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CHALLENGES OF TEACHING PHYSICS TO DEAF STUDENTS: SYNTHESIZING CONSIDERATIONS IN A COLLECTIVE SUBJECT DISCOURSE

Katia S. Veiga Lamberti

Universidade Estadual do Oeste
do Paraná – Unioeste,
Postgraduate Program in Teaching
Foz do Iguaçu – Paraná
<https://orcid.org/0000-0001-9673-1964>

Reginaldo A. Zara

Universidade Estadual do Oeste
do Paraná – Unioeste,
Postgraduate Program in Teaching
Foz do Iguaçu – Paraná
<https://orcid.org/0000-0002-9946-562X>

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Abstract: Diversity education and overcoming challenges in the classroom are faced daily by the school community, with the education of the deaf being an example of coping. In particular, this work focuses on teaching Physics to deaf students, and the challenges relating to the conceptual complexity and mathematics involved. In the context of Inclusive Education for the Deaf, obstacles in the dynamics between teacher, Libras Interpreter Translator (TILS) and deaf student have been discussed in different literature reviews. The reviews published between 2017 and 2022 constitute the objects of this work, being revisited and analyzed using the Collective Subject Discourse (CSD) technique. When using DSC, the aim is to simplify information, highlight concepts and avoid inappropriate generalizations. The DSC presented here brings together the difficulties in teaching, training, teaching action and structural and pedagogical obstacles, providing a unified discourse on the topic. The research identifies barriers in teaching Physics, failures and successes in teaching proposals, as well as difficulties in learning scientific concepts in Libras. The study highlights the continued importance of research, discussion and reflection on public policies in deaf education.

Keywords: Deaf Education, Physics Teaching, Inclusion

INTRODUCTION

The understanding and expression of physical phenomena related to current technological everyday life encourages teachers who teach the subject to arouse the interest of their students in training. The challenge intensifies considerably when it comes to teaching and learning physics in the context of inclusive physics, which deals with students who have physical, physiological, psychological or social conditions that bring

additional limitations to learning or access to good quality information. In this sense, inclusion in Physics classes imposes challenges on Educational Institutions, educators and professionals who deal daily with the included public, inducing and fostering discussions among Education professionals and scientific research on this topic.

Diversity in the classroom is an undeniable reality, and the inclusion of students with specific needs has become a priority in educational policies across the educational landscape. In particular, this article addresses the topic of teaching Physics in deaf education, highlighting the obstacles and challenges faced by the school community, based on the assumption that teaching Physics presents unique challenges due to the complexity of the concepts, creating an intriguing triad composed of by the Physics teacher, the Libras Interpreter Translator (TILS) and the deaf student.

The present study revisits literature review articles on teaching physics to deaf students, focusing on the difficulties and challenges faced by the aforementioned protagonists, bringing together the main findings of these reviews in the form of a collective subject discourse (Lefreve and Lefreve, 2006). With this, we seek to contribute to the understanding of specific issues related to the teaching of Physics in inclusive education for the deaf, highlighting the importance of research and reflection on current public policies.

In the educational context, the teacher plays a crucial role, since they are the ones who plan, execute and evaluate pedagogical strategies. In the case of inclusive education, for an effective and meaningful curriculum, it is essential to implement adaptations considering the diversity and individuality of students. On the other hand, we are aware that various obstacles, from linguistic, attitudinal and communication barriers, can impact the

learning and participation of deaf students in school activities.

At this point, the role of TILS stands out, as the professional acts as a linguistic-cultural intermediary, translating information between sign language and oral language, allowing deaf individuals to participate in different spheres of society.

METHODOLOGY

The methodology used in this work is literature review. In particular, we seek to understand different aspects of teaching physics to deaf students based on literature reviews already carried out by other authors, in different time frames and using different databases. Therefore, we revisited literature reviews on the topic, published in journals between 2017 and 2022, with the aim of deepening our understanding through the construction of a Collective Subject Discourse (CSD).

The discourse of the collective subject is a qualitative research technique developed by Lefevre and Lefevre (2006), which consists of analyzing statements from open questions, grouping extracts from statements of similar meaning into synthetic speeches written in the first person, as if a collective was speaking.

The DSC can be used to understand the social representations of a given group on a given topic, identifying consensus and dissent within the group, as well as the nuances and variations in social representations. The construction of the collective subject's discourse involves:

- **Data collection:** In general, statements are collected through interviews, questionnaires or other qualitative data collection instruments. In the case of this work, the statements consist of the conclusions drawn by the authors of the literature reviews, as an answer to the proposed research questions.

- **Data analysis:** statements are analyzed using content analysis techniques. In this case, we sought to identify consensus and dissent on themes that appear in the reviews analyzed, organizing the findings into grouping themes.

- **Construction of the collective subject's discourse:** the statements are grouped by similar meaning and, from these groups, the synthesis-discourses are constructed.

The construction of the DSC carried out in this work made it possible to bring together the difficulties in teaching, in the training of professionals, in teaching action and in facing structural and pedagogical obstacles listed in the analyzed reviews, proposing a unified discourse in which the different conclusions are discussed in an articulated way. Thus, the research made it possible to list the barriers encountered by the protagonists in the process of teaching and learning physics for deaf students, observe failures and successes in teaching proposals and perceive difficulties in teaching and learning scientific concepts in Libras.

THEORETICAL FRAMEWORK

The issue of language is especially important when it comes to teaching students with hearing impairment, since communication must be done in the Brazilian Sign Language (Libras) for deaf users of signed language, with the teacher and student not sharing a common language. common language, so that the mediation of a Sign Language Translator and Interpreter (TILS) is necessary. In this case, two main obstacles are observed: there are rare cases of teachers who master communication in Libras and there is little availability of TILS enabled for this purpose. Furthermore, even when available, Libras interpreters do not have knowledge in all disciplines, which can make explanation more difficult. Specifically, for the area of

interest of this text, most of the concepts in physics are very specific terms or terms used in specific conditions, for which there are no equivalents in Libras and which cannot simply be replaced by words in common use in everyday life, since that these can take on a different meaning from the scientific concept that is sought to be addressed.

Although the above obstacles are frequently cited in the literature, other limits and challenges for teaching deaf people are observed. Based on a literature review, Pereira and Mattos (2017) also point out that, in addition to the difficulty teachers have with using Libras in the classroom and communication problems with the interpreter, textbooks fail to meet the desires of students. users and there are a lack of appropriate teaching materials for use by teachers and students. Still in the context of teaching deaf people, Rautenberg (2017) explored the written production published in the Annals of the main scientific meetings that cover the teaching of Physics held between the years 2005 and 2017. Based on the selection of works that connect the Teaching of Physics with Teaching the Deaf, listed the difficulties encountered in the teaching-learning process of the concepts of the Physics subject for deaf students, highlighting the training of teachers with an inclusivist vision, the production of teaching material and teaching proposals, communication between deaf and hearing people, the signs and meanings, the interpreter's performance and the relationship between teacher, interpreter and student as the challenges to be faced in the process of teaching deaf people. Cambuhy and Mattos (2016) point out that when teaching physics in a classroom with the presence of a Libras interpreter, the main difficulties faced by teachers who do not master Libras involve overcoming the communication barrier with deaf students, distrust towards the interpreter, lack of specific teaching materials for the

deaf and the lack of signs of Physics terms in Libras. Interpreters, on the other hand, point out the difficulty in appropriating physical concepts to interpret them for students and the teacher's distrust of their work as the main barriers to their performance.

These observations corroborate the notes of Praça and collaborators (2011) who, when investigating the difficulties that Physics teachers and interpreters face in teaching and translating physical concepts to deaf students in regular schools, indicate the teacher's lack of confidence in relation to the work performed. by TILS when mediating the communication of Physics concepts, verifying that some teachers are suspicious of whether the interpreter transmits the content of their speech correctly.

In addition to the relationship of trust between teacher and TILS, the lack of specific Libras signs for technical-scientific terms and the interpreter's competence in the area are barriers to the interpretation process. In this context, the term "competence in the area" refers to knowledge of the specific content necessary for the interpretation process: the interpreter may be fluent in Libras, but have difficulty interpreting specific subjects due to lack of familiarity with the concepts, leaving gaps, inaccurately interpreting or even altering the content of messages, corrupting their meaning. Gaps, inaccuracies and changes made during interpretation can cause interference in the process of negotiating meanings of technical-scientific concepts between teacher and student, with the omission, suppression or inadequate interpretation of messages.

RESULTS AND DISCUSSION

Data collection took place in 2022, through a literature review in the Google Scholar databases and CAPES journal portal, using “Teaching Physics”, “Physics” and “Teaching the Deaf” as search terms, “Deafness” concatenated with the logical operator “AND” and having the period between 2010 and 2023 as a time frame. As an additional search criterion, articles that were literature reviews were selected. The articles selected to compose the analysis corpus are shown in Table 1.

Table 2 shows information about the selected texts, indicating the databases used in each review, the time frame to which the review refers and the objective of the work. Articles A01, A02, A04 and A05, due to the breadth of possibilities that the objective provides, are characterized as exploratory research that seeks to identify the characteristics of teaching

physics for deaf students. Article A03 has a more specific objective, focusing the study on investigating the challenges to be faced and exploring possible contributions to the topic.

After composing the research corpus, we analyzed the selected texts, taking as a reference the steps suggested in Bardin’s content analysis. Thus, in an initial skimming reading, excerpts from the texts highlighted as relevant to the work as well as points of similarities and disagreements between the results highlighted by the authors were selected and highlighted. Then, the highlighted excerpts were grouped into themes that brought them together, based on the similarity of the arguments. As the analysis deepened, these thematic groupings were elevated to the level of emerging categories, which are indicated in Table 3, together with the definition of the characteristics of each of these categories.

Article	Identification
A01	AGUIAR, Evaneide de Brito Feitosa et al. Systematic Review of the Literature on Teaching Physics to Deaf Students. <i>RESEARCH IN FOCUS</i> , v. 26, no. 1, 2021.
A02	PICANÇO, Lucas Teixeira; ANDRADE NETO, Agostinho Serrano de; GELLER, Marlise. Teaching Physics to the Deaf: the state of the art in education research. <i>Brazilian Magazine of Special Education</i> , v. 27, p. e0123, 2021.
A03	VIVIAN, Ellen Cristine Prestes; LEONEL, André Ary. Teaching-Learning Physics in bilingual education schools for the deaf. <i>Brazilian Journal of Research in Science Education</i> , p. e31335-27, 2022.
A04	DA SILVA, Marcelo Ribeiro; DE CAMARGO, Eder Pires. State of knowledge in physics teaching for deaf and hard of hearing students: foray into Brazilian theses and dissertations. <i>Alexandria: Science and Technology Education Magazine</i> , v. 13, n. 1, p. 251-275, 2020.
A05	DE SOUZA ALVES, Fábio; DA SILVA SOUZA, Luis Mateus; ROSSINI, Suzi Mara. The profile of research on Physics Teaching for the deaf in Brazil between 2002 and 2017. <i>science teaching</i> , n. Extra, p. 2551-2558, 2017.

Table 1: Articles that make up the analysis corpus.

Source: The authors, 2023.

Article	Base	Temporal cut	Objective
A01	Articles in Journals: <i>Scientific Electronic Library Online</i> (SciELO) and Google Scholar	2014 - 2020	Conduct a systematic review of the literature on teaching Physics to deaf students.
A02	Catalog of CAPES theses and dissertations, and the <i>ERIC</i> , <i>SciELO</i> , <i>SciVerse</i> , Scopus and Google Scholar directories.	1987 - 2019	Understand how teaching Natural Sciences to the deaf is taking place, based on a survey of the state of the art of research on the education of the deaf, in this area of knowledge.
A03	Annals of SNEF, ENPEC and EPEF (SNEF and ENPEC are biennial events and EPEF is annual).	2010 - 2020	Investigate the main challenges and contributions presented regarding the Physics teaching-learning process in school contexts of bilingual education and special education for deaf students.
A04	Summary of Tests and Dissertations - Capes Catalog of Theses and Dissertations	1987 - 2019	Investigate the state of Knowledge in Physics Teaching for deaf and hard of hearing students based on an incursion into Brazilian Theses and Dissertations, with the analysis of data from the abstracts available.
A05	Brazilian Digital Library of Theses and Dissertations (BDTD) Articles in newspapers in the area: (Science and Education; Revista Ensaio Pesquisa em Educação em Ciências; Revista Brasileira de Pesquisa em Educação em Ciências (RBPEC); Revista Investigações em Ensino de Ciências (IENC); Revista Brasileira de Ensino de Physics; Revista Brasileira Special Education).	2002 -2017	Present a profile of research on teaching Physics to deaf students, using the methodology called “state of knowledge”.

Table 2: Characteristics of the reviews selected for analysis

Source: The authors, 2023

Category	Definition
C1: Teaching Position	The teaching position category seeks to identify, based on representative excerpts from the texts, the place that the teacher occupies in relation to his actions in teaching activities in teaching deaf students and covers different dimensions, such as professional (specific academic training in his area), social (as an agent of transformation) and personal (human being, with their own experiences, values and beliefs).
C2: Structural Barriers	In the structural obstacle's category, elements are identified that point to structural obstacles to teaching deaf students, such as the lack of equipment, materials, physical structure, difficulty in accessing information.
C3: Difficulties in Teaching	In the Difficulties in Teaching category, we seek to identify elements that point to everyday obstacles to be faced in the classroom environment, by teachers, students and interpreters.
C4: Professional Training	In the Professional training category, we seek to identify elements about initial or continuing training, in-service training or other activities that contribute to improving the training of professionals who work in teaching deaf students, whether interpreters, teachers or other support professionals.

Table 3: Proposals for emerging categories and their characteristics.

Source: The authors, 2023.

For each of the proposed categories, the points highlighted as relevant by the authors of each review were listed. These points are listed in Table 4, in which each of the categories is associated with a set of highlights. Here, it is worth remembering that to be eligible for the list of characteristics of a category, a point does not need to appear simultaneously in

all texts, although some of the points listed are common to more than one review. Thus, points listed in a particular review can be complementary to the complete description of the category even if they have not been observed in other studies, also contributing to the formulation of the DSC.

Category	Highlights
C1: Teaching Position	<ul style="list-style-type: none"> • teacher's interest and concern with the inclusion of deaf students; • use of teaching methodologies and materials that respect the precepts of inclusive education; <ul style="list-style-type: none"> • In bilingual schools, teachers are immersed in deaf culture, using sign language in classes; • Teacher-interpreter interaction to share meanings in different languages. • Teachers interpret deafness as an obstacle to the teaching-learning relationship.
C2: Structural obstacles:	<ul style="list-style-type: none"> • the lack of financial resources to purchase equipment and develop teaching materials suitable for teaching deaf students; • lack of specialized professionals, whether they are teachers with command of Libras or interpreters who master the mediation of scientific concepts; • investment in research in the area of science teaching for deaf students • Scarcity and/or lack of technological and visual resources for a conceptual articulation of Physics with deaf culture
C3: Difficulties in teaching:	<ul style="list-style-type: none"> • lack of specific signs in the area of physics for translating from Portuguese to Libras, compromising the translation of concepts; • linguistic lack of learners, with difficulties with the written Portuguese language, resulting in the recording of speech related to physics concepts and the solving of exercises by students. • lack of teaching resources, and difficulty in accessing teaching strategies and interactions with services offered by Special Education, such as AEE and TILS. • lack of mastery of content by teachers and interpreters, makes it difficult for deaf students to acquire knowledge, compared to hearing students
C4: Professional Training;	<ul style="list-style-type: none"> • teachers' awareness of the responsibility for teaching and learning for all students; • training for inclusive teaching for teaching and interpreting, with recognition of the roles of both the teacher and the interpreter • Continuing training for teachers; • Investment in the creation and dissemination of signs and the production of bilingual visual teaching resources; • incentives from postgraduate Science programs to develop research on teaching Science for the Deaf.

Table 4: Composition of emerging categories

Source: The authors, 2023.

From the highlighted points, the DSC is constructed. In the case of this work, considering the existence of dominant thematic framework, we present, as a result of this work, a DSC for each theme.

DSC_C1: TEACHING POSITION

“Teachers, as fundamental agents in the educational context, demonstrate a growing interest and concern with the inclusion of deaf students. This commitment is reflected in the adoption of teaching methodologies and materials that respect the precepts of inclusive education, contributing to providing equal opportunities and access to knowledge for all students. In bilingual school institutions, teachers immerse themselves in deaf culture, recognizing the importance of sign language as an essential means of communication for the interaction and learning of deaf students, understanding and valuing the specificities of this group. Collaboration between sign language teachers and interpreters is a crucial component of the educational process. This interaction facilitates the sharing of meanings between different languages, promoting effective communication and ensuring mutual understanding between deaf and hearing students.

It is through this partnership that access to knowledge is made possible, overcoming language barriers. However, challenges still exist. There are teachers who interpret deafness as an obstacle to the teaching-learning relationship, highlighting the need for more investment in training and awareness programs”.

DSC_C2: STRUCTURAL OBSTACLES:

“When investigating possible obstacles that impact the teaching of physics to deaf students, different structural obstacles were identified. Initially, the significant lack of financial resources aimed at the acquisition

of specialized equipment and the production of adapted teaching materials is highlighted, which hinders the availability of fundamental resources, such as videos in Brazilian Sign Language (Libras), visual models and adapted equipment, making it difficult to in-depth understanding of physical concepts. The scarcity of technological and visual resources adapted to promote the articulation of physical concepts with the culture and visual language of the deaf community was an obvious challenge. Furthermore, the lack of technological tools, visual materials and resources that connect physical concepts to the reality and visual language of deaf students represents a significant barrier to understanding and engagement in Physics teaching. The lack of hiring of qualified professionals was also noted: the lack of teachers fluent in Libras and interpreters with technical knowledge in Physics or Science has been a significant challenge, which compromises the effective transmission of scientific knowledge, making it difficult to mediate physical concepts in a accessible and adapted to deaf students. Another critical point identified is the urgent need for investment in specific research for teaching Science to deaf students, since gaps in studies aimed at identifying effective pedagogical practices and methodologies adapted to this audience limit the evolution of more inclusive teaching strategies and efficient. Finally, it is worth highlighting that overcoming these obstacles involves directing efforts towards the implementation of inclusive educational policies already provided for in legislation, increasing investment in specific educational resources, training specialized professionals, encouraging dedicated research and development of accessible technological resources.”

DSC_C3: DIFFICULTIES IN TEACHING

“Physics teaching for deaf students faces, in addition to the structural obstacles inherent to inclusive education, it also presents specific difficulties for the area that interfere with the daily life of the classroom. The lack of availability of specific signs in the area of Physics for the linguistic mediation of Portuguese into the Brazilian Sign Language (Libras) appears as a crucial obstacle. This lack compromises the adequate description of physical concepts, making it difficult for deaf students to fully understand. Another critical point is the linguistic lack of learners who, although they may be fluent in Libras, use written Portuguese, considered a second language, as their main tool for direct communication with the teacher. The difficulties of deaf students with written Portuguese negatively impact the record of speech related to Physics concepts. Such linguistic limitations influence not only the understanding of content, but also the resolution of exercises and the expression of acquired knowledge. It must also be added that the lack of adequate teaching resources and the difficulty in accessing teaching strategies, as well as interactions with the services offered by Special Education, represent significant challenges to access to teaching and learning for deaf students. Another critical point identified was the lack of knowledge (or even familiarity) of the contents on the part of the interpreters. This gap compromises the effective mediation of knowledge, resulting in difficulties for deaf students to access the teacher’s speech and argumentation on the subject under discussion.”

DSC_C4: PROFESSIONAL TRAINING

“In relation to the training of professionals involved in teaching Physics to deaf students, the importance of concrete measures to promote a more inclusive educational environment is

highlighted. Among such actions, teachers’ awareness of the responsibility of teaching and learning for all students emerges as a crucial point, since recognizing the importance of inclusion and understanding the diversity of students is essential to creating a welcoming educational environment. Furthermore, it is necessary to clarify the roles of both the teacher and the interpreter and offer training that includes specific strategies to meet the demands of deaf students. Continuing training for teachers and interpreters is an essential measure to constantly improve their skills and knowledge and investing in this training allows professionals to be up to date with the best inclusive teaching practices, thus promoting a more suitable learning environment for all students. In the specific case of teaching physics to deaf students, investment in the creation and dissemination of signs and the production of bilingual visual teaching resources is crucial, as they function as elements that facilitate the understanding of physical concepts, providing better conditions for students to understand the content. deaf students. Concrete training and qualification actions also include encouraging postgraduate programs to develop research on teaching Science for the Deaf. Encouraging research in this area contributes to the advancement of more effective pedagogical methodologies adapted to the specific needs of deaf students”.

FINAL CONSIDERATIONS

By exploring the literature on Physics Teaching in Deaf Education, we identified not only gaps, but also relevant trends and debates. The dynamic nature of scientific literature highlights challenges, problems and barriers, requiring periodic review studies to keep the knowledge scenario on a given topic updated, as evidenced in this research.

The construction of the Collective Subject Discourse (CSD) from review

articles allowed us to observe different perspectives on inclusion, innovations in assistive technologies, nuances in pedagogical approaches and practices, the importance of Libras and the experiences of deaf students. This study focused not only on the student,

but on the teacher-student-interpreter triad, highlighting the need for improvement and continuous training of teachers and Libran Interpreter Translators (TILS). The objective is to improve educational services for deaf students in the area of Physics.

REFERENCES

CAMBUHY, J. F.; MATTOS, C. R. Quando a inclusão é exclusão: a falta de instrumentos mediadores no ensino de física para surdos. In: N.M.D. Garcia; M.A. Auth; E.K. Takahashi. (Org.). *Enfrentamentos do ensino de física na sociedade contemporânea*. 1ed. São Paulo: LF Editorial, 2016, v. 1, p. 291-314.

LEFEVRE, F.; LEFEVRE, A. M. C. O sujeito coletivo que fala. *Interface - Comunicação, Saúde, Educação*, v. 10, n. 20, p. 517-524, jul. 2006.

PEREIRA, R.D., MATTOS, D.F. Ensino de Física para surdos: Carência de material pedagógico específico, *Revista Espacios*, v.38, n° 60, p. 24-35. 2017. Disponível em: <https://www.revistaespacios.com/a17v38n60/a17v38n60p24.pdf> Acesso em: 04 out. 2022.

PLAÇA, L.F.; et al. As dificuldades para o ensino de Física aos alunos surdos em escolas estaduais de Campo Grande-MS, in *Anais do VIII ENPEC – Encontro Nacional de Pesquisa em Educação em Ciências*, 2011. Disponível em: https://abrapec.com/atas_enpec/viiipec/resumos/R0085-1.pdf Acesso em: 29 set. 2022.

RAUTENBERG, E. As dificuldades do Ensino de Física para alunos surdos (Trabalho de Conclusão de Curso - Licenciatura em Física), Universidade Federal de Santa Catarina, Centro de Ciências Físicas e Matemáticas, Florianópolis, SC, 2018. Disponível em: <https://repositorio.ufsc.br/handle/123456789/183466> Acesso em: 04 out. 2023.