Development of Mobile *Apps* for Deaf Patients by Nursing Students: Let's Consider the Difficulties through Deaf's Perspective

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Abstract

Communication between healthcare professionals and patients is essential for getting the right treatment and full recovery. However, the deaf community find difficulties worldwide as they need to communicate basically through sign language, in which most of these professionals have no or few knowledge. This study aimed at reporting the experience of nursing students in the development of cellphones *apps* designed to help deaf people during health attendance. This strategy intends to encourage students to experience the point of view of the deaf patient during the attendance in a playful and dynamic way, considering the importance of the language inclusion of the deaf in the health system. The study was developed by first year nursing students enrolled at a Federal University in the Rio de Janeiro state, Brazil. The group consisted of 9 students, divided in 3 groups, who developed applications to be used during nursing care of deaf people. Each software-design-group had pre-selected phrases important to the amnesics process according to their point of view. After this stage, the students have elected the healthcare terminology using the Brazilian sign language—Libras, and recorded videos as a proposition to improve the communication between nurses and deaf patients. Considering that no student had previous knowledge of the Libras prior to

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this event, the activity promoted a practical learning on how to use this translating material as well as on free *apps* development. This educational strategy also contributed to the professional development of such students, since it made them critically think about inclusion of minorities such as deaf people whereas preparing them to provide better healthcare to their future deaf patients.

Keywords

Education, Deafness, Inclusion, Mobile Application, Nurse

1. Introduction

The World Health Organization—WHO—estimates that 466 million people around the globe suffer from some hearing impairment and, out of this, 34 million are children. Around 60% of hearing loss in children is avoidable and 1.1 billion youngsters ranging 12 to 35 years old are in danger of having hearing compromised or lost due to noise exposure in recreational environments. Not adjusted hearing loss costs annually around US$ 750 billion and, beyond the economic impact, there is the socio-emotional effect, which leads to communication exclusion, the feeling of isolation, as well as frustration (WHO, 2023).

Skiliar (1998: p. 15) highlighted that for long time deaf education was thought to make them similar to normal people and to make them use oral language, which Pedagogy calls oralism. Listenism is "*a group of representations from listeners from the standpoint the deaf are demanded to see themselves and make themselves understood as if they were listeners.*" Nowadays Pedagogy tends to bilingualism, in which the deaf must have access to sign language as their first language, emphasizing the importance of contact with the deaf community, whereas the country's written language should be taught as second language (Gesueli, 2006).

Currently, the Brazilian hearing-impaired community still struggles to have access to information regarding everyday life, formal education, access to job opportunities as well as to civil rights. According to Souza et al. (2017), impaired people have been at the center of several debates in Brazil and worldwide regarding promotion of social, educational and health equity. Deaf people are considered as a linguistic and cultural minor community. Such fact corroborates the fight against the accessibility barriers imposed by society to many services, healthcare included.

Nurses are known to be the first healthcare professionals to establish contact with patients at health centers. Notwithstanding, according to Souza et al. (2017), the fact that nurses are not prepared nor have knowledge of the Brazilian sign language ends up highlighting communication barriers to deaf people, what makes not only the treatment a challenge to be taken into account but also complicates the inclusion of deaf community to social services. Therefore, it is rele-

vant to prepare these professionals as well as developing an educational strategy for teaching future nurses, since it raises the awareness of taking care of deaf people while allowing communication, and break barriers to achieve social and health treatment inclusion.

The 10.346/02 law, by the 5626/05 decree, acknowledges the use of the Brazilian sign language—Libras and states that public healthcare institutions must grant adequate access and treatment to deaf people (Brazil, 2002). Such fact does not always occur, since it is possible to observe many healthcare centers without a Libras interpreter. Moreover, the presence of a Libras interpreter may help, but it might also be either embarrassing or causing distress to the deaf person. It is far more interesting when healthcare professionals themselves are able to handle communication with the deaf patient (Chaveiro & Barbosa, 2005; Chaveiro et al., 2008).

At Nursing School, as well as other healthcare degrees at university level, the Libras subject is offered only as elective. The exception is for the Audiology degree. Therefore, many healthcare students graduate without having had previous contact with Libras. Such fragility on healthcare education regarding Libras results in communication issues between professionals and the deaf community (Brazil, 2005; Mazzu-Nascimento et al., 2020). In this way, it is important to highlight the importance of nursing students having contact with these barriers and cultural diversities during their academic route, especially at the very beginning, in order to notice their difficulties regarding the inclusion of deaf people in healthcare treatment as well as the access of healthcare information.

The 10.346/2002 law is a reason for the deaf community to be proud of in Brazil as their sign languange was finally recognized as an official language. However, it is urgent to draw strategies for deaf rights to be indeed ensured. Currently, it becomes the extremely important to use the technology to improve their accessibility, by using mobile phones and internet-based technologies, for instance, which reduce isolation, increase independence, and provide educational access (Alkadhi et al., 2021).

Considering the current scenario of technology development, mobile devices, like smartphones and tablets, as well as mobiles apps might be used to help deaf people at social and health-attending situations (Barra et al., 2017, Huyck et al., 2021). Therefore, this study is a report from nursing students from a federal university about a strategy regarding the development of applications destined to help them on treating deaf people. This article brings light on how future nurses can be previously sensitize about the situation of their future deaf patients in order to attend them with quality offering a feasible interaction by adopting a pro-active posture.

2. Methodology

This is an experience report carried out with the first year nursing students at a federal university in the state of Rio de Janeiro, Brazil. The strategy was devel-

oped during biochemistry classroom as a proposal for the students to understand their deaf patient perspective and to stimulate empathy for this public.

This proposal was mediated by the professor of the discipline of Biochemistry whereas health biochemical issues where discussed. The strategy requested the development of a mobile *app* to help healthcare professionals during attending deaf patients. On that purpose we requested them to create 10 sentences for the app development, considering the deaf patient perspective when attended by a nurse. Students were also asked to choose, out of these phrases, 10 to 20 health terminology words to be recorded in Brazilian Sign language that is called Libras in Brazil. Bearing in mind that most of the students had no previous knowledge of Libras and that task could be difficult for them, we presented the Hand Talk® application to consult the signs in Libras to carry out the activity. It is interesting to note that this activity was also intended to contribute to raise awareness of the problems faced by the deaf community.

In order to deal with the application development, it was used a free open-source tool called *Fábrica de Aplicativos*® ("mob apps factory", in English), available at https://fabricadeaplicativos.com.br, which can also contains a smartphone version available for Android operating system. This software allows people with no previous know-how of application development to build their own software, even without being an expert in the area. In doing so, with such platform, it is possible to design applications to meet various needs. One may even change the desired layout, thus allowing to explore creativity.

3. Results and Discussion

In order to enhance communication between the healthcare professional and the deaf patient, nursing students were invited to develop mobile *apps* in the biochemistry classroom to be used during the attendance moment. The proposal had involved the choice of at least 10 sentences that the students might find necessary during patient amnesics. After selecting them, students sorted out the words to be translated to Libras using Hand-talk translator. They also recorded videos using such scientific sings to add them available on the applications (Table 1).

Communication is a key factor in social relations, and it is by communication people establish dialog. As far as healthcare is concerned, knowing how to communicate is an indispensable tool among professionals and patients (Silva & Faria, 2014; Araújo et al., 2015; Silva & Benito, 2016). All the presented apps presented unique features and each group was free to establish the app's own layout and design, according to their own creativity and/or using free images. More than simply replicating existing and ready-to-use applications, the proposal was intended to make students reflect on their practices and that they would be able to develop their own solutions which could be improved according to their perceptions and daily routines. Similarly, it allowed students to learn from the difficulties faced by deaf people when treated in the healthcare system.

Table 1. Table type styles (Table caption is indispensable).

Group	App sections		
	App name	Amnesics' sentences	Healthcare terminologies
1	Health at hand	How are you feeling?/How would you like to be called?/Are you in use of any meds?/Are you allergic to any substances? It is important to mention us in order to avoid allergic reactions./In a scale from 0 to 10, how much pain do you feel? Do you know how to perform the breast self-examination?/It is important to do it, no matter if you are man or woman./High blood pressure might be related to elevated salt ingestion./Diabetes is related to elevated glucose in your blood./Diarrhea is given to liquid feces./In case of low blood pressure, ingesting liquids is essential to organism's regulation./One of the symptoms for heart attack is pain on the left arm due to referred pain.	Heart attack, diabetes, pain, temperature, vomit, breast cancer, diarrhea, high blood pressure, low blood pressure.
2	CBS Healthcare Libras	How are you feeling?/How long have you been feeling this?/Do you take any daily medications?/Have you got history of this condition in your family?/Have you taken any medication by yourself for these symptoms? If so, what medication have you used and for how long?/How is your diet?/Have you had temperature?/Have you got any food or drug allergy? In a scale from 0 to 10, how much pain do you feel? Have you got any questions on the treatment?	Headache, short breath, temperature, flu, infection, high blood pressure, cold sweat, dizziness, trembling, blurred sight.
3	Biochemistry assignment	My name is (Maria), I am the nurse who is going to attend you. How can I help you? If you need help or if you feel any discomfort, you may call me./ Have you got high blood pressure or diabetes? Have you had temperature?/Have you taken any medication before getting here?/How long have you been feeling like this?/Would you like someone else to be here with you?/Do you take any medication regularly?/May I check your blood pressure? Have you got history of diabetes in your family? Are you allergic to any substance?	Chest pain, burn, drug, break, swollen limbs, low blood pressure, heart attack, violence, itchiness, thirst, high blood pressure, bleeding, pain.

Source: developed by the authors.

According to Romero et al. (2019), to develop a health app it is essential to have as a starting point the universal accessibility of this app (specific language), thus increasing multi-directional communication between people with or without some type of disability, which is essential for social inclusion. Thinking about the creation of an assistive technology implies to consider the cultural appropriateness should be the most important point to the design of technologies. Only this way it's possible to ensure they are relevant to the communities they serve (Staccini & Lau, 2022). Apparently all three students groups take these ideas into account to produce their apps using figures and Libras in the highest interactive format also including videos on them.

The application "Saúde em Mãos" (Health at hand), developed by group 1, presented a main layout to highlight its name. An initial page contained four shortcut icons to the app's main functions: the first one to access a video on the developers/authors, in which they mention their roles and their participation on the app development. In addition, they talk about the importance of developing such application (Figure 1).

The second shortcut was to "*videos*" that when accessed, it leads the user to a new page containing the snippets with the healthcare terminologies in Libras, previously recorded by the students. On the third shortcut, students presented

and broadly described the Hand Talk app, the one used to translate the terminology into Libras. The choice of the sentences to be used during the amnesics moment is represented by the fourth icon (Figure 1).

The CBS Healthcare Libras *app*, developed by group 2, presents a main layout and a personalized design. On the main page the user will find five icons which are the core functions of the *app*, namely: "Who are we?", "Amnesics", "How to ask?", "Symptoms", and "Libras Alphabet". The "Who are we?" icon gives access to introductory videos recorded by the authors/developers, who report they experiences and roles throughout the app development (Figure 2).

One thing that draw our attention was the empathy presented by the group, who created Libras versions of the introductory videos as well as using the Hand Talk app as support. The page containing the main chosen sentences for the amnesics was provided both in Portuguese and in Libras. On the "Symptoms" icon there is a list of videos with healthcare terminologies also translated to Libras, as well as a footage of the nursing students performing Libras signs. Likewise, the students added a Libras sign alphabet available for consultation (Figure 2).

One thing that draw our attention was the empathy presented by the group 2, who created Libras versions of the introductory videos as well, using the Hand Talk app as support. The page containing the main chosen sentences for the amnesics was provided both in Portuguese and in Libras. On the "Symptoms" icon there is a list of videos with healthcare terminologies also translated to Libras, as well as a footage of the nursing students performing Libras signs. Likewise, the students added a Libras sign alphabet available for consultation (Figure 2).

The "Biochemistry assignment" app was developed by group 3 and it presents a personalized layout (Figure 3). The front page contains an image of a person holding a stethoscope with an image related to Libras accessibility on its diaphragm. The *app* presents six icons: In the first one the students described and defined Libras, presenting the important aspects of the language.
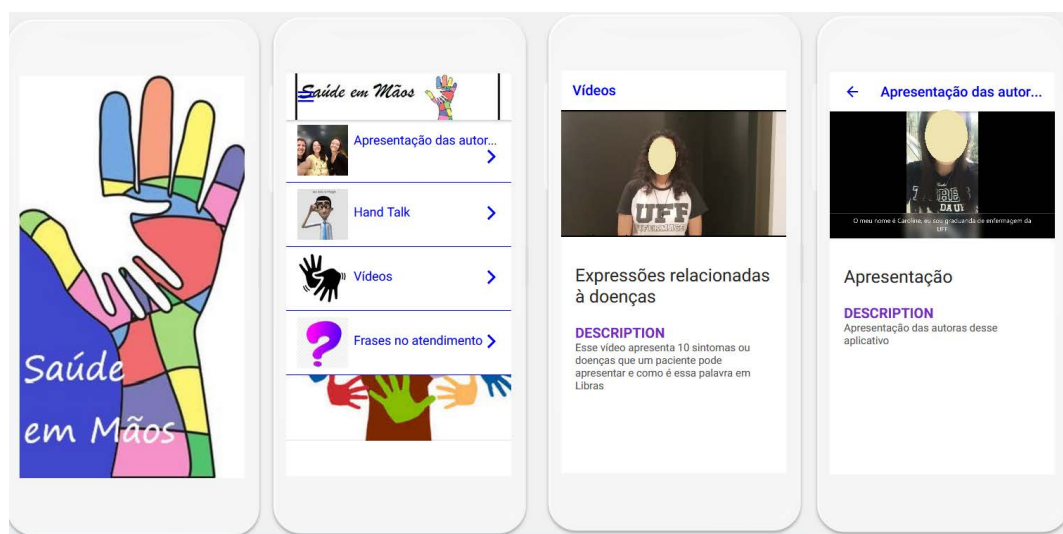

Figure 1. Health at hand *app* for communication with deaf patients developed by nursing students (Group 1). Available on: https://app.vc/saude-em-maos.
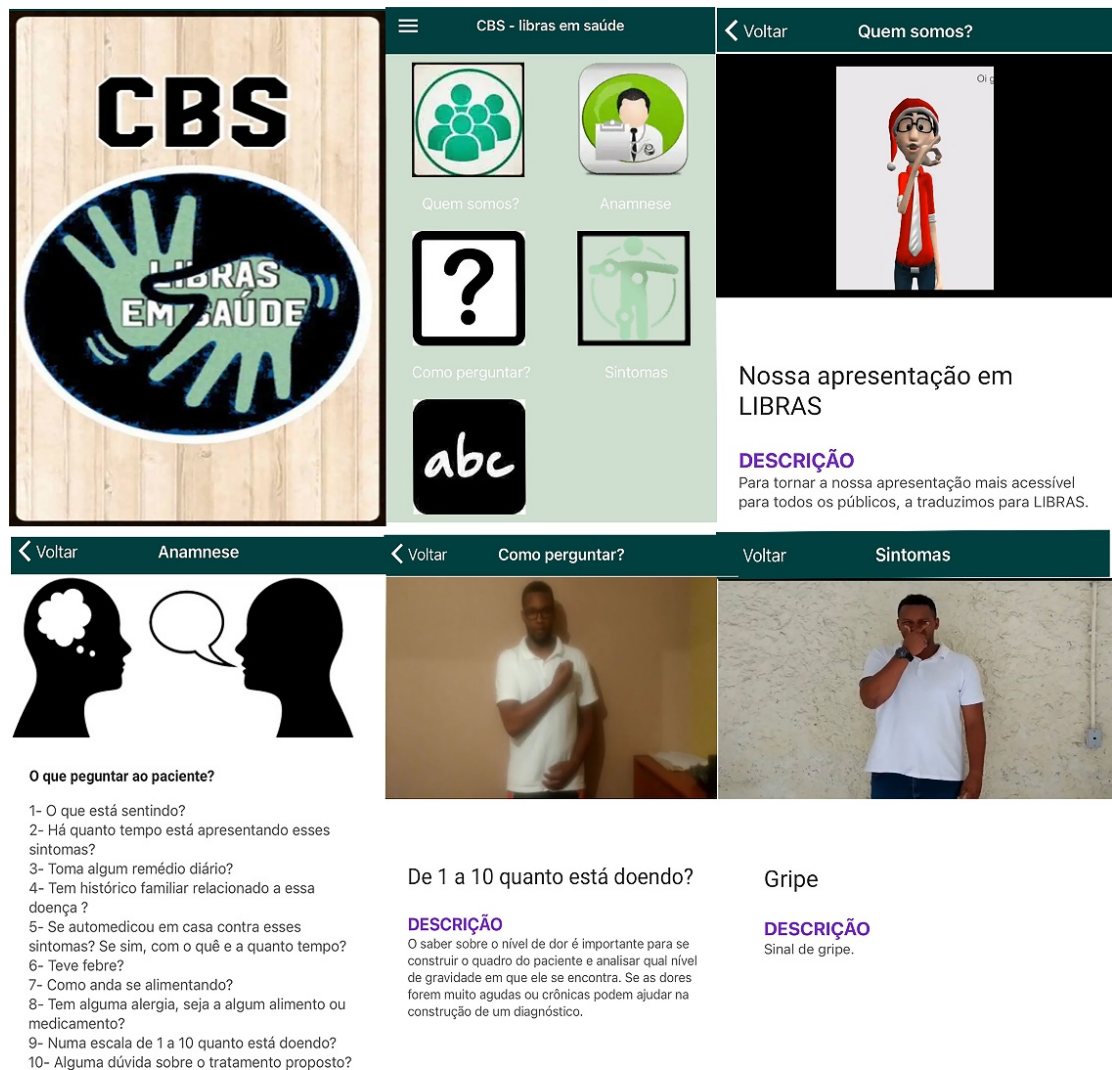
Figure 2. CBS – Libras em Health *app* for communication with deaf patients developed by nursing students (Group 2). Available on: https://m.app.vc/cbs#/home.

On the second icon, the students made sentences available for nurse attending, whereas the third icon leads users to healthcare signs recorded in Libras. The fourth initial icon refers to an extra sign alphabet (only the static signs). As for the remaining fifth and sixth icons, they lead to presentation/description videos by the students/developers, with their roles and responsibilities throughout the app development.

Mobile applications aim at making access to information viable to users, thus creating knowledge and reducing time and space barriers. It makes this technology fundamental for societies in the Information Technology Era (Barra et al., 2017). About nursing training, there is an urgent need to professionals think about this reality and make themselves opened to this new technological context by acknowledging the importance of their roles in a technological healthcare nursing service (Albrecht et al., 2015).
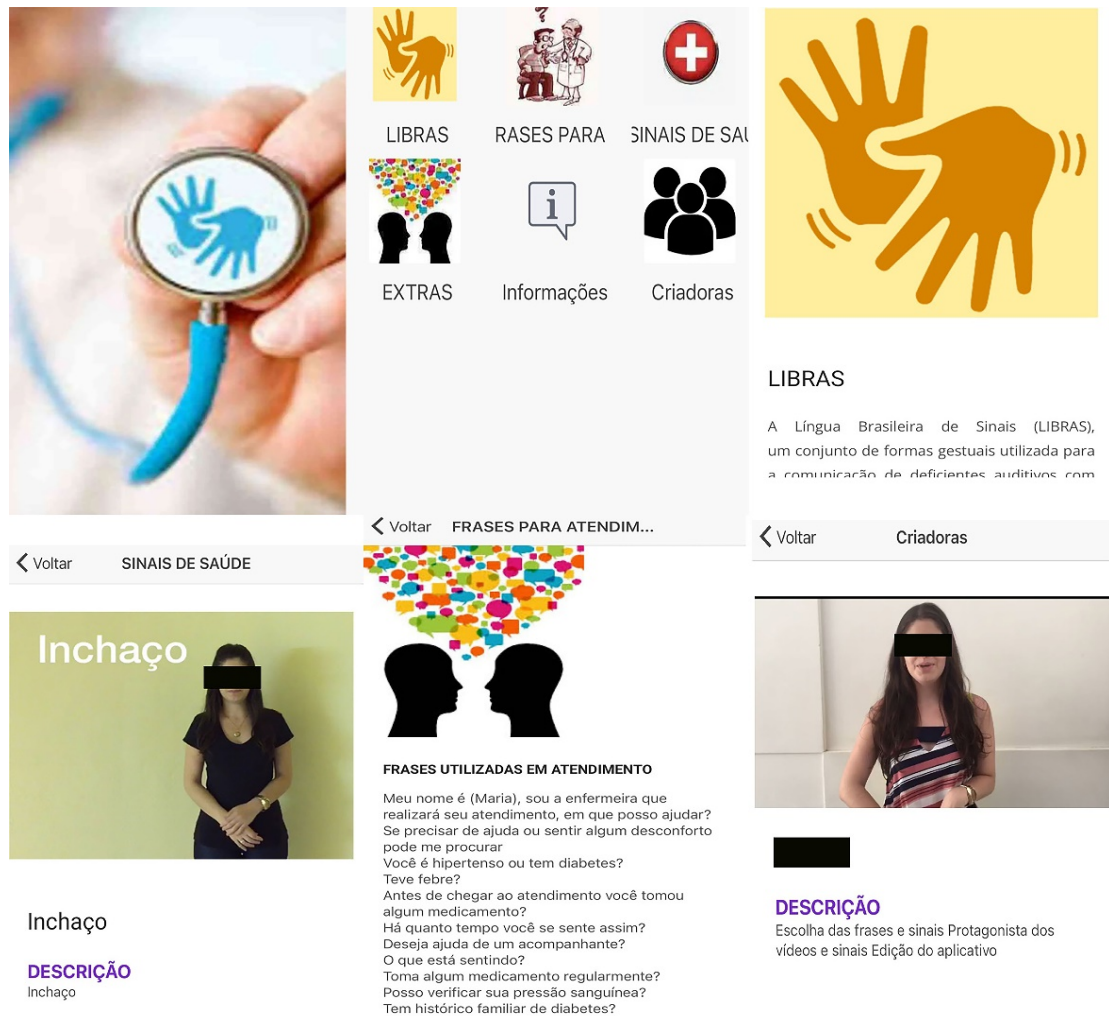
Figure 3. Biochemistry assignment *app* for communication with deaf patients developed by nursing students (Group 3). Available on: https://app.vc/trabalho_de_bioquimica.

Interestingly, all groups felt challenged to know more about Libras and the deaf culture. Throughout the entire work and on the presentation day, it was noticeable that groups were emphatic to the importance of Libras, how struggling it is to attend deaf people as well as the importance of creating alternatives to communication to mitigate the exiting realities on healthcare promotion.

At the end of the presentation, students delivered a report in which they presented their experiences developing the app. Besides making of it a reflection moment, it allowed us to assess students' opinions and perceptions regarding this process.

The students classified the task as challenging, as it is possible to observe on Student's A declarations:

"*Developing the app was challenging, with each difficulty being instigating, not only for the content to be presented but also to the technicalities required to edit it on the predefined platform.*"

To them, having to standardize their work was one of the difficulties students

found to offer the right communication between health professionals and deaf patients as quoted by Student B:

"*The biggest complication the group had was to set a standard for the contends and for editing material within the app to objectively cover the adversities faced in communication between healthcare professionals and deaf patients and how to minimize them.*"

This concern is important and in accord to Alkadhi et al. (2021) that reported that an efficient communication with the patient is a crucial element in providing care, otherwise, the quality of presented care can be affected. According to the same authors, in the United States, almost half of the hearing-impaired individuals have insufficient healthy literacy, which ends up making it necessary to create new strategies for the care of people with hearing impairment, pointing our strategy as important for the preparation of our Brazilian nurses.

When bringing educational technologies to the learning process, scholars might experiment new approaches as well as have access to information which goes beyond university walls (Pereira et al., 2019). Developing an app was not only ambitious but also a pleasurable moment for students to, who could then think about the importance of developing apps for their own professional activity, as quoted by Student C:

"*Developing videos was really fun and rewarding. The idea was wonderful for us nurses. We have the notion how to communicate with deaf patients and to better meet their needs.*"

Student D also highlighted that:

"*The app is a simple way to connect people who know nothing about Libras and help them on the process, establishing communication between patients and healthcare professionals.*"

Studies have shown that the use of technological resources by nursing attendees is indeed important, especially when there is an interactive application with an inclusive bias throughout the teaching-learning process (Pereira et al., 2019).

The application development task also stimulated the students creative side, since promoted imagination of all the app's details. In Student E's words:

"*Naming the app was one of the hardest tasks to be done, since it required a bit of our entrepreneur and creative sides to come up with a name which needed to be didactic and, at the same time, it carried on the group's mark.*"

For this student, using the members' initials plus a complement "Healthcare in Libras" was a perfect match considering a personality touch associated with a pedagogical purpose.

It was possible to conclude that the proposition of developing an application presented itself highly effective to make students think about the necessity the deaf community has in having inclusive treatment. It may be proven by one of the group members, Student F:

"*I must conclude that developing this app was an innovative was of making us learn something without relying on preestablished methods, and it was rather*

important. The idea of making us think outside traditional and archaic teaching methods was fascinating. Despite all the hard work, it was worth it."

Student G concluded that:

"The development of the application has proven to be, to some extent, an educational and enlightening task. It happens because, at the same time developers face themselves with a complete different reality, those lived by a part of our own population. Finally, seeing all the work done and fully functional, the group felt satisfaction with the wok done and with the educational progress achieved. So, it was an experience that, besides teaching and clarifying us, promoted the professional instruction of the students as a whole."

This student's view was rewarding to us because it was possible to realize that not only the goal was achieved but also it happened in a pleasure way to participants.

To Student H, the activity was also demanding, although she also emphasized the importance of thinking about alternatives for deaf patients to be treated with quality and inclusiveness in healthcare services. It is possible to read that on her comment:

"I believe the contend proposed is extremely important and that those applications might turn the odds of healthcare scenario in favor of people in need of such specialized care in Brazil. I agree to this idea of applications to train healthcare professionals in some sort of specialization in Libras. That would improve their chances of adaptability, thus making them more versatile and opened to more job opportunities."

As professionals, nurses play a fundamental role in inclusiveness facing a scenario in which communication barriers between them and deaf patients are real. Therefore, it is imperative to overcome such reality. In doing so, it is relevant for nurses know and value the Brazilian Sign Language, a tool which must be present in every healthcare practice and action, being it on prevention, protection or healthcare recovery (Brito & Lavareda, 2015).

Student I described the importance of the practical nursing, which is responsible for care. They also brought up a question of the importance of having quality communication as basis for the profession. It is observed when they state that:

"Nursing is responsible for the practice of care and, for that to happen as imagined and equally to all, it is required that the professional to be apt to deal with every kind of patient and their singularities. Therefore, knowing communication is of the basis for good practice in this career (because it's by it we come to know patients and meet their needs), it is necessary we know this Libras language in order to narrow the gap between us, nurses and deaf patients."

The best closure for our strategy analysis, which targeted to sensitize nurse students, came from the final conclusion of one of them:

"The present assignment was an enriching activity, which allowed us to access new and needed content. Besides, it allowed us a unique opportunity to make us

more capable professionals, coherent with the ethics of our profession and ready to assure the civil rights established by law to our patients."

Final Considerations

Inclusion of deaf people has become an important debated topic in the present time (Huyck et al., 2021). Some articles, including some from Otoom and Alzubaidi (2018), highlighted the potential of prototype assistive devices to bridge communication gaps for Deaf/Hard of hearing individuals, allowing them to access and comprehend content delivered through mobile streaming videos. The combination of real-time translation, attention-based feedback, and eye-tracking technology holds promise for enhancing communication and engagement in this community. Notwithstanding, it is still a great challenge to be overcome within healthcare services, despite the ongoing laws to assure full healthcare access to these people, especially in Brazil (Gomes et al., 2017). Thus the communication between the deaf patient and healthcare professionals is an issue that has been leading to significant loss in quality of life of this group and that should be a continued concern and a demand to attend for the health professionals (Silva & Bordas, 2020; Huyck et al., 2021).

This study consisted of an experience report of nursing students when making part of the development of a mobile *app* targeted to attend deaf people. It was possible to conclude that, from the reports observed, the proposed activity was rather challenging to them. However, it turned out to be a differentiated educational tool which is corroborated to be a greater student commitment, as well as for improving their knowledge on the needs of healthcare treatment for deaf patients.

Not only this experience contributed for students to realize the difficulties deaf people when they try to access healthcare services but also to make feasible for students to comprehend how possible and important it is to develop strategies aimed at reducing differences and inequalities to access information and correct healthcare treatment for the deaf public. It was clear that the activity was able to raise the students' awareness for the importance and benefits of informatics technology and communication tools may be brought to healthcare and to inclusion.

It is important to highlight that this study did not require from students knowing Brazilian Sign Language (BSL) in advance. However Brazilian professionals have learn the BSL basic level and it was possible to observe that, after experiencing the difficulties the task demanded, some students felt somehow motivated to change their views towards the necessity of learning this sign language to improve their skill on offering healthcare treatment to deaf people.

Although the apps allowed awareness and communication, the perception that health professionals may help on BSL signaling on health area together with deaf community in the near future was also achieved. Interesting enough, studies are still needed to address educational practices for other groups of future health

professionals, such as physiotherapists, doctors and dentists, Thus, the strategy described herein can be helpful on academic formation of different health professionals so deaf patients may have a fair access to the health system similar to the hearing people.

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Conflicts of Interest

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

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