Multimedia Based Sign Language Dictionaries: How are Potential Users Involved?

Žana Juvan*
zana.juvan@fe.uni-lj.si
Faculty of Electrical Engineering
University of Ljubljana
Ljubljana, Slovenia

Klemen Pečnik†
klemen.pecnik@fe.uni-lj.si
Faculty of Electrical Engineering
University of Ljubljana
Ljubljana, Slovenia

Abstract

Sign languages are rich visual-gestural languages that serve as the primary means of communication for the d/Deaf community. Despite their complexity and cultural significance, sign language dictionaries face challenges in terms of documentation, accessibility, and usability. Despite their linguistic richness, the development of comprehensive and user-friendly sign language dictionaries remains limited, especially in terms of adequate user testing, leading to a gap between technological advances and user satisfaction.

This paper examines the history and evolution of sign language dictionaries, from the early printed versions to interactive digital formats. It highlights their key features and technological advances and discusses the benefits of integrating modern technologies such as motion capture and artificial intelligence into sign language dictionaries to improve the accuracy and accessibility of sign language resources. The paper emphasizes user-centered design and calls for a thorough evaluation involving diverse target groups, including d/Deaf, hard of hearing, and hearing users. By addressing the current lack of empirical testing, this paper proposes a hybrid approach to the development of sign language dictionaries that are accessible, effective, and culturally sensitive, ensuring equal access to communication and information for all.

Keywords

online dictionary, sign language, sign language dictionary, user testing, evaluation

1 Introduction

The natural language of the d/Deaf, where "deaf" refers to a physiological state, while "Deaf" refers to a member of the Deaf community [1], is sign language, characterised by its unique visual-gestural modality, with each sign functioning as a lexical unit within a comprehensive grammatical system. These languages are fully-fledged and serve as important means of communication for people with varying degrees of deafness, whether prelingual or postlingual.

Despite their richness, sign languages face significant challenges in terms of documentation and supporting materials, like textbooks, grammar books and dictionaries [2]. High-quality sign language dictionaries are rare, and those that exist often suffer from poor accessibility and usability. Modern multimedia technologies offer a promising solution for a better representation of the spatio-temporal content. These technologies can be used to create more accessible and effective dictionaries that meet the target users' needs [3]. Yet, there is a notable lack of testing and evaluation of these dictionaries with all target audience groups [4]. This gap highlights a critical problem where effectiveness and practicality of these resources are often assumed rather than empirically tested.

This paper explores the development and key features of multimedia Sign Language Dictionaries (SLD), focusing on appropriate empirical testing with target groups. This could improve accessibility and usability, as well as better meet the needs of the Deaf community, their relatives, friends, and anyone who wishes to communicate in sign language.

2 Technical Aspects of Sign Language Dictionaries

In the interconnected world, access to information in one's natural language is a fundamental right that is essential for equal participation and involvement in society. Language is a carrier of culture, identity and knowledge. When people have access to information in their natural language, they can better engage and break down the barriers that exclude people from important conversations and opportunities. If information is only available in a few languages, most people become marginalised and their voices go unheard.

Conventional methods of information dissemination fall short when it comes to sign languages. General dictionaries rely on words, phonetics, pronunciation, and text-based explanations that are inadequate for sign languages. Sign languages are visual and spatial, and include hand and body movements as well as facial expressions which can modify sign meaning. To accurately represent these elements, SLDs must use additional means of communication such as videos, or other alternatives like animations, 3D animations, 360 videos, spatial videos and in addition, specialised notations [5].

Developing effective SLDs requires a hybrid approach that combines features of both learner's and explanatory dictionaries. Learner's dictionaries simplify definitions and provide clear examples to help beginners. Explanatory dictionaries provide detailed descriptions and a broader vocabulary for advanced users [6]. An ideal SLD would include a learner's section with videos demonstrating basic signs, accompanied by 3D animations and text descriptions, with the goal to focus on fundamental vocabulary and common phrases, making it accessible to beginners. The explanatory part would cover complex signs with multiple examples in different contexts. This hybrid model would ensure that SLDs are versatile resources for all users, promoting equal access to information and supporting the development of sign language skills. By creating advanced hybrid SLDs that embrace

*ORCID: 0000-0001-8859-180X
†ORCID: 0009-0004-1430-8054

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the visual and dynamic nature of sign languages, inclusion and equality would be promoted in the best possible way.

2.1 History and Development

The history and development of SLDs reflect the evolving understanding and appreciation of sign languages. The first sign language dictionaries were created in the 20th century [7] providing a valuable resource for both the Deaf and hearing communities. These dictionaries were printed works that used static images, line drawings of signs and textual explanations to depict the signs, which helped to somewhat bridge the gap in communication. These early dictionaries, while pioneering, had significant limitations when it came to accurately capturing the dynamic and spatial nature of sign languages. The static nature of used images often failed to convey the fluid and expressive aspects of sign languages, often making it very hard for people to understand and learn the signs correctly [3, 4].

A significant advancement in the representation of sign language was achieved with the introduction of notation systems. The first notation system was developed in 1960 by Stokoe, which was closely followed by SignWriting (1974) and HamNoSys (1985) notation systems. They use pictures and abstract symbols to describe the elements of each sign, which makes analysis of sign language structure possible. To describe a sign accurately, five parameters are needed: movement, handshape, location, palm orientation and non-manual signals [4, 8]. Printed SLDs used four of the five parameters to describe included signs, which allowed for easier categorisation as well as more efficient searching, since it was possible to organise signs by their characteristics instead of alphabetically [7].

Video technology made a revolutionary advance for SLDs. Early video dictionaries which began appearing in the late 20th century and used 2D video to demonstrate the signs [9, 10]. These video dictionaries provide a more accurate representation of signs compared to static images, as they show body movements and facial expressions. However, 2D video still lacks spatial information, which is crucial for fully capturing the three-dimensional nature of sign languages [11].

The development of 3D avatar dictionaries has addressed some of the limitations of 2D videos by incorporating spatial information. These systems use computer-generated avatars to perform signs, offering users to depict signs from multiple viewing angles, which facilitates better understanding and learning. Despite these advances, 3D avatars often struggle to adequately reproduce natural facial expressions and body movements, which are integral parts of signing, causing the Deaf community to not yet fully accept 3D avatars [12].

The most advanced SLDs today are exploring the use of sophisticated interactive systems to improve inclusion and interaction. Researchers are utilising technologies like motion capture, augmented reality and artificial intelligence to create more natural and accurate representations of signs. These systems aim to capture the full complexity of sign languages, including accurate facial expressions and subtle body movements [13, 14]. E.g. interactive platforms may allow users to view signs from different angles, slow down movements to study them in detail, and even converse with virtual assistants in sign language in real time.

Scientific publications have documented these advances and highlighted the associated technical and social challenges. Studies have examined the effectiveness of various technologies and their acceptance in the Deaf community, emphasising the importance of cultural sensitivity and user-centred design in the development of these aids [15, 16].

2.2 Advantages

Sign language dictionaries offer numerous advantages that significantly support the learning process and enhance communication and inclusion. They provide a standardised way of showing and understanding signs, which helps to standardise their meanings for different users and contexts. This promotes the recognition and use of the sign language, raises awareness and increases the participation of the d/Deaf in society. In addition, these dictionaries enable anyone to learn new signs or refresh their knowledge, ensuring accurate and effective communication, regardless of skill level - whether beginner or certified sign language interpreter. As a comprehensive resource, sign language dictionaries play a crucial role in promoting inclusion and bridging communication gaps between d/Deaf and hearing people [3, 11].

2.3 Key Features

SLDs have evolved from simple printed resources to sophisticated, interactive tools that are essential for learning, communication and inclusion. Initially, these dictionaries were based on static images and textual explanations, which were basic but limited in their ability to capture the full nature and details of sign language.

Modern SLDs [3, 6, 11, 17, 18, 19] have evolved considerably, incorporating a robust entry structure that typically includes the lemma, a video demonstration, and a detailed explanation. Each entry can also provide usage examples and information on frequency of use, along with grammatical details, synonyms, antonyms and collocations. Visual aids and notation systems such as Stokoe, HamNoSys, SignWriting further break down the components of each sign, improving understanding and learning.

The search function in these dictionaries is versatile and allows users to find signs by entering a word or phrase, search by sign components, or by thematic groups. The search results are listed by relevance, ensuring the most accurate match.

Interactivity is a key feature of modern SLDs. Video content offers controls to play, pause, change playback speed and jump to specific sections. Some dictionaries offer multiple synchronised 2D videos filmed from different viewing angles for better understanding, or even 3D avatars with 360-degree views, giving users the ability to freely change rotation or perspective.

As up-to-date and unlimited resources, online SLDs continually add new information, avoiding the limitations of printed versions. This approach mitigates the pressure of deciding which entries to include and allows for quick updates, keeping the dictionary current and comprehensive.

Additional features of modern SLDs increase their usefulness and educational value. Instructions on how to use the dictionary effectively, information on the history and context of sign language, and up-to-date information on the latest developments keep users informed and engaged. Features such as the "word of the day" encourage regular learning and exploration of new signs. These interactive features lead to better learning outcomes. More advanced SLDs incorporate additional features, allowing users to participate in quizzes and games, practise with structured exercises, and save and print customised vocabulary lists. In addition, SLDs can also support language rehabilitation by providing tools for continuous practise and improvement.

3 User Centered Design and Evaluations

The development of SLDs has mainly focused on its features, programming processes, and design. Numerous articles and papers meticulously describe the intricacies of these aspects, often emphasising the technical and linguistic challenges. However, there is a glaring absence in the literature when it comes to user evaluation of these dictionaries with the users. Since SLDs are used by deaf, hard of hearing and hearing users, these solutions should be tested and evaluated by all target groups with comparable tools.

User testing is crucial to the development of any effective educational resource, which is especially true for SLDs. Many studies have shown that involving end users in the testing phase is crucial to ensure effectiveness, efficiency and user satisfaction. One of the most widely used methods for this purpose is User Centered Design (UCD) [2]. This methodology emphasises effectiveness, efficiency and user satisfaction. Effectiveness ensures that the tools or services fulfil the intended purpose, efficiency minimises the effort and time required for users to achieve their goals, while user satisfaction creates a positive and engaging user experience. UCD focuses on improving usability and aims to develop tools that are intuitive and user-friendly. Ideally, SLD design should follow all UCD steps, including thorough user testing and evaluation. Unfortunately, in practise, many SLD development projects tend to skip the crucial fourth step of UCD — evaluation with actual users.

This omission leads to a gap between the theoretical benefits of SLDs and their practical usability. Without empirical evaluation, developers miss out on important feedback that could lead to improvements and adjustments. As a result, SLDs may not fully meet the needs and preferences of the d/Deaf and hard of hearing communities and hearing users, limiting their effectiveness as a learning or helping tool.

3.1 Target Users

The users of SLDs are diverse and they use these tools for various reasons, e.g. to learn a sign language, to interpret, to prepare for specific interpretations or to test their knowledge. Understanding these different user groups is essential for the creation of effective and accessible dictionaries.

Users can be categorised according to their purpose: Sign language learners who are seeking to expand their vocabulary, interpreters who need accurate signs for communication, teachers who use SLDs as teaching tools, and developers who are creating or improving sign language resources. Another categorisation is by hearing status: d/Deaf people for whom sign language is a primary form of communication and hearing people who use SLDs for learning, interpreting or teaching.

Sign language competence also defines user categories: Beginners who are just starting to learn, advanced beginners with basic proficiency, proficient users who engage in complex interactions, proficient users who often work in a professional context, and experts, including native signers and experienced certified interpreters or educators. It is important to understand all different user groups through user studies. They provide insight into how the different groups interact with SLDs, their specific needs, challenges and preferences. This knowledge is invaluable when it comes to customising features, increasing usability and improving accuracy to ensure SLDs are effective and user-friendly for all experience levels within the sign language community [2, 3, 20].

3.2 Evaluation Studies

The evaluation of SLDs can focus on both technical criteria and user experience. Categorising features of SLDs and determining what should be evaluated are crucial steps in this process.

From a technical perspective, the evaluations often look at how well the dictionary code or service works. However, this type of evaluation is insufficient, if the user experience is not taken into account. An effective evaluation should also include an assessment of functionality and usability, ideally involving the target audience. For example, the evaluation of an Electronic Malaysian Sign Language Dictionary [21] was conducted with actual users and provided valuable insights into its effectiveness. In contrast, most SLD evaluations often involve non-target groups of users, typically in very small numbers, which limits the relevance of the obtained feedback.

Unfortunately, many SLD projects do not report on user testing at all. Instead, they rely on simple functional testing or use metrics such as Google Analytics as a substitute for evaluation. This approach overlooks important aspects of user interaction and satisfaction.

A few articles emphasise the importance of thorough user evaluation and show how user feedback can lead to improvements. A study on the users of an online dictionary of sign languages titled "Proposing an instrument for evaluation of online dictionaries of sign languages" [4] provides a proposed framework for conducting comprehensive evaluations and further illustrates the benefits of involving users in the testing process.

3.3 Guidelines and Importance

The evaluation of sign language dictionaries is crucial to ensure that they are effective, user-friendly, and meet the needs of their diverse users. Key aspects of evaluation must include testing specific features, assessing usage and usability, ensuring ease of use and reviewing the quality of videos and content. Feedback and ideas from the community are invaluable for further development and improvement of any dictionary.

An evaluation of SLD should include all target user groups, including the d/Deaf and hard of hearing people, as well as professional interpreters, teachers and other hearing learners, in order to gain comprehensive insights. Methods that include interviews are preferable to written surveys to obtain more in-depth, nuanced feedback [22]. In a separate ongoing study, we were able to demonstrate that it is important to use tools translated into sign language for all users whose natural language is sign language, in addition to semi-structured interviews with participants. To summarise, it is important to tailor the evaluation methods to the specific user group and allocate sufficient time for thorough testing and feedback collection. Although there are some differences between countries in terms of certified interpreters and legal obligations, each method should consider all possible options to reduce the pressure on users by providing them with a comfortable environment and relaxed user testing to minimise the negative impact of testing methods on the final results.

The importance of these evaluations cannot be overemphasised as they lead to a better end product or service. Systematic evaluations improve functionality, usability, and overall quality, and ensure that the SLD or any other product or service actually serves the target audience for which it is intended. This iterative process ensures that the final product truly meets the needs and expectations of its users, resulting in a more effective and user-friendly sign language dictionary.

4 Conclusions

The evolution of sign language dictionaries from printed images to advanced interactive systems reflects significant technological and linguistic advancements. While early efforts provided basic resources, modern approaches strive to capture the complexity and richness of sign languages. As research and technology advance, the goal is to develop inclusive, accurate, and widely accepted resources that empower the Deaf community and improve communication for all. Sign language dictionaries have thus become indispensable, continually updated resources that support learning, foster inclusivity, and bridge communication gaps between deaf and hearing individuals.

To bridge this gap, it is essential that future SLD development incorporates comprehensive user testing into their methodologies. By doing so, developers can ensure that their dictionaries are not only linguistically and technically sound, but also genuinely useful and accessible for their intended users.

In conclusion, for SLDs to be truly effective, evaluations must extend beyond technical functionality and include thorough user testing. This involves categorising features appropriately, assessing content accuracy, and involving all targeted user groups to ensure the dictionaries meet the actual needs of the Deaf and Hard of hearing communities, as well as all other user groups who are using SLDs.

Finally, our research on SLDs and user testing methods has identified some exemplary approaches [20, 21, 22] that integrate users into the design, development, and evaluation stages. On the other hand, however, we could not find a suitable tool for user testing that was adapted to or created in sign language. This highlights a significant area for improvement, particularly in ensuring that solutions meet user needs without assuming that every solution and current evaluation methods are good enough.

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