given (Florianoópolis - Santa Catarina) Ronice Müller de Quadros	POSS(my)	00:00:07 - 00:00:07	en
2023/07/04	FLN_GR_F06_entrevista_cam03 translation not given (Florianoópolis - Santa Catarina) Ronice Müller de Quadros	NAME	00:00:07 - 00:00:08	en
2023/07/04	FLN_GR_F06_entrevista_cam03 translation not given (Florianoópolis - Santa Catarina) Ronice Müller de Quadros	F3(sedna)	00:00:08 - 00:00:11	en

Figure 15: List of the occurrences of each sign item available in the Signbank 2.0

The sections 'About' menu, 'Contact', 'Frequently Asked Questions', 'Terms of Use', and 'Privacy Policy' can be updated whenever necessary. For each of them, there is a list of previously published versions, the current one, and the possibility of adding new versions. After the version of the 'Privacy Policy' or 'Terms of Use' has been revised, users will be able to read and accept the updated version.

The last menu entry is that of the site settings. This includes a submenu for languages, institutions, professions, manuals, instructional videos, and platform identity. The manuals include updated versions of the platform manual and the annotation manual. These manuals can be updated to the latest versions, but previous versions are available for reference. Users in the platform access these latest versions of the manuals. The visual identity of the platform can also be modified as needed in the 'Platform Identity' submenu.

The publisher in the portal can visualize all changes to the dashboard. The edit history is listed and can be located using search tools within the dashboard. The whole system is designed for easy visualization and editing. The administrator can manage the roles of managers and the whole dashboard. It is important to note that developers work together with users, discussing and testing all implementation steps. We started with several meetings to understand all the requirements of Signbank 2.0, then designers prototyped the whole system for users to evaluate before developers started to produce the platform. The whole process is planned in a participative construction with all the actors: computer science engineers, designers, manager users and end users.

### 2.3 User evaluation

For the user evaluation, a workshop was organized with a small number of future users to evaluate the interface of Signbank 2.0 and its usability. The feedback of the users is overall positive, and they addressed a few topics.

Firstly, the Signbank 2.0 is also user-friendly for linguists and non-linguists. Persons who are not linguists can use it easily yet can access complex information about the existing lexical items. Annotators with basic linguistic knowledge can upload annotation files and videos and fill in the lexical information in a few steps. Explanatory videos in sign language guide the users as part of the user manual. Secondly, the users appreciated that Signbank 2.0 can read different annotation templates from other sign language corpora with modifications on files. Signbank 2.0 needs only an ID gloss tier to read the tokenized signs; thus, video-recorded materials with annotated files from different everyday language settings can be uploaded into Signbank 2.0. It allows us to expand the set of growing natural data that will be read by Signbank 2.0. Furthermore, the users will get contextual linguistic information, too, because Signbank 2.0 shows the appearance of certain lexical items by displaying the uploaded videos within the range of sign appearance. It is an advantage for different users like linguists, educators, trainers, students, and learners to see the sign in their natural contexts.

Thirdly, the users found the Signbank 2.0 interface is clear, yet the search engine is slightly complex. Persons without linguistic backgrounds may use the search engine with difficulties. However, it needs only three or four clicks to find any signs with the search parameters. They thought the sign frame (picture) was too small to present the salient form of signs. Fourth point: the users considered Signbank 2.0 a good toolkit for the verification process of the registered lexical items based on existing natural data because it is data-driven. The lexical items of Signbank 2.0 will



emerge from the context of natural linguistic behavior embedded in the uploaded videos via the glossing/lemmatization process.

The main problems identified were related to the search tools and the frequency of signs. The results were not correct because the system did not search in the appropriate level reference of the corpus.

### 3. Final Considerations

The development of Signbank 2.0 is the result of the experience with the Sign ID glosses and previous versions of the Signbank, starting with the technology available at the time of implementation in 2008, and the experiences of developers, administrators and end users. The identified problems with the design of the previous platform, with the search tools, and with the management of the changes required allowed us to design and build this robust platform with the portal and the dashboard.

The Signbank 2.0. is a sign language database that is mainly accessed by sign language professionals or students conducting studies with sign languages. It is also used by translators and interpreters to check the translations that a sign may have. However, the most common use is for technical reasons, when annotators are working with annotations and need to know the standard gloss associated with a particular sign, or when researchers are analyzing signs in different contexts of sign production. Interestingly, other signers also access the signbank to review signs for learning purposes. This includes both deaf and hearing people. In general, deaf signers appreciate the search options, as they include different visual representations of the results (word clouds, lists of signs side by side depending on linguistic features, and all signs based on specific selections). Non-signers can also use the database because there are options based on searching by letters or words. However, we have seen that deaf and hearing signers are the main users.

The user with the administrator role can manage the system tools. For example, they can add new handshapes to the list of available handshapes; they can add linguistic information to be filled when a sign is added to the database; they can change tutorials, they can update condition terms; they can change the logo, color patterns, fonts, instruction videos, menu videos, tutorial videos, web texts.

Signbank 2.0 is being developed to be applied to multiple sign languages in parallel, possibly building a sustainable network between the different sign languages. It is important to clarify that the Global SignBank concept has been adopted to develop SignBank 2.0. The move to a new version of this system is related to using new

systems available considering open access tools incorporated into the Signbank 2.0. The architecture of the applications that make up the platform uses the PHP language for the backend application (from the LARAVEL framework) and JavaScript for the frontend application (from the VUEjs framework). Communication between applications will be structured using the REST standard. Database default is structured with MYSQL. The evaluation process of the Signbank is happening along the development process through a collaborative design with deaf users and hearing signers related to sign language studies. The goal was to make available search tools and sign language data in different ways for different purposes, such as finding a written standard identity, visualizing the signs of specific linguistic categories, visualizing the frequency of the signs in the corpus available, searching signs by handshape, hands used in the sign, and location, visualizing the clouds of signs in the system with the possibility to restrict the linguistic category. The design was developed with visual design in mind for deaf people. The prominent target people are deaf and hearing signers working with sign language studies. However, we see that it is also being used by translators, interpreters, and general people who work in deaf education.

It is a platform designed to be integrated with sign language corpora, and it includes grammatical information associated with each sign of that database, with complex but easily manageable search tools. Considering the whole process, we also understood that planning for the sustainability of the platform is crucial. The plan is to share the signbank in its current state according to the same structure, and if one country decides to make feature improvements, these improvements ideally should apply to all countries using Signbank 2.0. This also makes it possible to create a network among all partners sharing Signbank 2.0. The Signbank network has two main innovative areas: the technological side and the linguistic side. The technology will be sustainably supported by a network, and the linguistic information shared between languages can feed sign language research worldwide.

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## Appendix: List of functionalities of Signbank 2.0

[for reference: <sup>1</sup> CRUD: Create, Read, Update, Delete ; <sup>2</sup> CRU: Create, Read, Update; <sup>3</sup> RUD: Read, Update, Delete; <sup>4</sup> Basic search: (1) Search text; (2) Newest order; (3) Order order; (4) Alphabetical order.]

The modules were listed in order of importance during the creation of the system. The planning was organized in terms of what would add value to each project with the following characteristics: (1) Project of sign language study; (2) Project of sign study for consultation; (3) Project adaptable to different sign languages; (4) Project adaptable to different institutions; (5) Project adaptable to different countries; (6) Project for the deaf people; (7) Open-source requirement; (8) Low resources for development maintenance.

### 1. Account

- 1.1. Register;
- 1.2. Login;
- 1.3. Forgot password;
- 1.4. Edit e-mail;
- 1.5. Edit password;
- 1.6. Confirmation password;
- 1.7. Delete account;

### 2. User

- 2.1. Edit some information user;
- 2.2. Change status account user;
- 2.3. Change type account user;
- 2.4. Change permission approver user;
- 2.5. Records who edit the user;
- 2.6. Read;
- 2.7. Search:
  - 2.7.1. Basic search<sup>4</sup>
  - 2.7.2. Pending Status;
  - 2.7.3. Activated Status;

### 3. Modules Categories Provided to User:

- 3.1. Institution:
  - 3.1.1. CRUD<sup>1</sup>;
- 3.1.2. Search:
  - 3.1.2.1. Basic search<sup>4</sup>.
- 3.2. Profession:
  - 3.2.1. CRUD<sup>1</sup>;
  - 3.2.2. Search:
    - 3.2.2.1. Basic search<sup>4</sup>.
- 3.3. Language:
  - 3.3.1. CRUD<sup>1</sup>.

### 4. Signs:

- 4.1. CRUD<sup>1</sup> Signs
- 4.2. Search signs:
  - 4.2.1. Handshape;
  - 4.2.2. Basic search<sup>4</sup>;
  - 4.2.3. Categories:
    - 4.2.3.1. Handshape of dominant hand;
    - 4.2.3.2. Handedness (searchable);
    - 4.2.3.3. Location (area);
    - 4.2.3.4. Movement shape;
    - 4.2.3.5. Orientation change;
    - 4.2.3.6. Relation between manual articulators;
    - 4.2.3.7. Word class;
    - 4.2.3.8. Semantic field;
    - 4.2.3.9. Variation.
  - 4.2.4. Pending Status;
  - 4.2.5. Published Status;

### 5. Categories Signs:

- 5.1. Semantic Field:
  - 5.1.1. CRUD<sup>1</sup>;
  - 5.1.2. Search:
    - 5.1.2.1. Basic search<sup>4</sup>.

- 5.2. Handshape:
  - 5.2.1. CRUD<sup>1</sup>;
  - 5.2.2. Search:
    - 5.2.2.1. Basic search<sup>4</sup>.
- 5.3. CRUD<sup>1</sup> Handedness:
  - 5.3.1. CRUD<sup>1</sup>;
  - 5.3.2. Search:
    - 5.3.2.1. Basic search<sup>4</sup>.
- 5.4. CRUD<sup>1</sup> Handedness (searchable group):
  - 5.4.1. CRUD<sup>1</sup>;
  - 5.4.2. Search:
    - 5.4.2.1. Basic search<sup>4</sup>.
- 5.5. CRUD<sup>1</sup> Handshape change:
  - 5.5.1. CRUD<sup>1</sup>;
  - 5.5.2. Search:
    - 5.5.2.1. Basic search<sup>4</sup>.
- 5.6. CRUD<sup>1</sup> Location Specific:
  - 5.6.1. CRUD<sup>1</sup>;
  - 5.6.2. Search:
    - 5.6.2.1. Basic search<sup>4</sup>.
- 5.7. CRUD<sup>1</sup> Location (area):
  - 5.7.1. CRUD<sup>1</sup>;
  - 5.7.2. Search:
    - 5.7.2.1. Basic search<sup>4</sup>.
- 5.8. CRUD<sup>1</sup> Relationship between manual articulators:
  - 5.8.1. CRUD<sup>1</sup>;
  - 5.8.2. Search:
    - 5.8.2.1. Basic search<sup>4</sup>.
- 5.9. CRUD<sup>1</sup> Orientation change:
  - 5.9.1. CRUD<sup>1</sup>;
  - 5.9.2. Search:
    - 5.9.2.1. Basic search<sup>4</sup>.
- 5.10. CRUD<sup>1</sup> Relative orientation: location:
  - 5.10.1. CRUD<sup>1</sup>;
  - 5.10.2. Search:
    - 5.10.2.1. Basic search<sup>4</sup>.
- 5.11. CRUD<sup>1</sup> Movement direction:
  - 5.11.1. CRUD<sup>1</sup>;
  - 5.11.2. Search:
    - 5.11.2.1. Basic search<sup>4</sup>.
- 5.12. CRUD<sup>1</sup> Movement shape:
  - 5.12.1. CRUD<sup>1</sup>;
  - 5.12.2. Search:
    - 5.12.2.1. Basic search<sup>4</sup>.
- 5.13. CRUD<sup>1</sup> Mouthing:
  - 5.13.1. CRUD<sup>1</sup>;
  - 5.13.2. Search:
    - 5.13.2.1. Basic search<sup>4</sup>.
- 5.14. CRUD<sup>1</sup> Mouth gestures:
  - 5.14.1. CRUD<sup>1</sup>;
  - 5.14.2. Search:
    - 5.14.2.1. Basic search<sup>4</sup>.
- 5.15. CRUD<sup>1</sup> Contact type:
  - 5.15.1. CRUD<sup>1</sup>;
  - 5.15.2. Search:
    - 5.15.2.1. Basic search<sup>4</sup>.
- 5.16. CRUD<sup>1</sup> Category of entity classifier:
  - 5.16.1. CRUD<sup>1</sup>;
  - 5.16.2. Search:
    - 5.16.2.1. Basic search<sup>4</sup>.
- 5.17. CRUD<sup>1</sup> Lexical types:
  - 5.17.1. CRUD<sup>1</sup>;
  - 5.17.2. Search:
    - 5.17.2.1. Basic search<sup>4</sup>.
- 5.18. CRUD<sup>1</sup> Variations:
  - 5.18.1. CRUD<sup>1</sup>;
  - 5.18.2. Search:
    - 5.18.2.1. Basic search<sup>4</sup>.
- 5.19. CRUD<sup>1</sup> Compounding:
  - 5.19.1. CRUD<sup>1</sup>;
  - 5.19.2. Search:
    - 5.19.2.1. Basic search<sup>4</sup>.

5.20. CRUD<sup>1</sup> Notes:

5.20.1. CRUD<sup>1</sup>;

5.20.2. Search:

5.20.2.1. Basic search<sup>4</sup>.

5.21. CRUD<sup>1</sup> Word Class:

5.21.1. CRUD<sup>1</sup>;

5.21.2. Search:

5.21.2.1. Basic search<sup>4</sup>.

5.22. CRUD<sup>1</sup> Tags:

5.22.1. CRUD<sup>1</sup>;

5.22.2. Search:

5.22.2.1. Basic search<sup>4</sup>.

6.7. Frequently Asked Questions

6.7.1. CRUD<sup>1</sup>

## 7. System Modules

7.1. Explanatory Videos Language Sign

7.1.1. RUD<sup>3</sup>

7.1.2. Search:

7.1.2.1. Basic search<sup>4</sup>;

7.1.2.2. Disabled status;

7.1.2.3. Activated stats.

7.2. Platform identity

7.2.1. Update

## 5. EAFS

5.1. CRUD<sup>1</sup> Videos EAF

5.2. Read file EAF for to extract the Occurrences

5.3. Read Occurrences

## 6. Institutional Modules

6.1. About Signbank

6.1.1. Edit

6.2. Privacy Policy

6.2.1. CRUD<sup>1</sup>

6.3. Terms of Use

6.3.1. CRUD<sup>1</sup>

6.4. Platform Manual

6.4.1. CRUD<sup>1</sup>

6.5. Annotation Manual

6.5.1. CRUD<sup>1</sup>

6.6. Contact

6.6.1. CRUD<sup>1</sup>

6.6.2. Search:

6.6.2.1. News order;

6.6.2.2. Older order;

6.6.2.3. Closed status;

6.6.2.4. Waiting status;

6.6.2.5. Text.