PRIOR KNOWLEDGE ABOUT SCIENCE FROM DRAWINGS BY A GROUP OF DEAF STUDENTS

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Abstract

The construction of a concept can be developed from the students' prior knowledge. Regarding deaf students, it is considered their conceptions conceived through vision. Given this, the present research was conducted with a group of deaf students in the 7th year of elementary school with the aim of verifying what ideas these students had about science. The research was carried out with a qualitative approach, using action research. For data collection, an activity was proposed with the elaboration of drawings, carried out in three stages: (1) initial conversation and elaboration of the drawings; (2) explanation of the drawings (in Libras); (3) closure of the activity. Drawings were prepared, speeches (in Libras) transcribed and notes from the logbook were used for analysis. The analyzed data revealed three categories in which students conceived decontextualized views, also demonstrating a distance from science and applications in everyday life. In relation to the visuality of the deaf student, the difficulty was evidenced in selecting and interpreting the various information that was conveyed around them.
Keywords: *deaf student, qualitative research, prior knowledge, science education*

Introduction

In science education, the construction of a concept can be developed from the students' prior conceptions (Carvalho, 2013; Driver et al., 2007). It is believed that science education can play an essential role in the formation of critical and aware citizens facing scientific challenges (Briccia & Carvalho, 2011; Cachapuz et al., 2011; Gil Perez et al., 2001; Lamanauskas, 2009; Pozo & Crespo, 2009).

Moreover, the World Conference on Science for the 21st Century, sponsored by United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Council for Science, has reinforced the need to establish a dialogue between the scientific community and society, as a way to provide science education (Budapest, 1999). According to this document, scientific education enables us to act ethically and cooperatively within our own spheres of responsibility, thus strengthening scientific culture and its applicability.

In view of this, inclusive education has also mobilized many countries to seek equity in the process of teaching and learning for students with special educational needs. In this regard, the World Conference on Special Education, organized by the government

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of Spain in cooperation with UNESCO, held in Salamanca in 1994, brought together 88 governments and 25 international organizations, including Brazil, which made a commitment to the education of people with disabilities, in this sense, assuming that inclusive school meets the needs of all (Salamanca, 1994).

Regarding the deaf student, the linguistic specificity is considered, in this case, sign language. In Brazil, the Brazilian Sign Language - *Libras*, was approved by law 10436 of 2002, and subsequently, by decree 5626 of 2005, this document reinforces the principles of inclusive education, ensuring linguistic recognition to the deaf, having *Libras* as his first language, and Portuguese as a second language in its written modality.

However, despite the legal backing, *Libras* is little known by the hearing community, highlighting the need for dissemination of the language to reduce the communication barrier. For Skliar (1998), the deaf are part of a minority group, inserted in an oral-auditory society. According to Quadros (1997), Brazilian Sign Language is a language that develops spontaneously where the deaf community lives.

Particularly, science teaching in deaf education shows gaps in the teaching and learning process, such as teacher training, the development of accessible materials, the absence of signs in *Libras* in scientific terminology, the lack of knowledge of the language by teachers, as well as the role of interpreters in the classroom (Gomes & Catão, 2022; Pereira, et al., 2022; Santana, 2021; Souza & Silveira, 2011). However, there are few studies that address the theme, demonstrating a little-explored scenario.

However, in general, it is common for students to present a stereotyped view of science. Pozo and Crespo (2009), have pointed out that students are bombarded by several sources from the media, producing an informative, superficial, and deformed saturation of the scientific nature. In this same direction, Arroio and Farías (2011), Gil Perez, et al. (2001), Mello and Rotta (2010), and Reis, Rodrigues and Santos (2006), have also evidenced these misconceptions, decontextualized, and even caricatured about science and/or the scientist coming from information obtained by TV, magazines, newspapers, textbooks, internet, among others. From this perspective, the views of science that students bring to the classroom may be linked to the information that surrounds their daily lives (Briccia & Carvalho, 2011; Cachapuz et al., 2011). However, for the deaf student, the opportunity to discuss this information is not always given to them, due to the language barrier, in fact, it is assumed that his/her perception of the world occurs through vision and the visuospatial modality of sign language (Campello, 2008).

Pereira, et al (2022), has argued that learning mediated by vision enables the learning of deaf students. In this same direction, Brito (2010), has stated that through sign language it is possible for the deaf student to build concrete and abstract knowledge, such as science for example. Locatelli et al (2010), have believed that visualizations (graphics, images, videos, for example) enable the student to become metavisual. Thus, this study aims to verify the conceptions that deaf students have about science, considering their perception of the world through visuality. For this, the research was guided by the following question: What are the ideas that a group of deaf students from a bilingual municipal school have about science?

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Research Methodology

General Background

This study is part of the doctoral research (in progress) about science teaching in deaf education. It is a qualitative approach (Stake, 2010) of the action research type, in which "researchers play an active role in solving problems encountered, monitoring and evaluating the actions triggered by the problems" (Thiollent, 2011, p. 21). This work, specifically, represents the initial phase of the research, considered of paramount importance for a course still under development. Participated in this research, five 7th-grade students of a public school of the municipal network of São Paulo that serves exclusively deaf students, called Municipal Bilingual School for the Deaf (EMEBS), in this case, a teaching based on two languages *Libras*/Portuguese.

The activity was carried out in two science classes following three steps: (1) initial conversation, and elaboration of the drawings, (2) explanation of the drawings, (3) closing of the activity. It is important to emphasize that all steps were conducted in sign language. It is also noteworthy that the records analyzed in this initial study will provide subsidies for the elaboration of an investigative teaching sequence to be developed during the doctorate.

Sample

The research setting, located on the east side of São Paulo, Brazil, allowed an immersion in the group, as well as obtaining a more accentuated view of the participants. The choice of the bilingual context was due to the opportunity to verify linguistic, identity, and social particularities since Libras is still not widespread in society. The uniqueness of this group dialogues with broader debates on inclusive education with the training as scientifically active citizens in the social sphere.

Five deaf students participated in this study: Marina (14 years old); Fernando (12 years old); Gustavo (14 years old); Ricardo (13 years old) and Rita (13 years old), whose fictitious names guarantee ethical precepts. All participants are children of hearing parents and had access to *Libras* in the school environment, according to a previous interview.

Instrument and Procedures

For data collection, we used as instruments, the drawings made by students, the video recordings with the students' explanations of the drawings (in Libras), and the records made in the logbook. For the initial conversation step (how do you imagine science?), the students were organized in a circle in order to facilitate the visualization of sign language. Next, the students were stimulated to represent their ideas by drawing a picture, and then the explanations occurred individually. In the closing stage, all the steps were systematized.

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Data Analysis

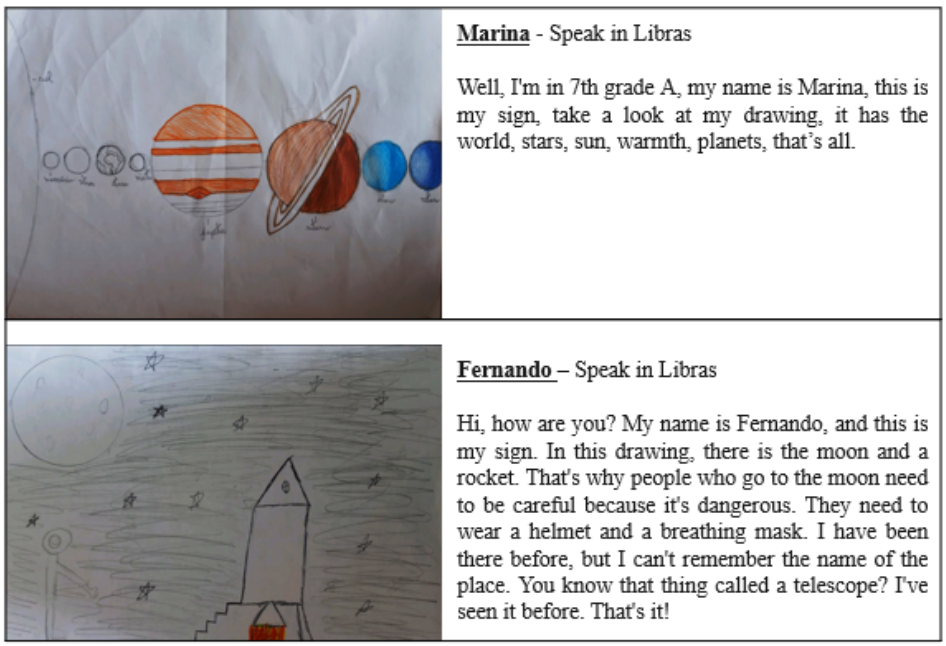
For the analysis of the obtained data, Bardin's Content Analysis was chosen, as it is a set of well-defined techniques and procedures, considering pre-analysis, material exploration and treatment of results, inference, and interpretation of material (Bardin, 2011).

Research Results

The results presented were based on the drawings elaborated by the students and on the transcriptions of the videos (in *Libras*). From this, data were grouped based on the similarity of ideas, resulting in three groups, as shown in Figures 1, 2, and 3.

Figure 1

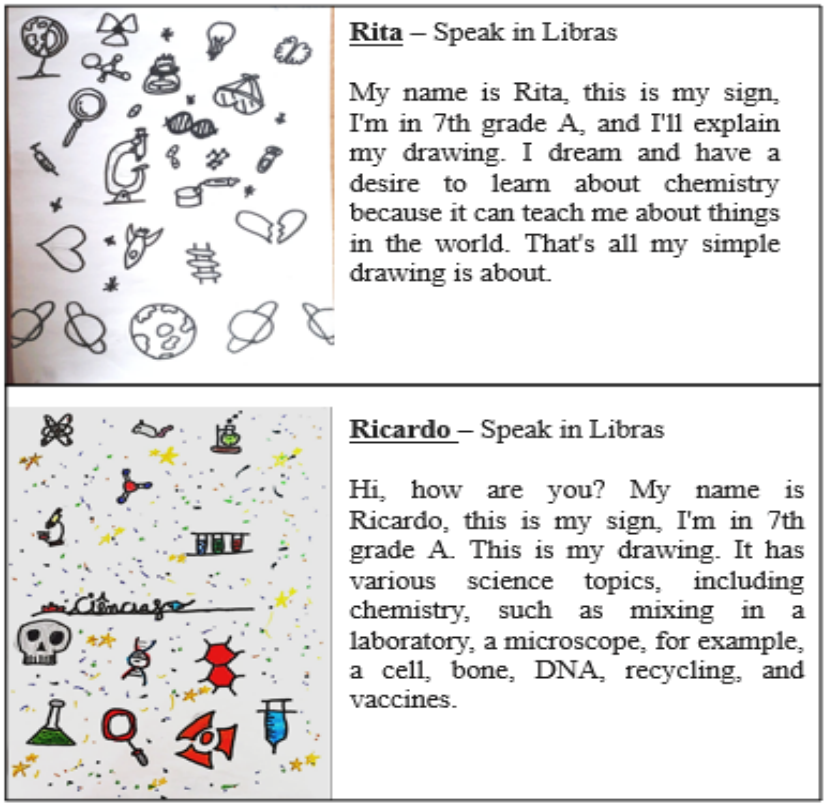
Drawings and Transcript of the Speech (in Libras): Students Marina and Fernando



Note: The authors

Figure 2

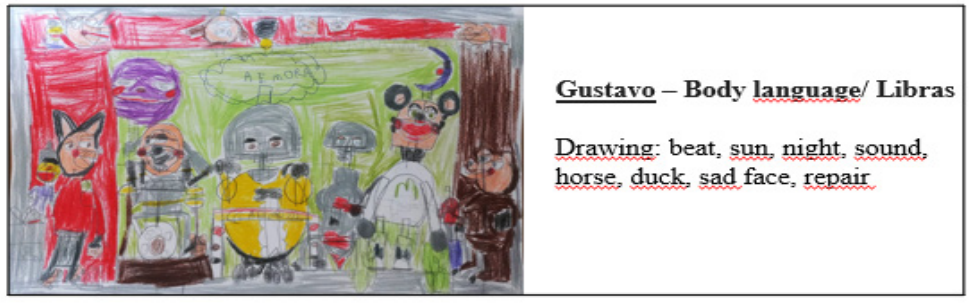
Drawings and Transcript of Speech (in Libras): Students Rita and Ricardo



Note: The authors

Figure 3

Drawings and Transcript of Speech (Body language/Libras): Student Gustavo



Note: The authors

Discussion

Category 1 – A Planetary-Spatial View

In this category, the drawings of the students Marina and Fernando (Figure 1) resemble each other in terms of ideas related to the planetary system and the presence of humans in space. Thus, it can be observed that the students revealed a spatial sense of science. However, some individual elements stand out as described. Marina presents the solar system, demonstrating attention to the dimensions and shapes of each planet, but her explanation was vague and disconnected.

Regarding Fernando's drawing, ideas related to science in the spatial context are also observed, such as the moon, the rocket, and the human figure (scientist/astronaut). The student demonstrated a conception of science in terms of "discovery", in this case, "the man who went to the moon", pointing to the work of scientists as something dichotomized from the nature of science (Arroio & Farías 2011). In Fernando's sign language speech, he emphasized some equipment for human safety on the moon (helmet, mask, for example). Thus, Fernando's drawing pointed to an elitist and individualistic thinking of the scientist's work, as isolated geniuses from social life (Gil Perez et al., 2001).

Finally, the student reported that he was inspired to create the drawing by a visit to a certain place (museum, science fair, perhaps), whose name he had forgotten. At this place, Fernando was able to visualize (he signals a telescope) this imagery reference, which for him is linked to science. The influence of these means on concept formation for students, in general, is noteworthy (Arroio & Farías, 2011; Pozo & Crespo, 2009). However, Locatelli and Arroio (2010) emphasized the use of visualizations (in the sense of the student becoming a metavisual one) as an opportunity in a more critical learning process. Considering the linguistic specificity of deaf students, the communication barrier in a predominantly hearing society may limit identifying and discussing the concepts brought by them to the classroom (Skliar, 1998).

Category 2 - A Science Mediated by the Internet

This category corresponds to the results of Figure 2, drawings by students Rita and Ricardo, where both had a similar action. At the beginning of the activity, they were quite insecure about drawing, so both students asked (first Rita, then Ricardo) if they could consult the internet on their cell phones, as they claimed to have difficulties in drawing. As it was an exploratory activity, the students were allowed to consult the Internet.

Both Rita's and Ricardo's drawings brought several very similar elements. The students copied symbols and images that alluded to their respective research. It is not known for sure which/how many sites were accessed; however, it was observed that they used the term "science" as a keyword when conducting their search. In fact, in Ricardo's drawing, the term appears with the drawings. As is known, nowadays, information is accessible and occurs very quickly, as seen in the example of Rita and Ricardo. However, regarding the nature of science, studies have revealed that this information

often attributes inadequate meanings to science (Arroio & Farías; Mello & Rotta, 2010; Reis et al., 2006).

The replication of the images represented in the drawings of these students was obtained through the visual channel, that is, the way deaf people perceive the world (Campello, 2008). Because they are inserted into a society full of information, they are also exposed to informational saturation (Pozo & Crespo, 2009), which is sometimes incorrect. Therefore, it is essential to reflect on how deaf individuals access the information that circulates in society as an opportunity to select and interpret the various media information, given that it is still a poorly disseminated language (Quadros, 1997).

For example, Rita explained that she is interested in learning more about the world through chemistry/experiments. Thus, there is an interest on the part of the student in understanding this scientific universe. However, in the drawing, there was a broad range of various areas, again suggesting an excess of information and a very generalized view. Specifically, in science education, Gomes and Catão (2022) have warned about gaps in the teaching and learning process in mediating scientific concepts in the interface with *Libras*.

In Ricardo's drawing, as well as in his sign language speech, the elements "vaccine" and "recycling" appeared, demonstrating a brief application of science in society but in a very succinct way. In light of this report, there is a need to discuss the applications of scientific knowledge as well as human activity in relation to nature. In addition, this moment can be an opportunity to break with misconceptions (Cachapuz et al., 2011).

Category 3 - An Atypical Drawing

The analysis of this category was based on the drawing of student Gustavo (Figure 3). This drawing represented an atypical production. As observed, the student brought figures that alluded to game characters, which according to reports from classmates, the student commonly does. Thus, there is no evidence that the student understood the activity guidelines or preferred to draw what he was already used to, so this category is considered atypical.

In this sense, the data reveal evidence that needs to be further studied, which will be done later, since this article is a preliminary study about the initial ideas of the students, which enable future planning and actions (Briccia & Carvalho, 2011). In addition, it is worth noting that Gustavo is 14 years old, his first contact with *Libras* was at the age of 7, and he joined this research school one year ago.

From the transcription (Figure 3), the term "body language/*Libras*" is observed. This initial and exploratory inference occurred due to the way the student explained his drawing, that is, Gustavo used random gestures (sun, horse, night, sound, fix, for example), which were expressed in an isolated way without referring to the drawing. In this regard, Quadros (1997) stated that language develops in the community where deaf people live. In this sense, it is believed that the student is still in the process of linguistic development.

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Conclusions and Implications

The need to promote a scientific education that can contribute to the formation of critical and participatory citizens in issues related to science and its application in society is notorious. However, the results obtained in this study revealed that students, in general, present a distance from scientific knowledge related to everyday life. Furthermore, it is necessary to disrupt misconceptions, which are often disseminated by information circulating in society from communication media, for example.

Thus, it was observed that information can influence students' conceptions of scientific nature. Particularly, deaf students involved in this research demonstrated, likely, image replication of what they saw on the internet, and visits to science fairs, among other sources, but disconnected from their realities.

It was noticed that *Libras* is still little disseminated in a predominantly hearing society. Thus, there are few spaces where deaf people can interact and discuss what communication media propagate, particularly topics related to science. In addition, the five students are children of non-fluent hearing parents in *Libras*, and according to reports from the students themselves, they communicate mainly with their families, which could influence their life vision.

In general, the categories discussed in this paper evidenced an individualistic and elitist view of the scientist's profession, in this case, a parallel world of the scientific community and scientific education, as well as the relationship between science, technology, and society. In short, identifying these students' ideas about science made it possible to reflect on the education of the deaf, specifically considering this small group. However, this is an exploratory study with some limitations linked to the context and the number of participants. However, the results indicated the need for studies that could deepen the theme presented.

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Declaration of Interest

The authors declare no competing interest.

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