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Inclusive landscapes of investigation in mathematics classrooms with deaf and hearing students

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This paper aims to discuss possibilities for educational mathematics practices addressing the inclusion of deaf students in regular schools. In order that I present reflections on the meetings amongst deaf and hearing students in mathematic classes in a Brazilian context. My reference for such discussions is the results of my doctoral research whose focus was interaction in a mathematics classroom in which students speak different languages – Portuguese and Brazilian Language of Signs. First, I present the context of deaf education in Brazil. Following, I present the design of the study and my reflections concerning the dialogical interaction pattern and aspects of Inclusive Landscapes of Investigation with reference to mathematics classes where deaf and hearing students are together. I conclude that educational practices based on Inclusive Landscapes of Investigation can support mathematics classes in the context of inclusion of deaf students in regular school.

Keywords: Inclusive mathematics education, meetings amongst differences, dialogue.

Introduction

Inclusive Education has been based on concepts related to human rights and progresses towards an ideal of equity, which recognizes the different means and conditions for different groups or people to have access to the same rights (Moura, 2021; Skovsmose, 2019). According to Kollosche et al. (2019), most investigations involving this theme in the context of Mathematics Education have been presented through concerns related to students with disabilities or special needs. For the authors, the main motivation for that has been established through legislation, international agreements, and educational practices in schools.

However, the notion of inclusive education, especially in the field of mathematics education, has been discussed as something that challenges the diversity we find in classrooms in general (Bishop et al., 2015; Skovsmose, 2019). In this sense, researchers have been discussing the different obstacles to inclusive education, as well as the possibilities for dealing with them through an agenda of equity and inclusion in mathematics education (Skovsmose, 2019; Moura, 2021; Roos & Bagger, 2021).

The discussions presented in this paper aims to contribute to this agenda through an experience in Brazil's educational context, where most of the concerns of inclusive education are related to schooling for people with disabilities. Since 2008, the introduction of new educational policies determines that these students become enrolled in regular schools¹. Thus, the proposed discussion

¹ Regular schools are public or private schools which do not include specially assigned special education or student behavioral intervention programs within or outside the enrolled schools

here is directed to the inclusion and permanence of deaf students, as well as the need to provide effective inclusive practices for these students.

The present paper aims to discuss possibilities for mathematics practices addressing the inclusion of deaf students in mathematics classrooms in regular schools. Such discussions are based on the results of a doctoral research that sought to understand how interactions happen in mathematics classes where deaf and hearing students are together, and the tasks are organized according to the perspective of Landscapes of Investigation (Moura, 2020).

The doctoral research data were generated in mathematics classes of a fifth-grade class of elementary school (10 years old) of a municipal public school in the state of São Paulo, Brazil. This school is recognized in the city for the work it has been doing for the inclusion of deaf students by adopting a pedagogical proposal based on a bilingual perspective of education, in which the first language of communication and schooling for deaf students is the Brazilian Sign Language (Libras) and the Portuguese language is used in its written form, which is teaching and learned based on the experiences obtained through sign language.

With a total of 22 participants, including three interpreters, two teachers, and 17 students, of whom five were deaf and 12 were hearing, data production involved the planning and development of the tasks were based on the proposal of Landscapes of Investigation, according to the perspective of Skovsmose (2000). In which follows I present the theoretical framework relate to the context of the research.

Theoretical Background

Although the presence of sign language interpreters doesn't guarantee the inclusion of deaf students in the teaching and learning practices, having this professional in the classes where deaf and hearing students are together is the first step to the promote equity. The role of sign language interpreters has been redefining over the last few years, in view of the demand for the classroom and the implementation of different practices. With this, the relationship between professors, interpreters, and students, as well as the ways of communication have been shown to be distinct (Moura, 2020).

Regarding the mathematics classes, research have been indicating that there is no direct interaction between deaf and hearing students and neither between teachers nor deaf students (Borges & Nogueira, 2019). Thus, usually teachers communicate with hearing students and interpreters. Interpreters mediate the interaction between deaf students and the teacher and with other students when there is an opportunity (or need). Deaf students communicate directly only with each other and/or with the interpreter, and the answers to the deaf student's questions are almost always given by the interpreter and not the teacher, causing the isolation of these students in the classroom.

Based on this fact, Moura (2020) suggests thinking of an interaction pattern like the one described in Figure 1.

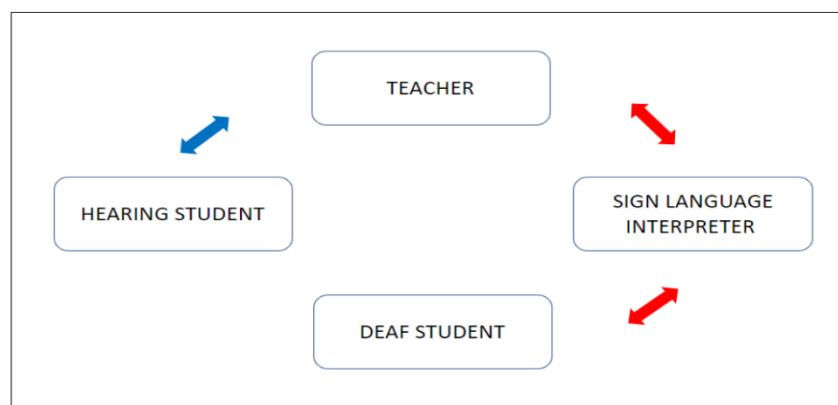


Figure 1: Interaction pattern in classes with deaf students and sign language interpreter

In the classes in which this communication pattern is common, it is also possible to realize the little interaction between teachers and interpreters. In this sense, it is believed that this interaction pattern contributes for the interpreter to assume the responsibility for teaching the contents to students. According to Silva and Oliveira (2016), situations like this are common in classrooms where are together deaf and hearing students, and in addition to giving the interpreter a role that does not concern him/her, they end up further distancing deaf students and teachers, since the reference of these students becomes the interpreter and not the teacher. In other words, they only share the same space with the hearing students, there is not an effective inclusion.

In mathematics classes, the concerns about these conditions are bigger, since the sign language interpreters don't have enough mathematics knowledge to teach the contents to deaf students (Pinto & Segadas, 2019). Usually, they teach what they understand from the explanations of the teachers, but certainly, this understanding can be incomplete or insufficient, causing inequality of opportunities of mathematics learning to deaf students.

In addition, this pattern of interaction also reinforces the practice of teaching methodologies designed and directed to listeners, based on the belief that the performance of the interpreter is enough to make the deaf understand the content (Borges & Nogueira, 2019). Although deaf students are educated through Libras, authors (Borges & Nogueira, 2019; Moura, 2020) emphasizes the importance of thinking about methodological strategies that consider the presence of deaf people in the classroom where the majority are hearing students.

Hence, the use of methodological strategies for each student could follow his/her own path towards knowledge, has been expanding. This new way of thinking methodological strategies that favor the learning of students with disabilities, Fernandes (2017) calls construction. According to this author, this proposal involves the construction of a context that allows for the sharing of perspectives and the negotiation of meanings, also enabling the development of autonomy and understanding of mathematical learning processes.

Thus, the ways of teaching and learning mathematics can be explored in a shared space, making the knowledge of this subject be understood in different ways. For this, it is essential to create learning environments that accommodate the differences of students and allow learning across them.

Design of the Study

This investigation used a qualitative approach and, as a methodological procedure, participant observation, which allowed me to investigate the object of study in its context from my insertion in the group of students (Queiroz et al., 2007). This method favored an understanding of how interactions happen in mathematics classes where deaf and hearing people are together, and also the tensions that exist in the process of inclusion of deaf students in regular schools.

These classes were recorded in audio and video and notes were made by the researcher. From these records, episodes were constructed in which the interactions between participants are described. To help structure the episodes, we sought to analyze the videos along with the audios, inspired by the analysis phases presented by Powell et al. (2004).

After, these episodes were analyzed in view of the aims of the research, where some aspects concerning the proposal of Landscapes of Investigation in a context with deaf and hearing students could be identified. In the following, we present results and discussion where we reflect on aspects that support inclusive mathematics practices addressing deaf students in classrooms in regular schools.

Results and Discussions

Seeking to create mathematics learning environments that accommodate the differences of students, in my doctoral research I presume that the Landscapes of Investigation proposal could provide an inclusive learning environment. Usually, in mathematics classes, the teaching is organized based on some theoretical explanations followed by exercises involving techniques and procedures presented previous by teachers. Landscapes of investigation break with this exercise paradigm through dialogical communication, allowing the students to be responsible for their own learning process and encouraging experimentations. The students are invited to engage in investigative tasks, which makes room for the discovery of mathematical facts, refutations, production of new meanings, critiques, reflections, hypothesis testing, and cooperation (Skovsmose, 2000).

Landscapes of Investigation played a central role in the research. The main pattern of communication is dialogue, in which the teacher leaves the centrality of the class and the perspectives of everyone else start to gain importance. Thus, through investigation, deaf and hearing students have the opportunity to interact. Whether directly or with the mediation of the interpreter, students get to know the perspectives of each other in a cooperative manner on an equity condition. The valorization of sign language encourages hearing students and teachers to learn the language to communicate with deaf colleagues, expanding the possibilities of interaction between students and conducting the investigation in different ways. It is possible to experience other ways of learning.

In the episodes of the classroom that made part of my doctoral research, I identified an interaction pattern in math classes with deaf and hearing students that I named Dialogical Interaction Pattern as illustrated in Figure 2.

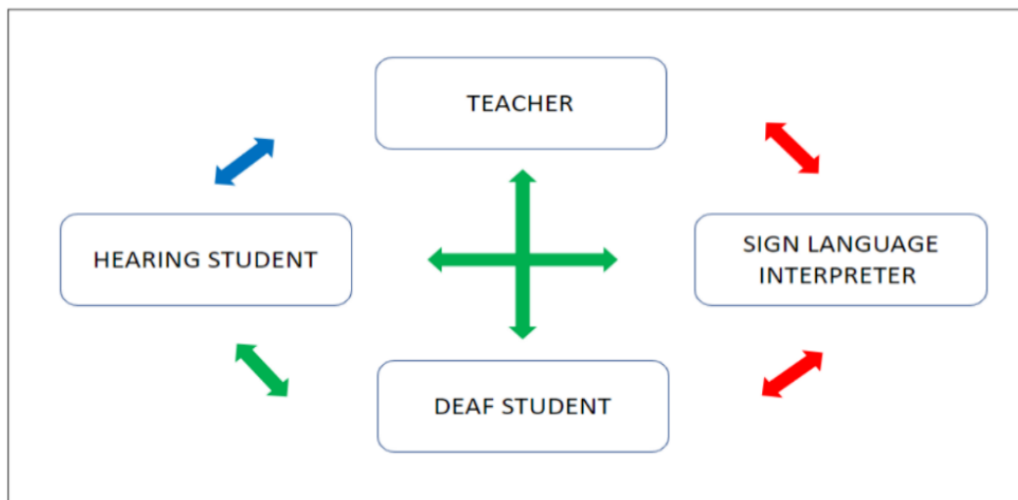


Figure 2: Dialogical Interaction Pattern

In this new pattern, the teacher leaves the centrality of actions enabling new interactions to emerge, namely, interactions between teachers and deaf students, interactions between deaf students and hearing students, and interactions between interpreters and hearing students.

When seeking to understand the perspectives of students and interpreters, the teacher leaves of being the only one to have something to teach. Active listening, as well as teacher displacement to understand the student's perspectives, contributes to overcoming the vertical relationship between professor and students. The teacher is still responsible for planning, mediation, decisions on methodologies appropriate to the various mathematical contents and by assessment strategies. However, the teacher is no longer the one who only teaches, and the student is no longer the one who only learns.

In this learning environment, teachers have the opportunity to learn too with deaf students and sign language interpreters. This movement towards overcoming the vertical relationship during classes allows deaf students to share their perspectives, their way to understand the world, and their language. For this, they rely on the help of a sign language interpreter who, after the deaf, is the main disseminator of deaf culture and identity. The partnership between teachers and interpreters is strengthened in order to contribute to the cooperation among deaf and hearing students. By moving to understand the perspectives of students, the teacher is open to the redefinition of ideas and positions, respecting the different ways of learning and paths to be followed. Thus, the planning and methodological assessment strategies start to also consider the perspectives of deaf students and how they experience the world, which is essential for the construction of equity.

To emphasize the potential of learning environments based on Landscape of Investigation for the inclusion of people with different skills or backgrounds, Skovsmose (2019) defines Inclusive Landscapes of Investigation. A proposal based on a universal design for learning perspective, which seeks to eliminate the need for adaptations through the construction of pedagogical strategies accessible to all students, highlighting the particularities of students as possibilities and not as obstacles to carrying out the tasks.

In Inclusive Landscapes of Investigation, dialogue is assumed as a pattern for interaction favoring cooperation and the construction of equity, in other words, is an environment of learning in which the Dialogical Interaction Pattern is established. From this idea, Skovsmose (2019) highlights three aspects concerning Inclusive Landscapes of Investigation: facilitate investigations; enable an environment of learning accessible to students; favoring for collaboration among students.

During the analyses of the classroom episodes, beyond these three aspects highlighted by Skovsmose (2019), was possible to identify more five as aspects essential which emerged from the Dialogical Interaction Pattern in this Inclusive Landscapes of Investigation: contribution to the construction of equity through the appreciation of sign language; recognition of the sign language interpreter as someone who can contribute to the learning of all; the opening of spaces for the negotiation of signs of mathematical terms that still do not have a defined sign in Brazilian Sign Language; possibility of other learning (and investigations) that support students' mathematical learning; opportunity for students to experience new ways of learning, contributing to the critical and reflective knowledge. Thus, we can say that there are eight important aspects when considering the proposal of Inclusive Landscapes of Investigation mathematics classes with deaf and hearing students.

The facilitation of investigation is an aspect that must be considered from the planning of tasks. Doing investigation is an open task that does not include solving an exercise list. Thus, it is important to seek to develop tasks with different possibilities for answers and to invite students to an investigation.

Enabling an environment of learning accessible to all students is an aspect that must be considered from the planning of tasks. Doing investigation is an open task that does not include solving an exercise list. Thus, it is important to seek to develop tasks with different possibilities for answers and to invite students to an investigation.

The favoring for collaboration among students is mainly due to the dialogic interaction between them. Include sign language in the curriculum of subjects, is a way to appreciate both the deaf culture and the sign language, supporting hearing students to learn sign language in order to interact with the deaf colleagues.

The recognition of the sign language interpreter as someone who can contribute to the learning of all is related to the relationship between teachers, students, and interpreters. The sign language interpreter beyond teaching sign language for all students, can encourage students to use this language for the interactions, as well as can engage in the investigation with the students, sharing the mediation tasks with the teacher.

Opening of spaces for the negotiation of signs of mathematical terms that still do not have a defined sign in sign language is extremely important in classes with the presence of deaf students, as it contributes to the understanding of mathematical concepts. Generally, these negotiations are not foreseen in the planning of tasks but having a learning environment that allows them to be carried out, as in the proposed Inclusive Landscapes of Investigation, is an essential support for the learning process of mathematics for deaf students.

The possibility of other learning (and investigations) that support student's mathematical learning concerns learning concepts or ideas that are not directly related to the subject investigated, but such understanding is necessary for mathematical concepts or problem situations understood or resolved.

The opportunity for students to experience new ways of learning, contributing to critical and reflective knowledge. This type of knowledge is related to the knowledge that allows students to develop their own mathematical strategies and conjectures.

Finally, I emphasize that Inclusive Landscapes of Investigate are constructions. Thus, the development of tasks based on this proposal can take on different characteristics and formats. There is no instruction guide for such constructions, however, the eight aspects presented are fundamental when considering a pattern of dialogic interaction and can be seen as aspects that contribute to the composition of these landscapes. In other words, these aspects are only possible through a change from the interaction pattern that usually happens in the mathematics classroom (Figure 1) for the new interaction pattern (Figure 2), which has dialogue communication as the protagonist. The inclusion of task proposals based on this format can create new possibilities for deaf and hearing students to learn mathematics together.

Concluding Remarks

Seeking to contribute to the construction of a culture of mathematics education that values differences and diversity, Skovsmose (2019) proposes that Inclusive Education be thought of as a new way of providing meetings amongst differences. Therefore, I understand these encounters as a human ability to be with the other (or others) experiencing a mutual relationship, which suggests a movement, an action of discovering, an act of being aware of new things.

Thinking inclusive education in terms of meetings amongst different people is to think of an education that recognizes and values the difference of each one and that envisions the possibility of learning from what is different. In other words, is an education that brings concerns about all students, whether this student with disability or not, with special needs or not. In this perspective, each student is unique and has their own way to handle mathematics. Knowing different ways of relating to mathematics also contributed to the development of a critical view that allows us to look beyond stereotypes and/or pre-established conceptions about the other.

In this regard, I see the meeting between deaf and hearing people at school as a meeting between students who speak different languages, who recognize and value this linguistic difference, as well as the learning possibilities that can emerge through cooperation and equity.

In this paper, I bring Inclusive Landscapes of Investigation as a possibility for mathematics practices addressing the inclusion of deaf students in mathematics classrooms in regular schools, in view of the meetings amongst deaf and hearing students in mathematics classes. Through dialogical interaction pattern, new meetings are facilitated in the classroom. Teachers meet deaf students and sign language interpreters, sign language interpreters meet hearing students, hearing students meet deaf students. These meetings do not only refer to sharing the same classroom, but to a movement of seeing the other, of wanting to be together, favoring cooperation and the construction of equity, crucial elements for the inclusion of deaf students in mathematics classes.

Finally, I understand that the reflections and conclusions presented in this paper may support mathematics education practices that focus on diversity. The feasibility of dialogic interaction between two culturally different groups – deaf and hearing people – shows us new possibilities for the participation of all students in conditions of equity and cooperation during the mathematics learning process.

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