

# International Deaf Contributions for Scientific Research: Giving Access to Brazilian Deaf and Hearing Communities

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## Abstract

Brazilian deaf students choose careers mainly from the areas of social sciences. Apparently this is associated with the lack of content in Brazilian Sign Language about scientific and technological areas or even due to the lack of knowledge about deaf professionals and/or scientists working in these areas. Thus, this work aimed to translate to Portuguese and evaluate an American website called “Deaf Scientist Corner” dedicated to publicizing deaf scientists and their achievements, followed by evaluation. The translated site in Portuguese is “O Canto do Cientista Surdo” that was evaluated by 35 people including deaf ones. The results showed great acceptance, and potential to motivate so that the deaf can be inspired by scientific and technological careers. This site can also strength and disseminates these workplaces to the deaf in the society. Therefore, this website translation analysis reinforced that the knowledge about deaf scientists has great potential to encourage deaf people to continue in technological and scientific areas.

## Keywords

Web Accessibility, Science and Media, Social Inclusion, Deaf Scientist, Inclusive Science Education

## 1. Introduction

In order to fully and better experience technology that is present in our life constantly, the society should understand science (Porter, 2014; Fischhoff & Scheufele, 2014; Burns & Medvecky, 2018; Alves et al. 2020). The literature reports

about difficult on this understanding for most of population worldwide (Castel-franchi et al., 2013; Dudo & Besley 2016; Burns & Medvecky, 2018; Reincke, Bredenoord, & van Mil 2020), but this is aggravated in the case of deaf community that has little access, especially in Sign language (Rose, 2020; Castro et al., 2020). In Brazil, when it comes to international data, the scenario is even worse (Almeida, Schiaffino, & Rumjanek, 2014; De Cicco, 2016; Silva et al., 2020). It is clear that there is a communicative barrier between deaf and listeners regarding the language of scientific communication, especially involving biological and technological data (Reis, 2015; Rosa 2015).

Currently, there are about 10 million of deaf and hard of hearing in Brazil but only 10% of this population is included in the scholar system (IBGE, 2010; INEP, 2015). Despite the Brazilian law 13.146/2015 that states the use of Brazilian Sign Language (Libras, BSL) as the first language of deaf community, and Portuguese as their second one for teaching purpose, this is still not assured in the most states of the country (Cruz & Alves, 2016; Dias et al., 2014; Brasil, 2002, 2015). Compared to hearing students, the education of Brazilian deaf students is less efficient since the bilingual teaching is still not fully accomplished and/or available to the whole deaf community (Smith & Allman, 2010).

In addition to this complex teaching scenario, since Libras/BSL is a young language, there are not enough scientific signals to report the whole richness and complexity of biological and technological topics, still missing glossaries and dictionaries in BSL (Smith & Allman, 2010; Dias et al., 2014).

The absence of national academic signs makes even more difficult to understand these contents as they are 1) presented using dactylography; and/or 2) significantly reduced; and/or 3) have their complexity resumed; and/or 4) new signs are created without a national standardization, which is even worse (Dias et al., 2014). This is not a problem exclusive of Brazil as many countries with great scientific development also report the same issues. This led to the emergence researchers and development groups of glossaries and dictionaries (Barral & Rumjanek, 2018).

It is important to mention that it is not enough to have a sign for the topics but the analogous meaning is also expected somehow. An environment focused on study and research the specific biological or technological topic is better for the appearance of new and meaningful signs. Therefore, the participation of deaf researchers on these specific areas may increase and improve BSL. Unfortunately, Brazilian deafs with a doctorate degree (PhD) in technological, biological or health sciences areas are rare. According to the literature, not only the accessibility of the contents in sign language, but also psychological and even financial issues to pay an interpreter, is among the reasons of choosing the social instead the technological area (Mori & Sander, 2015).

In science education, the content should not only use the sign language as main language of instruction, but also visual strategies (Campello, 2008; Cruz & Alves, 2016). It is also important to encourage critical thinking on this public together with practical experiments, similar to what is proposed to the hearing

students (Pinto-Silva, Martins, & Rumjanek, 2013).

This scenario reveals the difficulties to deaf education regarding scientific area. The schools are the strongest and main link between scientific research and popular dissemination, but currently the scientific content also reaches students through internet, and social media on the cellphone, tablets and computers (Hsu, 2004; Kastrup, 2000). Importantly, the internet lowered the differences between deaf and listeners as they both may use the internet to establish social relationships and to seek important information to their academic life. The visual resources, such as graphics and images, animation and videos, contributes to the wide access of deaf people to these contents although the language is still the most important barrier (Rosa & Cruz, 2001).

In addition, Rocha et al. (2020) emphasize that communicational accessibility is scarce at museums and science centers, and when it comes to translation resources for sign languages, these are almost nonexistent in the reality of Latin America, especially in Brazil. This affects the access to scientific information, especially those aimed at the general public but not accessible to the deaf community.

Considering the context of an inclusive scientific education, Brazilian deaf students should be able to find deaf people who contributed to science since it may increase their interest to these areas, as they value the identity and their performance in different fields of work (Santana & Sofiato, 2017). However, there are enormous difficulties to find information about deaf scientists in portuguese and even in English. One exception is the website called the “Deaf Scientist Corner” (<https://twu.edu/dsc>). from the United States of America, where it is possible to find data about deaf scientists, whether in the humanities/social, technological or biological fields, all gathered in this website dedicated to the biographical dissemination of these famous deaf scientists.

The website was developed by Dr. Chad E. Smith (Texas Woman’s University, Dexton, Texas, USA, <https://twu.edu>), and by the teacher Jennifer Borgman (Sherman Regional Day School Programs for the Deaf, Sherman, Texas, USA) (Smith & Allman, 2010), based on different books including: 1) “A Biographical Dictionary: Deaf Persons in the Arts and Sciences”, published in 1995 by Lang e Meath-Lang; 2) “Silence of the Spheres: The Deaf Experience in the History of Science”, published in 1994 by Lang; 3) “The New York Public Library Science Desk Reference”, published by Barnes-Svarney in 1995. Since deaf culture reinforced the importance of the “*visual experience*” (Strobel, 2009), everything showed on this website is developed in the most visual and colorful way possible.

Considering that, the scientific content in science education should not only use sign language as main language of instruction, but also include visual strategies (Campello, 2008; Cruz & Alves, 2016) and encourage critical thinking on this public, similar to what is proposed to the hearing students (Pinto-Silva, Martins, & Rumjanek, 2013). Thus, the translation of this website can be a promising way to awaken and maintain interest, especially with regard to deaf celebrities who impacted the development of scientific and technological know-

ledge.

Therefore, the aim of this work was to allow the access of Brazilian deaf and hearing people to the information about deaf researcher contributions showed by the “*Deaf Scientist Corner*” website by translating it to Portuguese. In this work we also evaluated this translated site by deaf people, including professors and teachers of deaf students, interpreters and also professors with Master degree in Diversity and Inclusion of Federal Fluminense University of Brazil.

## 2. Methods

### *Reconstructing and translating the website*

An intensive online search was performed to find sites about deaf scientific community, using the keywords: *deaf*, *site*, *research*, *science*, *deaf scientist* and *deaf researcher*, in English and in Portuguese.

The website “*Deaf Scientist Corner*” (<https://www.twu.edu/dsc>) was found in our survey and was also referred by a coworker, Dr Jean F. Andrews (Lamar University). This site was registered by Drs. Chad E. Smith (Texas Feminine University—<https://twu.edu/>) and Jennifer Borgman (Sherman Regional Day School Programs for the Deaf), who granted authorization for the translation of the full content of the site. They constructed the original site based on the books: 1) “A Biographical Dictionary: Deaf Persons in the Arts and Sciences”, published in 1995 by Lang e Meath-Lang; 2) “Silence of the Spheres: The Deaf Experience in the History of Science”, published in 1994 by Lang; 3) “The New York Public Library Science Desk Reference”, published by Barnes-Svarney in 1995. The site authors who granted authorization for the translation of the full content of the site.

The Brazilian translated site was initially constructed in Wix platform (<https://pt.wix.com/>, Wix.com, Inc, Gush Dan, Israel) using the Texas University website as a template. After translation, all information as well as pictures, colors and organization were reproduced identically. We decided to translate meanwhile only to Portuguese written form considering: 1) this is a Brazilian Language for both deaf and hearing people; 2) the avatar accessibility technology is considered by Deaf and hard of hearing still inadequate due to the absence of the facial expression, one of the main parameters of all sign languages worldwide (Sacks, 2010); 3) Brazilian sign language (BSL) has several signs for the same scientific term due to regionalism, which demand a selection of terms for translating the site for BSL (Amorim et al., 2020; Castro et al., 2020). However, most important, there is no searching program (eg. Google) capable of finding Brazilian Sign Language keywords. There is no such problem with Portuguese, thus allowing the translated site to be searched, found and consulted.

### *Evaluating the translated website*

A questionnaire with 16 questions was constructed in a google formulary (Google forms) and sent by WhatsApp and email for more than 50 people including deaf people, professors and teachers of deaf students, and interpreters.

The questionnaire was composed of the following questions:

- 1) What is your relationship with uff?
- 2) What's your profession?
- 3) Genre;
- 4) Age;

5) Do you have any special needs/disabilities? What?

In this section choose a grade from 0 - 10 to the following aspects;

- 6) The layout (visual) of the site;
- 7) Use of photographs;
- 8) Quantity of texts on the site;
- 9) Organization of the information;
- 10) Accessibility;

11) Does the site meet your expectations?

12) The final note for this site is;

13) Can the site well disseminate deaf researchers?

14) Do you know any website that promotes deaf researchers? Cite it;

15) Do you think this site is important and should be published? Why?

16) Write, if you want, any suggestions or comments to improve the site.

From the 50 submissions of the forms, we obtained a response from 35 volunteers (21 - 65 years old, 94% women) answered including: deaf people (5), professors (n = 5) and teachers of deaf students (n = 20), and interpreters (n = 3), among others. This study was executed as part of the extension program School of Inclusion of Federal Fluminense University.

### 3. Results and Discussion

#### The translation to create the Brazilian website “*O Canto do Cientista-Surdo*”

Before our work, the site “*Deaf Scientist Corner*” was offered only in an English version, which prevented deaf community from knowing about famous scientists that they can admire and inspired by to choose scientific careers. The automatic translations (eg. Google) were not accurate and even more complicated, thus needing a careful and adapted translation to get comprehensive in other languages such as Portuguese.

The Brazilian website was constructed in the Wix platform (<https://pt.wix.com>) (Wix.com, Inc, Gush Dan, Israel) by using the same layout of colors and figures style of the American site (**Figure 1**). The platform allowed the construction of an exact copy of the American site, including distribution of pages and text, without changing its main features, maintaining its accessibility and intuitive profile for both deaf and hearing communities.

Therefore, the free hosting, easy access and use, as well as the simple aesthetics, allowed the creation of the Brazilian website version named “*O Canto do Cientista surdo*”, since “canto” means corner or convergence, a place where the searcher meet the deaf scientists (<https://cientistasurdo.wixsite.com/inicio>).

The initial translation was made by using internet translators as well as an expert

**Deaf Scientist Corner**

Welcome to Deaf Scientist Corner, a Web site devoted to biographies of famous deaf scientists!

Sir John Warcup Cornforth  
Picture Courtesy of the Nobel Prizing

Ruth Benedict  
Picture Courtesy of the Library of Congress

Oliver Heaviside  
Picture Courtesy of University of Adelaide

Annie Jump Cannon  
Picture Courtesy of Wellesley College

These are over thirty scientists found within this site.  
There are [biologists](#), [chemists](#), [paleoneurologists](#), [astronomers](#), [anthropologists](#), and many more!

[Table of Contents](#)  
[Teacher's Corner](#)  
[References](#)  
[About the Authors](#)

[Em Português / Portuguese translation](#)

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[Dr. Chas E. Smith](#) Director of Deaf Education, Texas Woman's University  
[Jennifer Boraman](#) Teacher of the Deaf, Sherman RDSPD

**Ó Canto do Cientista Surdo**

Bem-vindo ao Canto do Cientista Surdo, um site dedicado as biografias de cientistas surdos famosos !

Sir John Warcup Cornforth  
Foto Cortesia do Prêmio Nobel.org

Ruth Benedict  
Foto cortesia da biblioteca do Congresso

Oliver Heaviside  
Foto cortesia da Universidade de Adelaide

Annie Jump Cannon  
Foto cortesia de Wellesley College

Mais de trinta cientistas surdos podem ser encontrados neste site.  
Há biólogos, químicos, paleoneurologistas, astrônomos, antropólogos e muitos mais!

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[Canto do professor](#)  
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[Sobre os autores](#)  
[Sobre os tradutores](#)

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English Version      Curso Mestrado Profissional em Diversidade e Inclusão

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**Figure 1.** Comparison of the American “Deaf Scientist Corner” website (up) and its Brazilian version (down) translated from English to Portuguese, with linguistic adaptation.

in both English and Portuguese languages that was also consulted. All webpages of the “Deaf Scientist Corner” were translated, including those with the 35 deaf scientists descriptions and the 20 scientific areas with some adaptations (**Figure 2** and **Figure 3**).

One question about the translation of this site that was raised by our group was: considering that the deaf person can learn a third foreign language such as English (Sousa, 2014), why translate this website? In fact, in Brazil it is more common to have access to English language offered to the hearing students, than to the deaf students, especially when it comes to the use of the Brazilian sign



**Figure 2.** Example of adapted translation for the site “Deaf Scientist Corner”. (A) original Site and (B) Brazilian version with linguistic adaptation on “Rockettry” (Source: author).

**Figure 3.** Comparison of the “Deaf Scientist Corner” website with its Brazilian version. On the Left (up and down), the original website page in English; On the center (up and down), the Brazilian version translated from English to Portuguese, with linguistic adaptation; On the Right (up and down), Pages added in Portuguese about the Authors; and Translators group (Source: author’s production).

language as the teaching language. Thus, the access and fully understanding of the English language by Brazilian deaf people is extremely rare. Hence, creating a Portuguese version of the American website “*Deaf Scientist Corner*” is one important step to make science even more accessible for this community whereas also allows Brazilian hearing community that has no English skills to access as well. Thus, it is important to observe that the translated website is not to be used exclusively by deaf students as can be visited by Brazilian hearing people, helping them to know more about deaf researchers. Thus, this website may help to disqualify the myth that deaf community has a disability/deficiency that is a

huge limitation that prevents them to full participate in the academic research scenario.

After translation, we obtained a site with 62 (sixty-two) translated pages (<https://cientistasurdo.wixsite.com/inicio>) containing the academic life of 35 (thirty-five) deaf scientists trained in different areas, including technological, humanities and biological areas, in a total of 20 (twenty) diverse areas. The only additions were about the relationship among this translation, the master degree of the main author of this article, and with the original site of Texas University, added in the index page (<https://cientistasurdo.wixsite.com/inicio>) as well as the addition about our translator group (<https://cientistasurdo.wixsite.com/inicio/sobre-os-tradutores>).

Considering that the Brazilian Deaf students mostly have chosen post graduation degrees in Pedagogy, Sign language Literature and social sciences (Zillioto, Souza, & Andrade, 2018; Monteiro, 2018; Mourao & Karnopp, 2020), our website version allows to show in Portuguese that there are other interesting professional choices including Physics, Chemistry and even Rocket science. Thus, it can stimulate the deaf students to conquer and occupy other scientific profession spaces, encouraged by these Deaf scientists academic life.

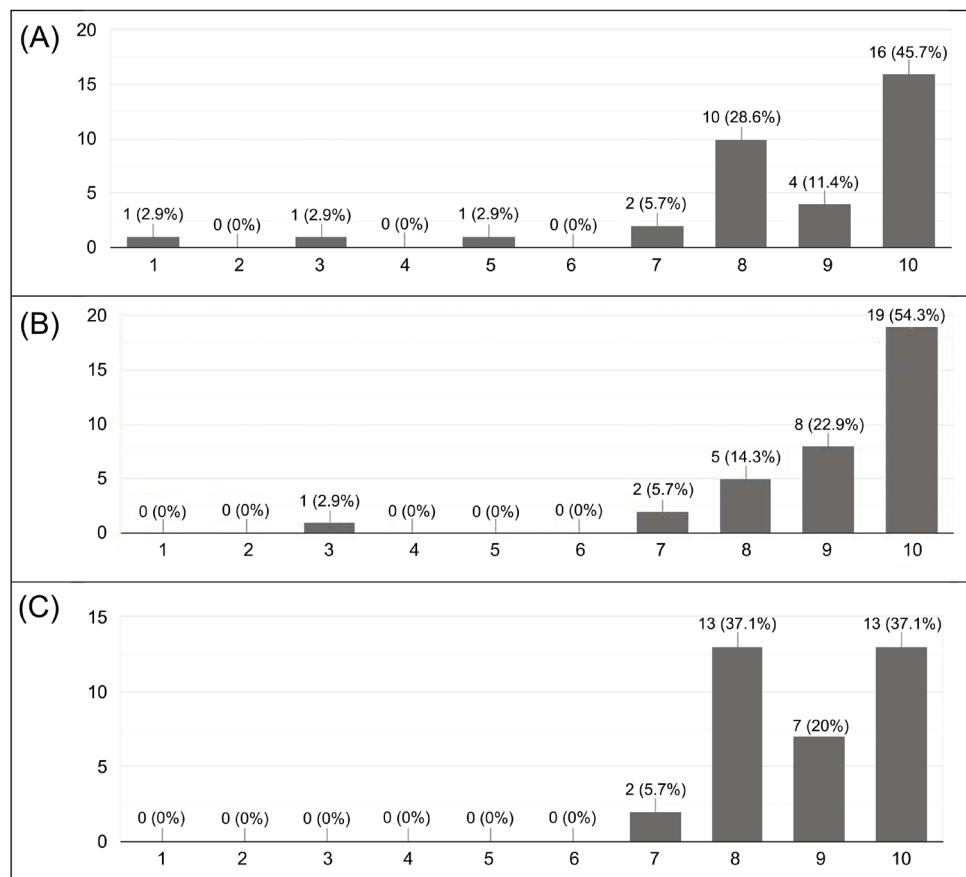
In this work, the Brazilian website version was evaluated by using a Google form questionnaire applied to 35 volunteers including deaf people, professors and teacher of deaf students, and interpreters. Mostly of the volunteers were women (94%) with 21 - 65 years old that had to select one evaluation note, from 1 (bad) to 10 (excellent) in the questionnaire to rate the site specific layout features.

The initial questions were about the visual organization of site, an important issue to the deaf and hard of hearing persons according to the literature (Campello, 2008; Barral & Rumjanek, 2018). According to their answers, 91% of volunteers considered the layout of the site from good to excellent (Figure 4(A)), which reinforced our decision on making no changes on the original layout.

The use of photos is another relevant point to deaf and hard of hearing persons as well as the limited use of written texts, and according to the volunteers, the site was approved by 97% (Figure 4(B), Figure 4(C)). The amount of texts was unanimously approved, with the evaluation from great to excellent, once again proving the translation adapted as the best strategy (Figure 4(C)). Some authors discuss about text reduction on comprehension, but in the case of this website, the focus on the theme is necessary with clarity and direct purpose (De Quadros, 2003; Burnham et al., 2008).

In the organization and ease-to-find information, 100% of volunteers gave grade above of 6, and 44% of them considered excellent (Figure 5(A)).

About the accessibility of the Brazilian site, 73% of volunteers selected grades from 8 to 10 (Figure 5(B)). They pointed the absence of translation for sign language as a justification for the lowest grades. Some volunteers also suggested the use of audio-description of the images for better accessibility to blind and

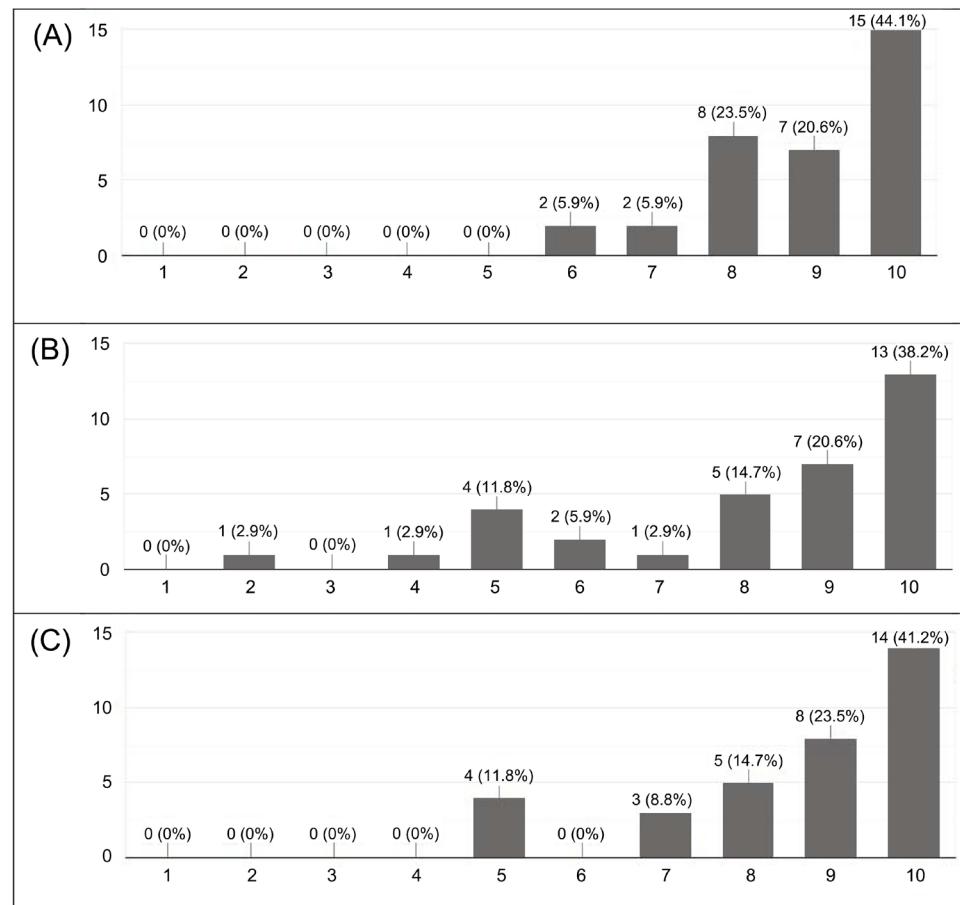


**Figure 4.** Evaluation (grades 1 - 10) of the Brazilian website version by 35 volunteers including deaf people, professors and teachers of deaf students, and interpreters. (A) Overall Layout; (B) Use of Photos; (C) Amount of Written Text (Source: author).

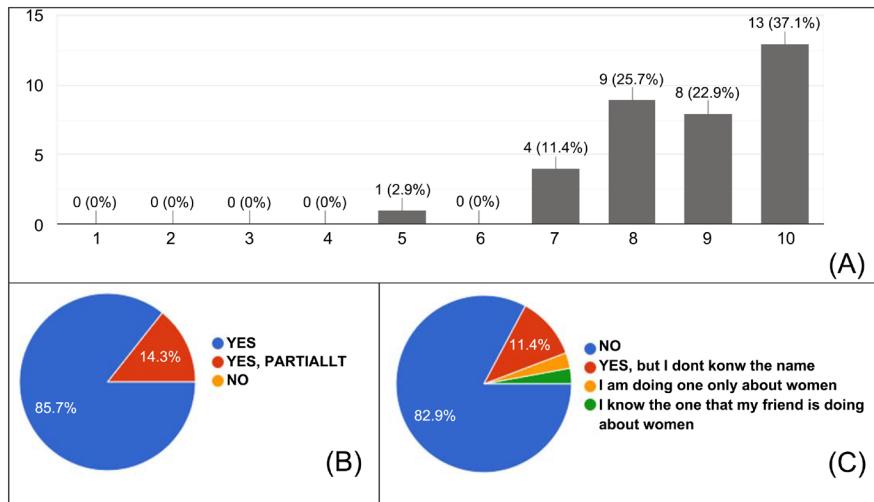
low vision users. The literature point that sign language material are more available in the internet (Stumpf, 2000). However, looking for any data through BSL online is still not feasible as there is no such platform on the internet for that yet. Therefore, the first attempt to use Portuguese for spreading the deaf researchers contributions is the most accessible way in the present moment in this work of translation.

Importantly, the majority approved the Brazilian site with final grade from 7 to 10 (97%), stating that it meets their expectations (88%) (**Figure 5(C)** and **Figure 6(A)**).

We also asked to the volunteers if they knew any website with divulgence of deaf researchers and more than 80% of the answers were negative (**Figure 7(C)**). Despite the American website “*Deaf Scientist Corner*” being online for years, its divulgence in Brazil is very low, probably because it is in English which difficult the access to its content. It is important to consider that the original site from Texas University was never evaluated by the Brazilian public, whereas these answers confirmed that our Brazilian website version may occupy an open space, and it may increase the divulgence about the deaf scientist researchers for everyone, which is the purpose of both English and Brazilian version of this site.



**Figure 5.** Evaluation (grades 1 - 10) of the Brazilian website version by deaf people, professors and teachers of deaf students, and interpreters (n = 35). (A) Organization; (B) Accessibility; (C) Meeting expectations (Source: author).



**Figure 6.** Evaluation of the Brazilian website version by deaf people, professors and teachers of deaf students, and interpreters (n = 35). They selected one evaluation note from 1 (bad) to 10 (excellent) to rate the site specific layout features. (A) Final grade for the site; (B) The Brazilian site version is able to divulgate deaf researchers properly; (C) Knowledge about other sites that divulgate deaf researchers (Source: author).

| <b>Do you think this site is important and should be published? Why?</b>   |  |
|--|--|
|   | 1. Yes<br>2. For sure.<br>3. Without a doubt!<br>4. Information is important<br>5. Yes. To show the absence of barriers<br>6. Yes, to demystify disability as a limiting factor<br>7. Yes, as there are few disclosures in this area.<br>8. Yes, to show the progress of the deaf community.<br>9. Yes, because it is a means of scientific dissemination<br>10. Yes, to disseminate research in the area of deafness<br>11. Yes, to show the ability of the deaf and inspire them<br>12. Very important, to give visibility to deaf researchers for society.<br>13. Yes. For people to be aware of that the science also needs the deaf |
| 14. Yes. All historical-cultural knowledge is important to disseminate and socialize.  |  |
| 15. Yes. I found it interesting. It can inspire deaf people to believe in their potential  |  |
| 16. Yes, as I do not know another site on the subject, I believe that there should not be many.  |  |
| 17. Yes, to publicize that people with disabilities are very capable. Besides spreading the science  |  |
| 18. Yes, for people to meet deaf researchers and understand the role of these individuals in society   |  |
| 19. Yes. It must be disclosed. Knowledge is always good and we need to value everyone who does science   |  |
| 20. I think, because it allows other students and other people to have access to and get to know innovative work   |  |
| 21. Yes, People with Deafness need to be seen, heard and understood, in addition to showing their value and potential.   |  |
| 22. For sure! It is an innovative proposal that contributes to the dissemination of the scientific production of deaf people.  |  |
| 23. Very important and must be disclosed because any accessibility tool developed with responsibility is always welcome.   |  |
| 24. Yes, it is very important and should be widely publicized, as there is no other website (I don't know) that gathers this information.  |  |
| 25. Yes. So that the deaf and hearing communities get to know researchers and demystify some myths about (in) capacity of the deaf.  |  |
| 26. For the relevance of the dissemination of scientific research carried out by deaf researchers, who only contribute to academic learning.   |  |
| 27. Yes, I found the website to be very important and fundamental for the dissemination and knowledge of the potential of deaf people in different areas   |  |
| 28. Yes. Because we have little publicity about the deafness deficiency, people don't know that they can reach their goals. They think that being deaf is not going to get anywhere.   |  |
| 29. Yes it should. Every human being, whatever their disability, is capable of being a great specialist in any area. The site is very relevant to also show deaf people that they can study any area they want.  |  |
| 30. Yes, as it will help deaf teachers find information. According to the site, there will be a platform for lesson plans and so on. In addition to some text being in LIBRAS (which I haven't yet or haven't found).  |  |
| 31. Not only for ordinary people to become aware of issues related to the inclusion of deaf people in society as a whole, but also to realize that people with special needs can and should contribute, as they have already done, to scientific and cultural human development. |  |

**Figure 7.** Evaluation of the Brazilian website version by deaf people, professors and teachers of deaf students, and interpreters (n = 31). Answers for the question “*Do you think this site is important and should be published? Why?*”. *Inset:* Analysis of the word frequency on their answers by using <https://wordart.com/create>.

Finally, we asked to the 35 volunteers if the Brazilian website version is important and why should it be published online. The answers were listed in **Figure 7** and were analyzed according to the word frequency by using <https://wordart.com/create>.

Interestingly, *Disclosure* was the word most cited by the volunteers that answered the question “*Do you think this site is important and should be published? Why?*” pointing to the achievement of our purpose with the translation of the American site to Portuguese.

Our analysis also revealed that the Brazilian version site, according to the answers of these volunteers, is “*important and fundamental for the dissemination and knowledge of the potential of deaf people in different areas*”. Answer regarding helping the teachers activity on participating on this dissemination was also present (“*Yes, as it will help deaf teachers find information...*”) pointing the site as a tool to stimulate the youngest deaf student to the knowledge about technologies and professions/researches such as referred by the literature ([Smith & Allman, 2010](#); [Pinto-Silva, Martins, & Rumjanek, 2013](#); [OECD, 2019](#)).

The need for spreading the knowledge for deaf and hearing people about deaf professionals skills is also observed in the answers of these two volunteers: 1) “*Because we have little publicity about the deafness deficiency, people don't know that they can reach their goals. They think that being deaf is not going to get anywhere*”; and 2)... “*to demystify disability as a limiting factor*”).

According [Monteiro \(2018\)](#), more and more deaf people search for master and PhD degrees, but social sciences are still the most preferred among all sciences ([Monteiro, 2018](#); [Mourao & Karnopp, 2020](#)). So more strategies have to

be created to change this profile that may help not only the deaf community but also the whole society. Based on the fact that diversity is pointed as a factor for creativity and innovation, our society has a lot to gain with deaf researchers participation in the technological and biological areas (Fisher et al., 2019; Shatunova et al., 2019; Fisher et al., 2019).

#### **4. Conclusion**

The American website “*Deaf Scientist Corner*” specialized in the dissemination of 35 famous deaf researchers and their major contributions to science are now available in its Brazilian website version “O Canto do Cientista Surdo” and it is officially linked to the original site directly in their index/main page.

According to the volunteers that evaluated the site, it is really important as it shows and amplifies knowledge about famous deaf scientific researchers and their contributions to research worldwide in different areas of science. The website also makes academic-scientific words accessible, whereas helps to enrich the personal scientific dictionary of each one that access it. As the volunteers said “*It can inspire deaf people to believe in their potential*” ... whereas ... “*publicize that people with disabilities are very capable, besides spreading the science*”.

Unfortunately, the translation of the content into Brazilian sign language was not possible, considering especially the programming difficulties and the specific signs of the scientific and technological areas. This gap demands new computational strategies that allow greater accessibility to the deaf.

Despite of that, the translation of the content in English into Portuguese (the second official language of the deaf in Brazil) certainly favour access and disseminates the culture and achievements of deaf scientists. This translation, even if in written language, can be considered as a practice for the internationalization of academic experiences of deaf people in scientific areas, with great motivating potential within the deaf community, regardless of the country.

Finally, it is worth mentioning that the main author of this work is a biologist, deaf, with a master's degree in Diversity and Inclusion, who intends to provide people, deaf or listeners, access to knowledge about deaf scientists and how much they have already contributed to humanity, although in “silent” way” until now.

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#### **Author Contributions**

Conceived and designed the search: HCC. Performed the research: FVS. Ana-

lyzed the data: FVS, NNTDC, OC, HCC. Wrote the paper: NNTDC, GA, HCC.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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