Educación Química

Chemistry by hands: creation of signs in libras (brazilian sign language) for Essential terms for teaching chemistry

Química con las manos: creación de señas en Libras (Lengua de Señas Brasileña) para términos esenciales en la enseñanza de la química

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Resumen

La base educativa del estudiante sordo radica en Libras, un sistema lingüístico basado en la modalidad visual-espacial. A pesar de haber sido reconocida legalmente durante más de 20 años, esta lengua aún carece de señas para términos científicos, incluidos conceptos esenciales en la enseñanza de la química, lo que dificulta la comprensión de esta ciencia para las personas sordas. Según la literatura, esta escasez terminológica destaca la necesidad de estudios enfocados en ampliar el repertorio léxico de Libras. En este sentido, esta investigación tuvo como objetivo producir señas para términos químicos en Libras y contribuir a la construcción adecuada de conceptos científicos para estudiantes sordos de secundaria en el Instituto Federal de Bahía, Campus Guanambi. Se crearon señas para diez términos: Base, Hidroxilo, Enlace Covalente, Mezcla Heterogénea, Mezcla Homogénea, Oxidación, Reducción, Solución, Soluto y Solvente. La metodología se basó en los presupuestos de la investigación-acción a través del proyecto de extensión "Química con las Manos". El procedimiento para la creación y validación de estas señas siguió el enfoque propuesto por Nascimento en 2016, con adaptaciones sugeridas por Pizano y colaboradores en 2021. El léxico de señas creado está disponible virtualmente en el canal de YouTube @QuimicapelasMãos y en el perfil de Instagram @_quimicapelasmaos. Se concluyó que las señas creadas y validadas son de suma importancia para la expansión léxica y el enriquecimiento del vocabulario de los usuarios de la lengua, ya que permiten un avance hacia un aprendizaje más significativo y fomentan una mayor inclusión de los estudiantes sordos en las clases de química.

Palabras clave: creación de términos-seña; libras; enseñanza de la Química.

Abstract

The deaf student's educational basis lies in Libras, a linguistic system grounded in the visual-spatial modality. Despite being legally recognized for over 20 years, this language still lacks signs for scientific terms, including essential topics in chemistry teaching, making it difficult for deaf individuals to grasp this science. According to the literature, this terminological scarcity indicates the need for studies aimed at expanding the lexical repertoire of Libras. In this direction, this research aimed to produce signs for chemical terms in Libras to contribute to the proper construction of scientific concepts for deaf high school students at the Federal Institute of Bahia Campus Guanambi. Signs were created for ten terms: Base, Hydroxyl, Covalent Bond, Heterogeneous Mixture, Homogeneous Mixture, Oxidation, Reduction, Solution, Solute, and Solvent. The methodology was based on the assumptions of action research through the extension project "Chemistry by Hands." The procedure used for the creation and validation of the sign-terms followed the approach proposed by Nascimento in 2016, with adaptations suggested by Pizano and colleagues in 2021. The created sign lexicon is virtually available on a YouTube channel @QuimicapelasMãos and on an Instagram profile @_quimicapelasmaos. It was concluded that the created and validated signs are of utmost importance for lexical expansion and vocabulary enhancement for language users, as they allow for advancement towards more meaningful learning and provide greater inclusion of deaf students in chemistry classes.

Keywords : creation of sign-terms; libras; chemistry teaching.

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Introduction

Chemistry is an experimental science that studies the composition, structure, and properties of matter, as well as the changes it undergoes during chemical reactions. To achieve this, it assumes a fundamentally abstract character, which requires the creation of mental models to represent what occurs at the submicroscopic level. Thus, in its teaching-learning process, it uses a peculiar terminology to contribute to the student's ability to read and interpret adequately the many imagetic signs present in the context of this curricular component.

Teaching Chemistry to students with deafness proves to be potentially challenging due to several factors. Among them, the scarcity or inadequacy of various terminologies in Libras that can describe specific scientific phenomena and concepts stands out.

It can be affirmed that the education of deaf individuals in Brazil has undergone significant advances during the last two decades. A milestone of these advancements is the creation of Law No. 10,436/2002, the "Libras Law," regulated by Decree No. 5,626 in 2005. Another recent achievement of the deaf community was the inclusion of bilingual education for the deaf in Law No. 9,394/96, the National Education Guidelines and Bases Law (LDB), through Law No. 14,191 of August 2021. Furthermore, the literature has recorded a significant increase in studies such as those by Barth (2021) and Felten (2016), which seek initiatives to make teaching more meaningful for this audience.

This scenario also highlights the emergence of works aimed at the construction and registration of terminologies in Libras. Such works play a fundamental role in the representation of specific and specialized scientific knowledge, as they constitute an essential tool for deaf individuals to effectively access scientific environments.

However, even with all these advancements, offering quality inclusive education for deaf people remains a challenge. Studies such as those by Saldanha (2011), Santos et al. (2015), Ferreira et al. (2014), Benite and Benite (2014), Oliveira (2015), Gomes et al. (2015), Fernandes (2017), Freitas and Paz (2020), and Rizzatti et al. (2022) indicate that, despite legal support, deaf students face difficulties in learning various school subjects.

The challenges indicate that the presence of deaf individuals in school does not necessarily imply inclusion. One might even observe the opposite effect, as deaf individuals, due to not interacting substantially with school content, end up feeling excluded from the educational process. This panorama reveals that there is an urgent need for researchers, educators, and students in the area to seek pedagogical solutions that facilitate the process of teaching science to students with deafness Rizzatti and Jacaúna(2022).

That said, it is worth highlighting the growth of studies for the development of technical and scientific terms in Libras as a response to the need for expanding the lexicon of the sign language in specialized areas (Faulstich, 2016 and Tuxi, 2017). It is understood that initiatives aiming to improve the comprehension of scientific terminologies can contribute to the retention and learning of deaf individuals in educational environments.

In this context, the objective of this work is to analyze the use of these terminologies in Libras in the teaching-learning process of Chemistry for deaf high school students at the Federal Institute of Bahia, Guanambi Campus, as well as to create signs for essential terms in this process that did not yet have an appropriate sign in existing sign lexicons. The

activities disclosed here stem from the extension project entitled "Chemistry by Hands," the result of this author's desire to contribute to a better effectiveness in the dissemination of chemical concepts for deaf students.

Literature review

The American William Stokoe, a pioneer in sign language research, concluded in 1960 that these languages, like oral languages, have their own structure. In Brazil, the first linguistic studies on the topic were conducted by Brito (1990), followed by Karnopp (1994), Quadros (1997), and Felipe (1998). These studies also confirmed the structure and grammar unique to sign languages, as well as their essential visual-spatial nature for deaf communication.

Brazilian Sign Language: structure, importance, and legal support

FIGURE 1. Hand configurations cataloged by INES. Source: INES (2022).

Ultimately, is Libras a language or a communication system? To answer this question, one must first observe the definition of these two terms: while language is conceptualized as any type of manifestation of communicative intention, a language corresponds to a communication system used by a community, containing its own vocabulary and grammatical structure (Ferreira, 2014). Libras, possessing its own grammatical structure and exclusive vocabulary, is therefore a language, whereas the act of communicating through Libras is referred to as language (Brito, 2005).

Thus, to organize the linguistic structure of Libras, signs are formed respecting five basic parameters:

- Hand Configuration (HC);
- Articulation Point (AP);
- Movement (M);
- Orientation (O); and
- Non-Manual Expressions (NME) (Quadros & Karnopp, 2004, p. 57).

HC is the shape the hand takes to execute the sign, and according to the National Institute of Education for the Deaf (INES), 79 configurations have been cataloged so far (INES, 2017) (Figure 1).

The Articulation Point (AP), accordig to Quadros (2021), is the area on the body or in space where the sign is articulated, with the hand able to touch the body or be in a neutral vertical space (from the middle of the body to the head) or horizontal space (in front of the signer) as illustrated in Felix's work (2010) (Figure 2).

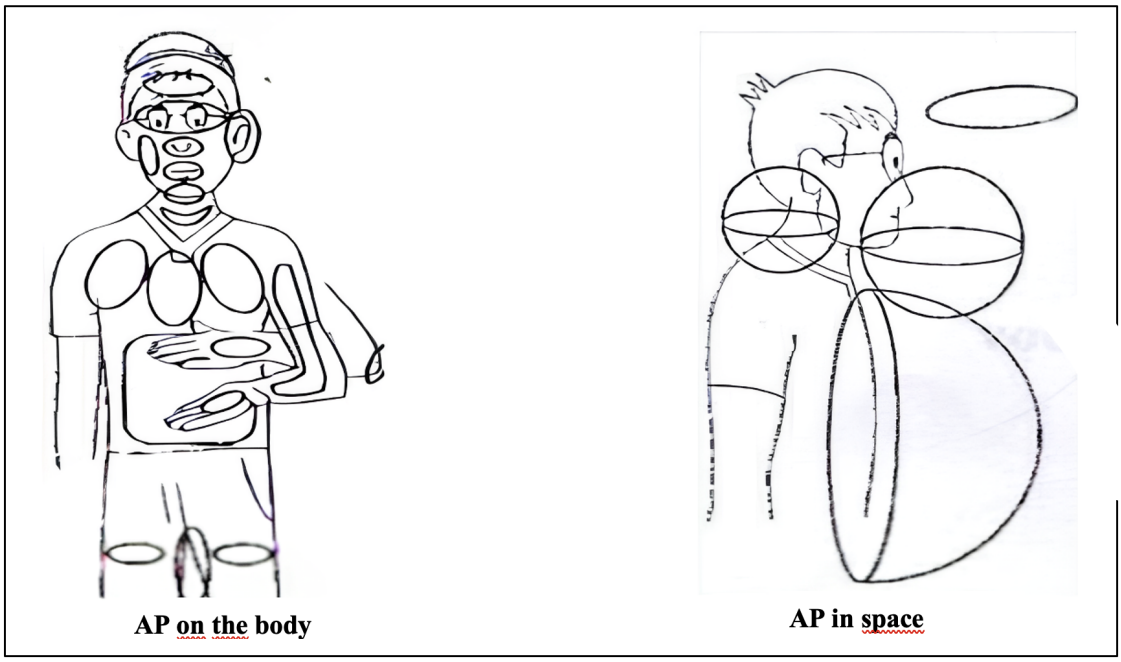

FIGURE 2. Representation of articulation points on the body and in space. Source: Felix (2010).

Orientation (O) is the direction in which the palm of the hand points during sign production (Choi et al., 2011), and finally, Non-Manual Expressions (NME) determine the intensity of the sign, or even if it is a question, an affirmation, or a negation; they can be facial or bodily.

The results of studies on sign languages have driven the expansion of Brazilian legislation relevant to the topic, providing the opportunity to create laws considered important for the deaf community, among which is Federal Law No. 10,436, of April 24, 2002, which recognizes Libras as a linguistic system with its own grammatical structure that allows communication, information, and education for the hearing impaired through visual-motor experience (Brasil, 2002).

In 2005, Decree No. 5,626 regulated Law 10,436 and provided for the mandatory inclusion of Libras as a curricular subject in teacher training courses for teaching, at both high school and higher education levels, among others. Furthermore, according to the Decree, a deaf person can be considered someone who, due to hearing loss, understands and interacts with the world through visual experiences, mainly expressing their culture using Libras.

The most recent legislation directly related to education for the deaf is Law No. 14,191, of August 2021, which amends the LDB to address the bilingual education modality for the deaf. Bilingual education for the deaf, for the purposes of this Law, is understood as the school education modality offered in Libras and written Portuguese, as the first and second languages, respectively (Brasil, 2021). This amendment adds to the LDB text

the guarantee of respecting the human, linguistic, cultural, and identity diversity of deaf, deaf-blind, and hearing-impaired people. It ensures that educational systems will develop integrated teaching and research programs to offer bilingual and intercultural school education to deaf students, ensuring their access to technical and scientific knowledge of societies, whether deaf or not. To this end, the Union's counterpart will be technical and financial support to these systems, with the development of educational programs and research aimed at systematically producing and publishing bilingual, specific, and differentiated teaching materials.

Teaching Chemistry in Libras and the process of creating signs

Due to its high level of abstraction, Chemistry requires the use of specific terminology. For this reason, many words have different meanings from those known in everyday life, which can lead to difficulties in accurately translating the content (Moreira, 2021). It should be clarified that this is not only a peculiarity of chemistry but of scientific language. For example, the term "heart" has distinct signs for common lexicon, referring to the romantic aspect, and for specialized lexicon, referring to the organ of the human body (Figure 3).

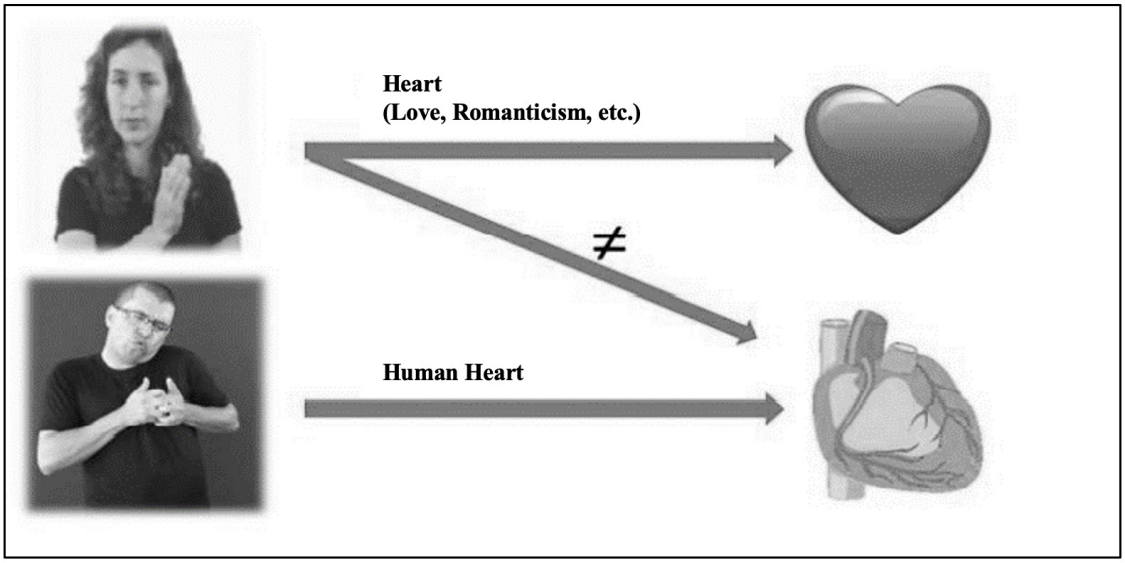

FIGURE 3. Sign for "heart" in different contexts. Source: Costa (2012).

The crux of the discussion about teaching Chemistry to the deaf, therefore, is the use by this curriculum component of its own language to represent reality and chemical transformations through symbols, formulas, conventions, and codes. However, deaf individuals do not have access to this language because, often, there are no corresponding terms and concepts in their native language (Reis, 2015; Souza et al., 2018).

Souza and Silveira (2011) and Lacerda (2006) assert that this scarcity leads to distortions in translating chemical concepts from Portuguese to Libras, compromising the meaningful learning of deaf students during Chemistry classes.

The studies also highlight the importance of this topic being discussed by teachers, together with Brazilian Sign Language Translators and Interpreters (TILS), and deaf students, so that they can jointly assess the adequacy of the signs needed for understanding chemical concepts.

Faulstich (2001) suggests that, after thorough research and analysis, if the absence or inadequacy of a specific sign is identified, a sign creation process should occur. For this, a detailed explanation accompanied by practical demonstrations is essential, so that a sign can be assigned to the addressed concept, a task exclusively for the deaf.

However, this creation process only becomes effective when it undergoes a phase of technical and specialized validation, followed by broad dissemination. The goal of this validation is to prevent the same concept from having different signs, which compromises conversation and understanding (Razuck, 2011). According to Costa (2018) and Saldanha (2011), the expansion of the lexicographic axis and the meaning of concepts, stemming from sign creation projects, lead to a more significant and intense participation in the construction of scientific knowledge by deaf individuals.

Methodology

The work is of a qualitative nature and consists of action research. According to Brandão (1984), this type of study includes the researcher as an integral component of the elaborated object, as Thiollent (2003) asserts that no phrase or discourse inciting to 'doing' will be as powerful as "doing-doing." Furthermore, according to this author, part of the research process involves formulating the problem, interacting, and negotiating with those involved, and thus, based on their own experience, seeking a more suitable action for reality. Therefore, the interaction of this researcher with the environment, with the culture, with the deaf identity, and with Libras itself, was considered fundamental.

The procedure used for the development of this work was proposed by Nascimento (2016) with adaptations suggested by Pizano et al. (2021), composed of four stages, as summarized in Figure 04.

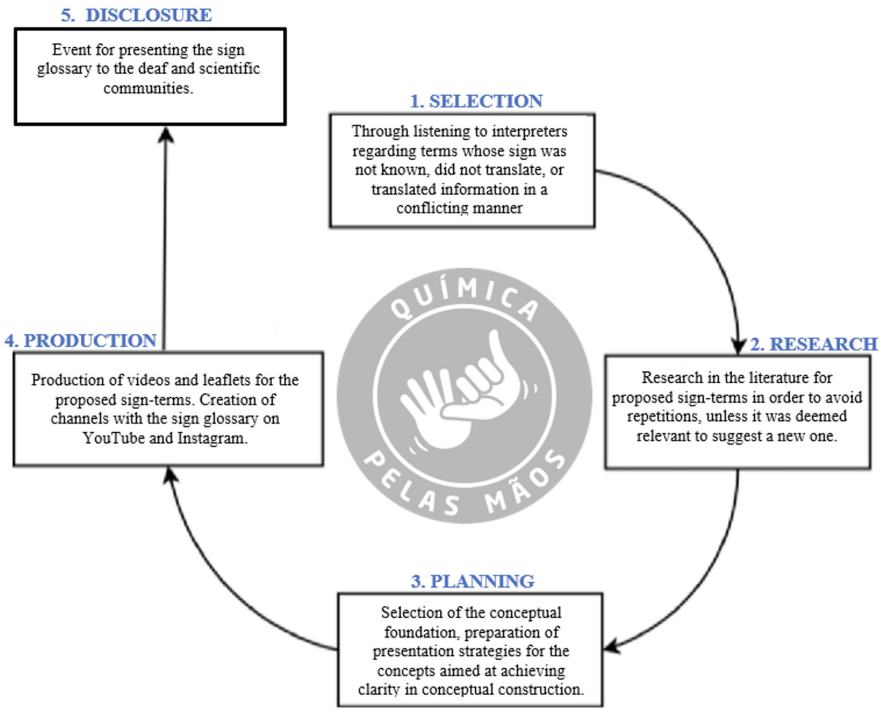

FIGURE 4. Outline of the methodology for the creation and validation of sign-terms. Source: Developed by the authors.

Results and discussion

The extension project "Chemistry by Hands," which originated this work, was developed at the Federal Institute of Education, Science, and Technology of Bahia, Guanambi Campus. Located in the southwestern region of the state of Bahia, where the Antonio José Teixeira Agrotechnical School used to operate, this Campus is the result of the expansion of the Federal Networks of Professional and Technological Education by Law No. 11,892 of December 29, 2008 (Brasil, 2008).

According to Vygotsky (1993), it is through a language that thought can be expressed. For Marinho (2007), it is through sign language that the deaf abstract concepts, interpret, and categorize meanings. Capovilla (2000) further adds that the absence of a well-shared linguistic base compromises broad communication, leaving the deaf individual confined to stereotyped behaviors learned in limited situations.

Authors such as Fernandes et al. (2019) and Andrade et al. (2020) emphasize that the terminological gap in Libras for chemical terms can compromise the educational process of deaf students. This is because, in the scientific field, terminologies are substantial in the teaching and learning process, significantly favoring the appropriation of concepts. In the same vein, at the beginning of this study, the TILS team at the Federal Institute of Baiano Campus Guanambi reported difficulties in interpreting certain chemical topics due to the absence or inadequacy of signs for some terms.

Given this scenario, the researchers in this work initiated a process of analysis and creation of signs for ten chemical terms considered essential for Chemistry education. Among them, the terms "solution" and "base." After all, even though these already had a sign in use by interpreters, upon analysis, it was noticed that the information was being transmitted in a conflicting manner, since the sign used was decontextualized, which, according to Gomes (2014), hinders the learning process of the deaf.

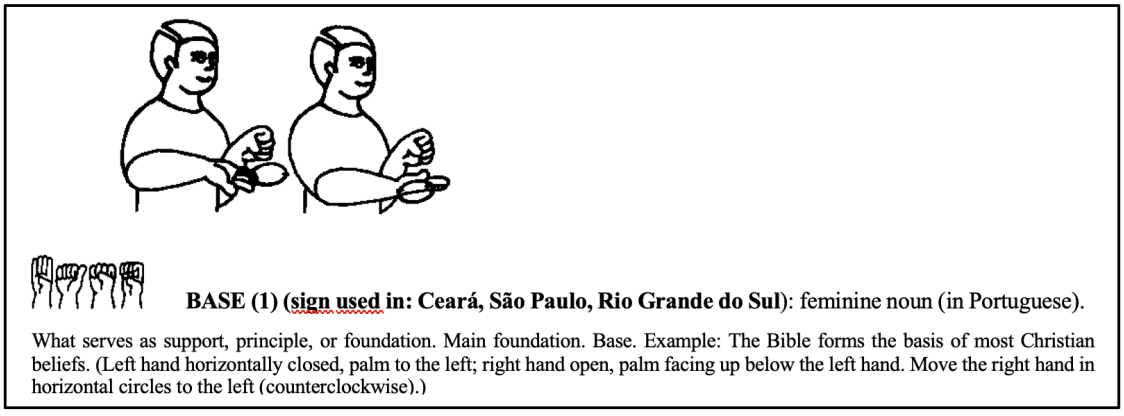

FIGURE 5. Signal and concept for base. Source: Dicionário da Língua de Sinais do Brasil: A Libras em suas Mãos (2019, p. 385).

As an example, the sign used for "solution" was the same as that for "mixture." However, as Pulido (2021) conceptualizes, every solution is a mixture, but not every mixture is a solution. In addition, to the sign used for base, as shown in Figure 5, is attributed the meaning; according to the Brazilian Sign Language Dictionary, "that which serves as support, principle, or foundation," which diverges from the chemical sense, given that in Chemistry, a base is a substance with a pH greater than 7, representing alkaline compounds (Pulido, 2021).

Thus, chemical concepts ended up being translated to deaf students incorrectly. Souza and Silveira (2011) and Reis (2015) state that events like these, arising from the specificity of Chemical language, combined with the scarcity of chemical terms in sign language, affect the quality and fidelity of translated chemical concepts, thus compromising the teaching and learning process of students who are still internalizing this knowledge.

Observations made by Festa et al. (2013) confirm that the suppression, addition, or confusion of information during interpretation means that the deaf individual, even with the help of an interpreter, does not consistently have access to the same information as their hearing peers.

For the other terms ("covalent bond," "hydroxyl," "oxidation," "reduction," "homogeneous mixture," "heterogeneous mixture," "solute," and "solvent"), for which no previous sign was found, a creation process was initiated in accordance with the guidelines of Winagraski (2017) for the development of scientific signs. In line with the directives of this author, a teacher and a Libras Interpreter were present, representing language professionals; four Chemistry undergraduate students, under the remote guidance of a Chemistry teacher, representing the scientific field; a deaf individual, directly responsible for creating the signs.

Facundo (2012) states that to create a sign-term, it is necessary to reinforce the scientific concept attributed to it, since, in this field of knowledge, its meaning is different from that assumed in common language. Saldanha (2011) argues that it is through the combination of known elements with visual information that deaf individuals first understand the meaning of the word and only then create the sign that can express it. And this is indeed what was observed during this sign creation process, as only after clearly understanding what was being explained, did the deaf individual create the signs.

The studies of Rodero-Takahira (2016) add that deaf individuals consider the parameters of Libras, especially the understanding of the word's meaning, to either create new signs for terms in Libras through lexical borrowing or through analogy between existing concepts. Boxes 1 and 2 present the ten signs created, how to perform them, and the linguistic parameters employed.

After being created, all sign-terms were validated by deaf or non-deaf fluent signers of Libras, as recommended by Prometi (2020). They verified whether the sign-terms were in accordance with linguistic levels, parametric elements, and context of use. The participants in this stage were:

- A deaf researcher;
- Two non-deaf researchers;
- A deaf bilingual pedagogue specializing in Libras;
- A graduate in Libras Literature and specialized in Special Education, Translation, and Interpretation;
- A master's degree holder in Education and specialized in Special Education and Libras.

The signs were also validated by the four Chemistry undergraduate students present, as, according to Prometi (2020, p. 151), sign-terms generally undergo technical validation that can be carried out by students or professionals in the relevant technical field.

During this validation process, participants were asked whether they accepted the created sign or not. In case of disagreement, justification was required, however, there was no need for it as the participants unanimously authorized the use of all created sign-terms and, in consensus, also pointed out that they would be very useful for Chemistry teaching, due to the good correspondence between the sign-terms and the concepts presented. According to Rodrigues (2023), this joint study indicates excellence in the development of sign-terms.

Subsequently, the created and validated signs were re-recorded in the studio, and the videos were properly edited with the term's name and representative images. Fernandes et al. (2019) argue that it is not enough to create new sign-terms for use in Chemistry classrooms. For him, it is very important to develop mechanisms for dissemination within the deaf communities and schools so that teachers and interpreters can work on Chemistry teaching that is closer to the linguistic reality of these students.

Agreeing with this argument, the recorded signs were allocated to a channel on YouTube (@QuimicaPelasMaos) and a profile on Instagram (@_quimicapelasmaos) because it is believed that in digital format, the sign glossary can reach a larger number of deaf students, TILS, and Chemistry teachers across the country, making this material increasingly comprehensive and accessible.

The created sign glossary was initially presented to teachers and students of the Biological Sciences and Chemistry Teaching courses at the IF Baiano Campus Guanambi, as well as to the deaf community of the city, during a meeting held in the institution's auditorium. On this occasion, after the project members' report, the coordinators of the courses pointed out the importance of projects like this in the construction of the teaching identity of the students present.

Members of the deaf community expressed great enthusiasm for the presented results. They indicated that initiatives like this are very important for bringing deaf individuals closer to scientific environments. Among the interpreters present, four reported having already used the new signs in translating Chemistry classes and that there was a good acceptance and use by deaf students. The others reported that they intend to use them as soon as the topics involving the signs are taught. In his studies on sign creation, Faulstich (2001) mentions that this presentation moment is crucial because, as language is something alive within a linguistic community, it will then be dynamic and can undergo modifications when necessary, since linguistic changes and adaptations are a natural process.

The project's results were also featured on the Univerciência program on TV Uesb, which aims to broadcast educational, technical-scientific, and sociocultural content to contribute to the popularization of science.

The episode was aired by the broadcaster between August and September 2023, available on the Globoplay digital streaming platform. It is hoped that, with this visibility, the created sign-terms can reach a larger number of Chemistry teachers, interpreters, deaf students, and others interested in the topic.

FIGURE 6. Pamphlet with sign glossary. Source: Developed by the authors.

Final considerations

Chemistry has a distinct language from common speech. This linguistic specificity, coupled with the scarcity of chemical terms in sign language, can compromise the understanding of chemical knowledge by deaf students. The observed terminological scarcity can be explained by the fact that Libras is a relatively recent language (Brasil, 2002). Given this gap, the elaboration and dissemination of works like this, focusing on the development of specific scientific terminologies in Libras, are very important.

In this perspective, this work presented ten new sign-terms for chemical concepts created by the "Química pelas mãos" project. The proposed glossary is available on the YouTube channel "QuimicaPelasMaos," on the Instagram profile "_químicapelasmaos," and in a printed format with representative images and QR codes, which redirect to the sign-term videos.

It is important to note that this proposition was guided by a conceptual basis of the terms to allow language speakers to have a visual perception of the scientific meaning, which conceptually differs from that of common language. For this purpose, this construction was carried out inseparably in light of Libras linguistic parameters.

However, it is worth noting that the availability of these sign-terms in the language's repertoire does not necessarily guarantee success in building chemical knowledge. Moreover, they will be essential to support the practice and the teaching and learning process of deaf students, the curriculum, methodological actions, and the continuous interaction among teacher, student, interpreter, and other members of the educational environment.

It is understood that chemical terminologies play a fundamental role in the teaching and learning process of students. Thus, it is expected that the proposition of these new sign-terms implies a conceptual gain, which will contribute to attenuating the linguistic barrier present in Chemistry classes for deaf students.

Finally, it is advisable that further studies be conducted to ascertain whether the created sign-terms have been incorporated into the translations of Chemistry classes, and if so, to analyze the influence of this new linguistic repertoire on the understanding of chemical concepts by deaf students.

References

Benite, A. M. C., Benite, C. R. M., & Vilela-Ribeiro, E. B. (2014). Educação inclusiva, ensino de Ciências e linguagem científica: possíveis relações. *Revista Educação Especial, 1*(1), 83–92. https://doi.org/10.5902/1984686X7687

Brandão, C. H. (Org.). (1984). *Repensando a pesquisa participante*. São Paulo: Brasiliense.

Brasil. Ministério da Educação. (1996). *Lei de Diretrizes e Bases da Educação Nacional*. Lei nº 9.394 de 20 de dezembro de 1996. Estabelece as diretrizes e bases da educação nacional. Brasília.

Brasil. Ministério da Educação. (2002). *Lei N° 10.436, de 24 de abril de 2002*. Dispõe sobre a Língua Brasileira de Sinais. Brasília.

Brasil. Ministério da Educação. (2005). *Decreto N° 5626, de 22 de dezembro de 2005*. Regulamenta a Lei N° 10.436, de 24 de abril de 2002. Brasília.

Brasil. Ministério da Educação. (2008). *Lei nº 11.892, de 29 de dezembro de 2008*. Institui a Rede Federal de Educação Profissional, Científica e Tecnológica, cria os Institutos Federais de Educação, Ciência e Tecnologia, e dá outras providências. Brasília.

Brasil. Ministério da Educação. (2021). *Lei Nº 14.191, de 03 de agosto de 2021*. Altera la Lei nº 9.394, de 20 de dezembro de 1996 (Lei de Diretrizes e Bases da Educação Nacional), para dispor sobre a modalidade de educação bilíngue de surdos. Brasília.

Brito, L. F. (1990). Uma abordagem fonológica dos sinais da LSB. *Espaço Informativo Técnico-Científico do INES, 1*(1), 20–43.

Capovilla, F. C., Raphael, W. D., & Temoteo, J. G. (2017). *Dicionário da Língua de Sinais do Brasil: A Libras em suas mãos*. Editora da Universidade de São Paulo.

Choi, D., Vieira, M. I. da S., Oliveira, P. R. G. de, & Nakasato, R. (2011). En Pereira, M. C. da C. (Org.), *Libras: conhecimento além dos sinais* (1ª ed.). São Paulo: Person Prentice Hall.

Costa, D. A. F. (2002). Um novo olhar sobre a singularidade – compreendendo a gênese da escrita de aprendizes surdos. *Revista Brasileira de Educação Especial, 8*(1), 75–92.

Costa, M. R., & Ribeiro, D. P. (2018). Criação de sinais-termo nas áreas de especialidades da língua de sinais brasileira – LSB. *Revista Educação Especial, 49*, 131–151. http://dx.doi.org/10.20395/re.v0i49

Facundo, J. J. (2012). A formação de novos sinais em Libras a partir do parâmetro fonológico "ponto de articulação". En *Anais do X Encontro do CELSUL – Círculo de Estudos Linguísticos do Sul*, UNIOESTE, Universidade Estadual do Oeste do Paraná, Cascavel-PR, 24–26 de outubro.

Faulstich, E. (2001). Proposta metodológica para elaboração de léxicos, dicionários e glossários. Brasília. Disponible en: http://canaluniversitario.desenvolvimento.gov.br/monografias/ja_disponiveis.htm

Faulstich, E. (2016). Especificidades semânticas e lexicais: a criação de sinais-termo na Língua Brasileira de Sinais. En Bidarra, J., Martins, T. A., & Seide, M. S. (Orgs.), *Entre Libras e o Português: desafios face ao bilinguismo* (pp. XX–XX). Cascavel, PR: EDUNIOSTE; Londrina: EDUEL.

Felipe, T. A. (1997). A escola inclusiva e os direitos linguísticos dos surdos. *Revista Espaço INES, 7*(9), 41–46.

Felix, A. (2010). O papel da interação no processo de ensino-aprendizagem de português para alunos surdos em uma escola inclusiva. *Revista Trabalho em Linguística Aplicada, 48*(1), 119–131.

Felten, E. F. (2016). *Glossário sistêmico bilíngue Português-Libras de Termos da História do Brasil* (Tesis de maestría). Universidade de Brasília, Brasília.

Fernandes, J. M., & Reis, I. F. (2017). Estratégia didática inclusiva a alunos surdos para o ensino dos conceitos de balanceamento de equações químicas e de estequiometria para o ensino médio. *Química Nova na Escola, 39*(2), 186–194. http://dx.doi.org/10.21577/0104-8899.20160075

Ferreira, W. M., Nascimento, S. P. F., & Pitanga, A. F. (2014). Dez anos da Lei da Libras: um conspecto dos estudos publicados nos últimos 10 anos nos anais das reuniões da Sociedade Brasileira de Química. *Química Nova na Escola, 36*(3), 185–193.

Festa, P. S. V., Guarinello, A. C., & Berberian, A. P. (2013). Youtube e surdez: análise de discursos de surdos no ambiente virtual. *Distúrbios da Comunicação*, *25*(1), 5–14.

Freitas, R. de C. R. Q. de, & Paz, M. S. de O. (2021). Aplicação didática inclusiva no ensino de Química para um aluno surdo. *Research, Society and Development, 10*(7), e29210716525. https://doi.org/10.33448/rsd-v10i7.16525

Gomes, E. A., Souza, V. C. A., & Soares, C. P. (2015). Articulação do conhecimento em museus de Ciências na busca por incluir estudantes surdos: analisando as possibilidades para se contemplar a diversidade em espaços não formais de educação. *Experiências em Ensino de Ciências, 10*(1), 81–97.

Gomes, M. F. (2014). Estratégia bilíngue (Português/Libras) para o ensino do tema condutividade elétrica. Trabalho de Conclusão de Curso, Instituto Federal de Santa Catarina, São José, Brasil.

Instituto Nacional de Educação de Surdos (INES). (2017). *Dicionário da Língua Brasileira de Sinais.* Disponível em: https://www.ines.gov.br/dicionario-de-libras/main_site/libras.htm.

Karnopp, L. B. (1994). Aquisição do parâmetro configuração de mão na Língua Brasileira de Sinais (LIBRAS): estudo sobre quatro crianças surdas, filhas de pais surdos. [Tese de doutorado, Universidade Federal do Rio Grande do Sul].

Lacerda, C. B. F. (2006). A inclusão escolar de alunos surdos: o que dizem alunos, professores e intérpretes sobre esta experiência. *Cadernos CEDES, 26*(69), 163–184.

Marinho, M. L. (2007). O ensino da biologia: o intérprete e a geração de sinais. [Dissertação de Mestrado, Universidade de Brasília].

Moreira, F. S. R. (2021). Criação de sinais-termo: o conceito na descrição das estruturas sintáticas em Português para surdos. [Tese de doutorado, Universidade de Brasília].

Nascimento, C. B. do. (2016). Terminografia Língua de Sinais Brasileira: proposta de glossário ilustrado semibilíngue do meio ambiente, em mídia digital. [Tese de doutorado, Universidade de Brasília].

Oliveira, W. D., & Benite, A. M. C. (2015). Estudos sobre a relação entre o intérprete de LIBRAS e o professor: implicações para o ensino de ciências. *Revista Brasileira de Pesquisa em Educação em Ciências, 15*(3), 597–626.

Pizano, G., Catão, V., & Gomes, E. A. (2021). Sinais-termo em Libras: uma proposta terminológica para favorecer a apropriação de alguns conceitos da termodinâmica química. *Scientia Naturalis, 3*(4), 1649–1661.

Prometi, D. (2020). Glossário bilíngue musical: instrumento para atuação de tradutores e intérpretes na educação musical de surdos. In N. Schleder Rigo (Org.), *Textos e contextos artísticos e literários: tradução e interpretação em Libras* (Vol. II, pp. 68–93). Petrópolis: Arara Azul.

Pulido, M. (2021). *Moderna Plus Química: Conexões com a Química - Volume 1.* São Paulo: Editora Moderna.

Quadros, R. M. de, & Karnopp, L. B. (2004). *Língua de Sinais Brasileira: Estudos Linguísticos* (Vol. 1). Porto Alegre: Artmed.

Quadros, R. M. de, & Lillo-Martin, D. (2021). Língua de herança e privação da língua de sinais. *Revista Espaço, 55*, 213–222.

Quadros, R. M. de. (1997). *Educação de surdos: A aquisição da linguagem.* Porto Alegre: Artes Médicas.

Razuck, R. C. R. S. R. (2011). A pessoa surda e suas possibilidades no processo de aprendizagem e escolarização. [Dissertação de Mestrado, Universidade de Brasília].

Reis, E. S. (2015). O ensino de Química para alunos surdos: desafios e práticas dos professores e intérpretes no processo de ensino e aprendizagem de conceitos químicos traduzidos para Libras. [Dissertação de Mestrado, Universidade Federal do Ceará].

Rizzatti, I. M., & Jacaúna, R. D. P. (2022). Tecnologias assistivas e a aprendizagem significativa no ensino de química para alunos surdos. *Educación Química, 33*(3). https://doi.org/10.22201/fq.18708404e.2022.3.81151

Rodero-Takahira, A. G. (2016). *Incorporação de numeral na Libras*. En Estudos linguísticos - textos selecionados /ABRALIN. João Pessoa: Ideia.

Rodrigues, L. M., & Gediel, A. L. B. (2023). O processo de criação de sinais-termo em libras: a representação de conceitos na área da educação a partir da atuação de TILS no ensino superior. *Revista Científica Multidisciplinar Núcleo do Conhecimento, 8*(4), 5-21.

Saldanha, J. C. (2011). *O ensino de Química em Língua Brasileira de Sinais* (Dissertação de Mestrado). Universidade do Grande Rio "Prof. José de Souza Herdy", Duque de Caxias.

Santos, L. F., Campos, M. L. I. L., Lacerda, C. B. F., & Goes, A. M. (2015). Desafios tecnológicos para o ensino de libras na educação a distância. *Comunicações, 22*(3), 203-219. https://doi.org/10.15600/2238-121X/comunicacoes.v22n3p203-219

Sousa, S. F., & Silveira, H. E. (2011). Terminologias Químicas em Libras: A Utilização de Sinais na Aprendizagem de Alunos Surdos. *Química Nova na Escola, 33*(1), 37-46. http://qnesc.sbq.org.br/online/qnesc33_1/06-PE6709.pdf

Souza, V. C. de A., & Pereira, K. L. (2018). Acessibilidade Linguística para um estudante surdo na disciplina de Química Fundamental do curso de Licenciatura em Química da Universidade Federal de Viçosa. *Revista de Ciências Humanas, 18*(2), 1-21.

Stokoe, W. (1960). *Sign Language Structure: An outline of the visual communication systems of the American deaf*. Studies in Linguistics, 8. University of Buffalo.

Thiollent, M. (2003). *Metodologia da Pesquisa-ação*. São Paulo: Cortez / Editores Associados.

Tuxi, P. S. A. (2017). *A Terminologia na língua de sinais brasileira: proposta de organização e de registro de termos técnicos e administrativos no meio acadêmico em glossário bilíngue* (Tese de Doutorado). Universidade de Brasília, Brasília.

Vygotsky, L. S. (1993). *Pensamento e linguagem*. São Paulo: Martins Fontes.

Winagraski, E. (2017). *O Ensino De Ciências Para Surdos: Criação E Divulgação De Sinais Em Libras* (Tese de Doutorado). Instituto Oswaldo Cruz, Fiocruz, Rio de Janeiro.