

# The Use of Computational Artifacts to Support Deaf Learning: An Approach Based on the Direct Way Methodology

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**Abstract.** Deaf users face various difficulties accessing the Web. These difficulties are frequently due to low skills on written language, which is a consequence of approaches that do not favor appropriate methods such as bilingual literacy. This method make use of sign language skills to teach a second written language. In this paper, we present studies with deaf students that explore the direct way methodology articulated with computational artifacts aiming to promote the bilingual literacy. This article presents 10 meetings where we performed learning activities with 3 teachers and 12 deaf students. The objective was to apply our approach to improve the reading and writing skills on Portuguese language, as a second language. The studies point out positive results, and the possibility of exploring this approach from the early years of child literacy.

**Keywords:** Web accessibility · Deaf accessibility · Deaf literacy · Direct way methodology

## 1 Introduction

Deaf literacy challenges and barriers have been addressed by various studies [2, 6, 8]. Such challenges and barriers are related to numerous issues, which occur even when the deaf students are immersed in a bilingual context (i.e., when the first language is a sign language – L1 and the second language is a written language – L2).

A key issue is the adoption of inappropriate bilingual education strategies, which are mostly guided by listeners teaching contexts (i.e., in alphabetization principles) [11]. Principles of alphabetization based on the phonetics are indeed not suitable for deaf learning, which must be based on their own literacy context [2, 5]. Although this is highly accepted, there are many open questions related to deaf literacy methods, such as: “Are there methods able to promote fully literacy skills on deaf student?” and “Could deaf students to become critical readers?”

Our hypothesis is that the answers to these questions are “yes”. Thus, we based our proposal on previous studies [2, 5], as well as the “direct way” literacy methodology. This methodology was proposed by the French Reading Association (AFL- *Association Française pour la Lecture*) aiming to educate *critical readers*. It has the objective of goes “from the message to the code” as argued by Foucambert<sup>1</sup>. This methodology has been applied on French schools for more than 40 years and it has proven results in acquisition of a second written language by foreign students [4, 11, 12].

Previous studies adapted and experienced the “direct way” methodology in the context of deaf literacy on L2 [3]. Thus, this article has two goals that complement existing studies: (1) to validate the application of the “direct way” methodology in the context of adult education, aiming improve their understanding on L2. In our case, the Portuguese language is learned by lessons explained using Brazilian Sign Language – Libras (L1); and (2) to explore the potentials of computational artifacts (e.g, Websites, portals, blogs and text editors) for boosting literacy activities using the direct way.

Aiming to achieve these goals, we conducted a qualitative and exploratory study with the participation of 12 deaf students aged from 12 to 29. This study was held during 8 meetings with students and 2 meetings with a teacher targeting to elicit and prepare the activities and artifacts used in the study. The students had various levels of education (from elementary to graduated), all of them use Libras as first language (L1) and Portuguese as second one (L2), 5 of which also oralized. Two bilingual teachers participated of the meetings, both with proficiency certification in Libras and large experience in teaching deaf. The practices were structured according to five principles proposed by the “direct way” methodology.

As a result, we systematized a set of literacy process issues grounded on the practices with the students. This process is described in the article and the perspectives of application of this process in a long term project are also discussed. We considered difficulties, limitations and challenges of applying this process in regular activities of the Deaf Service Center of Amapá state, Brazil.

The work is structured as follows: Sect. 2 presents the theoretical background and related work including the direct way methodology and web accessibility issues and methods; Sect. 3 describes the activities with deaf users, including the participants, artifacts and procedures; Sect. 4 presents the interpretation of the results, discussions and limitations; and, Sect. 5 concludes the paper.

## 2 Theoretical Background and Related Work

In this section, firstly, we present the importance of the Sign Language as a mediating tool for the acquisition and improvement of written language skills. With this objective, we investigated new perspectives for bilingual literacy aiming to amplify the reading and writing autonomy of the deaf. In order to achieve this objective, we explored the “direct way” methodology, which proved positive in previous studies [4, 10]. In this

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<sup>1</sup> [http://www.lecture.org/ressources/anglais/from\\_message.html](http://www.lecture.org/ressources/anglais/from_message.html).

sense, we argue that the direct way methodology can be explored with Web accessibility concepts and tools.

### 2.1 Direct Way Methodology

As mentioned before, the direct way literacy methodology was proposed by AFL with the objective of educate critical readers working on texts in a systematic way in order to “go from message to code”. A code is classified as a graphic [9] or orthographic. The students have access to graphic resources of a book by understanding the written messages.

This methodology aims to explore the text in the following aspects:

- The organization of the text (*e.g.*, genre, articulations, structure, ...), besides its relations with other texts (*e.g.*, references to others books, ...);
- The grammatical structures (*e.g.*, organization of sentences, punctuation, grouping of words, expressions, order, ...) and the effects produced by grammatical changes in the expressions;
- The words, including lexical fields, sonorities, meanings, functions, spelling, transformation, family, constructions and synonyms, to cite some [1].

This methodology purposes to deeply explore texts making the readers to acquire researcher’ skills [1, 5]. Including, for instance, the abilities to develop hypotheses, to identify provisional rules, and to compare them with other texts to validate them [5].

Thus, in the direct way methodology, the reading process is considered as a model that supposes the permanent interaction between the reader’ previous knowledge and information presented in the text (Fig. 1). Razet emphasize that “the objective, when

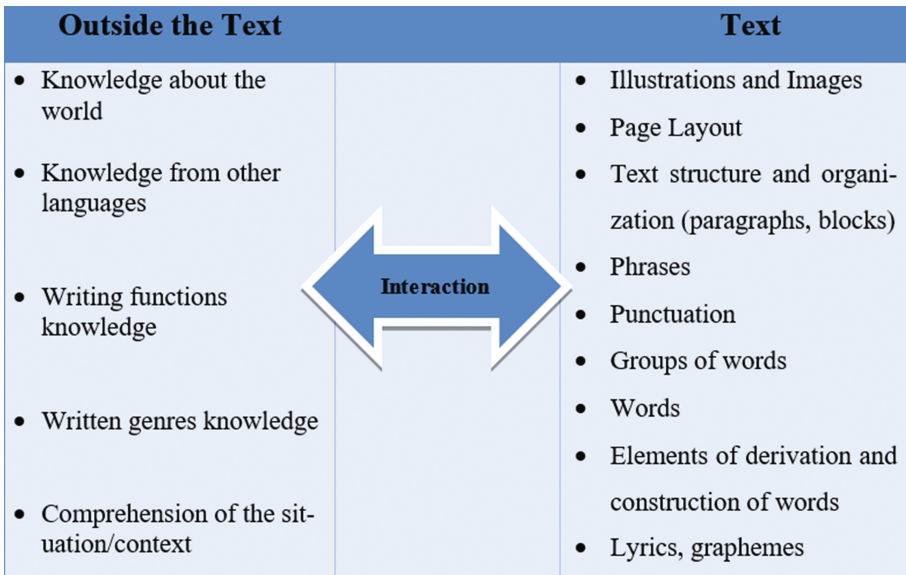


Fig. 1. Elements of interaction between outside and text zone (Based on [1])

presenting the text, is to make the students realize that there is, in the act of reading, a constant interaction between the information coming from the reader and the information contained in the text itself” [12:75].

Regarding the selection of texts to be worked on the learning activities, the AFL [1] stresses that they should not be produced to be a text for “learning to read”, but rather, texts should be produced as writing work (in physical or virtual medium). These texts can have, for instance, content about the students’ social context, news, among other contents that have a relation with all the areas the life of the students. The teacher should produce or select text that stimulate the contact with the everyday use of written language, for instance: personal letters, forms, tickets, news, culinary recipes, package inserts, comic books, shopping list, restaurant menu, e-mails, computer chats, virtual classes, among others.

## 2.2 Web Accessibility

In this work, literacy issues are articulated with web accessibility issue, we studied how the literacy can affect the accessibility, as well as how literacy can make the Web more comprehensible to deaf people [7, 10]. According to Shneiderman (2000), universal usability aims to allow access to information to the largest number of possible users on the Web. The interfaces should provide accessibility to different types of users, as a way to guarantee access to information and services available on the Web [13].

Accessibility on the Web means that people with disabilities in fact can perceive, understand, navigate and interact in addition to being able to contribute to the Web [7]. Consequently, with the objective of making the Web accessible, W3C’s Web Accessibility Initiative (WAI)<sup>2</sup> published three guidelines as follows:

- Web Content Accessibility Guidelines (WCAG) that contains criteria to make Web content accessible to people with disabilities;
- Authoring Tool Accessibility Guidelines (ATAG) that focus on Web content authoring tools making them more accessible to authors with disabilities and supporting the production of more accessible Web content;
- User Agent Accessibility Guidelines (UAAG) that focus on how developers can design user agents that make web more accessible to people with disabilities.

The WCAG 2.0 specification includes four principles that provide the foundation for Web accessibility: 1. Perceivable – including 4 recommendations (text alternatives, time-based media, adaptable and distinguishable) on how to make content perceivable to all (it can’t be invisible to all of their senses), 2. Operable – including 4 recommendations (keyboard accessible, enough time, seizures and navigable) on how to make components and navigation operable, 3. Understandable – including 3 recommendations (readable, predictable and input assistance) on how to make information and operation understandable, and, 4. Robust – including a recommendation

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<sup>2</sup> <http://www.w3.org/WAI>.

(compatible) on how to make content robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies.

In the specific case of deafness, the W3C proposes solutions such as to have text equivalent to audio content. Other complex techniques, such as the use of avatars are also present in the literature. These type of recommendations and techniques are useful, however the deaf still faces difficulties in reading texts and interacting on the Web, demanding design from methodologies that make use of the existing solutions to fit their needs [7].

This work make use of the bilingual literacy philosophy by means of Direct Way methodology mediated by accessible computational artifacts. The long term objective is to propose a new method for providing a full learning of the Portuguese language, in order to make the deaf able to read and write fluently in a written language (L2) as well as to explore these abilities to access information and interact on the Web.

### 3 Studies with Deaf Users

We report 10 meetings with deaf users and teachers held at the the Deaf Service Center CAS (Centro de Atendimento ao Surdo) in the city of Macapá, state of Amapá, Brazil. The first two meetings were conducted only with the three teacher of the CAS. The first teacher is a listener, hold graduation degree in pedagogic, had 48 years old and is fluent in LIBRAS. The second teacher is deaf, hold graduation degree in pedagogy, had 43 years old and is fluent in LIBRAS and lip reading. The third teacher is deaf, hold graduation degree in pedagogy, had 51 years old and is fluent in LIBRAS and lip reading.

The center had 12 deaf students enrolled, being 6 students in the morning and 6 students in the afternoon. The students had between 12 and 29 years, being 4 female and 8 male. Considering their educational levels, two participants held university degrees, while the others are high school or elementary school students. All students have profound hearing loss (legally considered deaf) and are able to do lip reading. Sign language is used by all students.

The classes take place twice a week, the listener teacher give classes in both periods, one deaf teacher take turn in the morning and the other in the afternoon. So, there were always two teachers (a listener and a deaf) in a class of six students. For the research activities, the class was divided into groups of 3 students each, as they do activities with psychologists and speech therapists.

The objective of the two initial meetings were to plan the next teaching/learning meetings, making an evaluation of the context and preparing the artifacts to be explored in practical activities with the students (that took place from the third meetings). In the following paragraphs, we describe the scope of each meetings, including the planning meetings (1 and 2) and the meetings developed with students in sequence.

#### **MEETING 1 (Planning Meeting)**

*Participants:* 3 teacher and the researcher

*Duration:* 2 h

*Objectives:* The objective was to prepare an agenda for the next meetings and decide key themes to be work during the practical activities.

*Developed Activities:* After an initial group discussion, the participants investigated (using the Web and their own experiences) alternatives to define an activity and theme that is accessible to all students. Thus, in this meeting the participants decided that the theme to be explored would be “HEALTHY FOOD”. They agreed that this is a broad theme, with easy access to Web content by teachers and students, and this was considered a topic of general interest.

It was also of common agreement that deaf students already had prior knowledge about this theme, and, consequently, this theme could be explored in various types of activities. It was decided that during the meetings that teachers could also emphasize the importance of creating healthier eating habits from the adolescence to have a healthy old age.

## **MEETING 2 (Planning Meeting)**

*Participants:* 3 teacher and the researcher

*Duration:* 3 h

*Objectives:* Design of the practical activities.

*Developed Activities:* At this meeting, the participants divided the activities to be worked on in the following 8 meeting. For the participants (teachers and researcher), it was clear that the focus should be to provide collective learning opportunities, by means of an organized writing practices, exploring a vocabulary in Libras (L1) and Portuguese Language (L2) including texts and content Web. Therefore, making use of various artifacts related to the same theme, including various content sources such as blogs and websites. The participants decided that the students would use mobile devices to perform the proposed activities.

The group also decided that for a better efficiency of the activities, 3 students should participate in each activity at a time. The participants also defined the document set that should be explored in each activity. Each of the planned meetings should had the maximum duration of 30 min.

## **MEETING 3**

*Participants:* 2 teachers (a deaf and a listener) and 3 deaf students

*Duration:* 30 min

*Objectives:* Practice reading and evaluating the use of unfamiliar words

*Developed Activities:* Firstly, the teacher read a text in Libras, while each student received a copy of the written text. This text was selected on the web, and synthesized, using a text editor, and then printed by the teachers. After, the students expressed their concerns about reading the text, consequently, the difficulty of the participating students with the written Portuguese language was made explicit in this meeting.

## **MEETING 4**

*Participants:* 2 teachers (a deaf and a listener) and 3 deaf students

*Duration:* 30 min

*Objectives:* Explore other types of artifacts and content

*Developed Activities:* Firstly, each student should report what they normally eat in their houses using sign language. The teacher explained the need to have healthy meals. They stressed the necessity of eating various types of food. Then, the teachers wrote on the board the foods mentioned by the students, and they cut out the foods from



**Fig. 2.** Pictures of Meeting 4

textbooks (left side of Fig. 2) to make a poster (right side of Fig. 2). They also did web searches using their mobile apps.

### MEETING 5

*Participants:* 2 teachers (a deaf and a listener) and 3 deaf students

*Duration:* 30 min

*Objectives:* Construct a glossary with the words of the presented texts

*Developed Activities:* Firstly, the teachers searched on the web text related to the theme, formed it in a text editor, and printed. Then, the teachers gave to the students another text about healthy eating and they were asked to mark the words they already knew. The idea was to build a glossary with them. The student should verify the words with highest occurrences in the text. In addition to exploring the text, the teacher also explained in Libras the importance of having a healthy and balanced diet. Each food mentioned by the students would be written on the board. Then, with the objective of creating a glossary in Libras and Portuguese, the students cut out the words from the text, and fixed them in their exercise books.

### MEETING 6

*Participants:* 2 teachers (a deaf and a listener) and 3 deaf students

*Duration:* 30 min

*Objectives:* Verify the vocabulary extension (words about foods) of the deaf students knew in Portuguese and Libras

*Developed Activities:* This meeting focused on working the Food Groups (Cereals, Milk, Meat, Fruits and Vegetables). Each student should choose in a piece of paper with the name of a food and classify it in a group of food. In addition, to verify the students' vocabulary, this meeting also aimed to improve the awareness about the need of eating healthy foods. In sequence, the students did search on the Web in group, and then they synthesized the recovered content in a text editor, printed it and discussed with other students (Fig. 3).



**Fig. 3.** Teachers during the meeting 6

### **MEETING 7**

*Participants:* 2 teachers (a deaf and a listener) and 3 deaf students

*Duration:* 30 min

*Objectives:* Explore the selection of foods for a meal, associating the food names (written) with meals types

*Developed Activities:* In this meeting the students had to set meals menu. The teachers had 4 meals options for the students: breakfast, snack, lunch and dinner. The student should choose the foods written in piece of papers and compose the foods to constitute a healthy meal, i.e., the students selected small number of foods for the meal from an extensive list. After that, using a text editor, they printed their meals and presented to the others. The teachers made videos of this meeting and sent to the students at the end.

### **MEETING 8**

*Participants:* 2 teachers (a deaf and a listener) and 3 deaf students

*Duration:* 30 min

*Objectives:* Practice words learned from past activities





**Fig. 4.** Picture of the teacher explaining the activities of meeting 8

*Developed Activities:* This meeting (Fig. 4) initiated with reading another text about healthy eating. The text was selected on the web and printed. Each student had to explain what (s)he understood. The teachers did not aid the students to read, they focused on verify the words learned in the last meetings and the words that were not assimilated. At the end, the teachers explained to the students the unfamiliar words.

### **MEETING 9**

*Participants:* 2 teachers (a deaf and a listener) and 3 deaf students

*Duration:* 30 min

*Objectives:* Check which words were learned from past activities

*Developed Activities:* The teacher prepared a set of foods written on pieces of paper and collected pictures of these foods from the Web. The students cut the names and pictures and placed them together. The teacher also presented Web images that could be explored by the students.

### **MEETING 10**

*Participants:* 2 teachers (a deaf and a listener) and 3 deaf students


*Duration:* 30 min

*Objectives:* Explore the written form of the Portuguese language

*Developed Activities:* In meeting 8 the students received a homework, whose results were used during meeting 10. The teacher asked to the students to take note what they eaten in the main meals. The teacher digitalized the annotations (Fig. 5) and shared on a Web driver. They were also printed and distributed to the students during the meeting. After, each student presented the food that they eaten to their colleagues, explaining each kind of food they eaten, the groups of foods and whether the food is healthy or not.

Escola: CB-3  
 Data: 13/12/2016 Turma: ESCOLAFUNCAO.COM  
 Aluno: Darciana da Silva Santana

**PSICOLOGIA**  
 A IMPORTÂNCIA DA QUALIDADE DA ALIMENTAÇÃO NO DESENVOLVIMENTO DA CRIANÇA



- Pedir para a mamãe, durante três dias, anotar tudo o que você come, inclusive todas as balas, chocolates, sucos artificiais e refrigerantes.

**Segunda**  
 manhã café de pão come  
 tarde carne de galinha  
 noite mago da come

**Terça**  
 manhã café de pão come  
 tarde carne de come  
 noite banana de come

**Quarta**  
 manhã  
 tarde  
 noite

Observação: na rodinha, o professor junto à turma deve fazer a avaliação de cada criança, para ver as condições alimentares relatando a ingestão de alimentos com produtos naturais: frutas, legumes e sucos, em vez de chocolates, sucos artificiais e refrigerantes.

Fig. 5. Example of Students' meals annotations

## 4 Results, Discussions and Limitations

The analysis of the results pointed out that the major difficulty that the students faced on this study was their limited vocabulary in Portuguese and Libras. The teachers realized that the students do not know the various synonyms of a word. For example, during the meetings they frequently recognized a fruit, but they did not know how to writing the name and even the sign in Libras.

The main limitation of this study is the number of students, since today there are only 12 students enrolled in the center, divided in two classes, one in the morning and the other in the afternoon. However, the groups of 3 students each contributed to carry out the activities in a faster and efficient way. This small groups was also important to provide a closer relationship with the students. According to the teachers, in initial observation with groups of 6 students the students were agitated. The teachers had concerns that the activities with “many” students would be more time consuming. The limit of 30 min was also important to guarantee a good development of the activities, as they had other classes in the same day, and consequently long meetings could reduce the motivation and concentration of the students in the activities.

Some simple words such as “vitamin” were not recognized by the majority of the students. In this case they usually knew the some fruits has vitamin, but they were not aware of that our body needs vitamins. For instance, when the teacher questioned about the word vitamin in a text about the benefits of the vitamins, the student reposed:

“I make this at home sometimes, I put some fruit and milk” (referring to fresh fruit mixed drinks with milk). So, the teacher requested that they should search on the web (using their mobile) word “vitamin”. They explored the results in the classroom, and only after this the teacher explained in Libras the need for vitamins for health.

The teachers do not reported difficulties in using technology devices. They use technological devices in their daily lives, for example all students had a mobile phone and used common mobile applications.

According to the teachers, the students had difficulties in memorize the meaning of a new written word: “When we teach a new word they can not memorize its meanings, and always forget it in a short period”, this reinforce the need to practice in several forms the same word, including situations of their daily lives, as proposed by the direct way. For instance, the teachers noticed that the students could understand better the text during the 7th meeting. As mentioned before, they set meals menus based on healthy foods, avoiding industrialized products. This is contextualized in your daily experiences, for instance, a student said “I frequently eat sweet cookies at dinner, can I do this?”, the teacher interacted with the student explaining “You can do this sometimes, but not every day, because this is not healthy”.

Finally, at the end of the meetings, the researchers asked to the teachers stress five important points learned from the meetings, which can be synthesized as follows:

- Deaf students were interested in using technology in the classroom, they considered that technology resources make classes more productive and interesting;
- The use of computational resources are well accepted by the teachers too;
- The purpose of the texts explored in the activities were understood by all the participants;
- The methodology was applied in a productive way;
- The methodology needs to be explored on gradually and continuously way.

## 5 Conclusion and Future Work

Nowadays, the literature presents some useful Web accessibility alternatives for deaf users. However, they still find barriers related to difficulties with the written language (L2). In this article, we use the direct way methodology of literacy mediated by accessible computational artifacts, to support teaching L2 to deaf students. The objective is to improve reading skills and provide full autonomy in accessing information on the Web.

The practical activities with deaf students produced positive results. The general propose of the meetings were properly understood, and the deaf students also understood the importance of eating healthier (secondary objective). Teachers also stressed that the methodology is very productive, and it needs to be explored on gradually and continuously way. Thus, for more consistent results, it should be applied in a continuous learning process in a longer term program. As the next steps of this research, we propose to explore the approach to teach the syntactic and semantic structures of the Portuguese language (L2).

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