Sociedade Brasileira de Educação Matemática

RIPEM

Collaborative Mathematics Education and the school's expectations on the learning of the visually impaired student

Evanilson Landim
Universidade de Pernambuco
Petrolina, PE — Brasil
✉ evanilson.landim@upe.br
0000-0003-2742-4850

Lícia de Souza Leão Maia
Universidade Federal de Pernambuco
Recife, PE — Brasil
✉ liciaslma@hotmail.com
0000-0002-9525-3777

Wilma Pastor de Andrade Sousa
Universidade Federal de Pernambuco
Recife, PE — Brasil
✉ liciaslma@hotmail.com
0000-0002-1786-7917

2238-0345 ISSN

10.37001/ripem.v14i5.3771 doi

Received • 03/02/2024
Approved • 20/05/2024
Published • 20/12/2024

Editor • Gilberto Januario

Abstract: The article analyzes the expectations of teachers regarding the inclusion of students with disabilities in Mathematics classes, particularly those with visual impairment, in order to answer the question: what specificities in the inclusion of students with visual impairment in school are recognized by the teachers? A total of 65 mathematics teachers and 33 who taught other subjects participated in the research. Data was collected using a questionnaire consisting of six items. The results showed that the teachers' understanding of students with disabilities, particularly those with visual impairment, still exposes the existence of stereotypes, low expectations and, sometimes, disbelief in the potential of these students, all of which linking to scenarios of exclusion. From this perspective, instead of the student being seen from the point of view of his or her potential and skills, he or she is considered to be "all disabled". While the commitment and hope of teachers in favor of inclusion are recognized.

Keywords: Pedagogical Personalization of the Class. Equity. Educational Inclusion. Co-teaching. Teacher Training.

Educación Matemática Colaborativa y expectativas de la escuela en el aprendizaje del estudiante con discapacidad visual

Resumen: El artículo analiza las expectativas de los profesores con respecto a la inclusión de los estudiantes con discapacidad en las clases de Matemáticas, en particular, de aquellos con discapacidad visual, con el fin de responder a la pregunta: ¿qué especificidades en la inclusión de estudiantes con discapacidad visual en la escuela son reconocidas por los profesores? Participaron en la investigación 65 profesores de Matemáticas y 33 de otras disciplinas. La recolección de datos se realizó a través de un cuestionario compuesto por seis ítems. Los resultados indicaron que la comprensión de los profesores sobre los estudiantes con discapacidad, particularmente aquellos con discapacidad visual, aún revelaba la existencia de estereotipos, bajas expectativas y, en ocasiones, desconfianza en las potencialidades de estos estudiantes, lo que se vincula a escenarios propios de la exclusión. Desde esta perspectiva, en lugar de ver al estudiante desde sus potencialidades y competencias, se lo percibe como "completamente discapacitado". Por otro lado, se reconoce el compromiso y la esperanza de los profesores en la inclusión.

Palabras clave: Personalización Pedagógica del Aula. Equidad. Inclusión Educativa. Co-

enseñanza. Formación Docente.

Educação Matemática Colaborativa e as expectativas da escola na aprendizagem do estudante com deficiência visual

Resumo: O artigo analisa as expectativas dos professores a respeito da inclusão nas aulas de Matemática dos estudantes com deficiência, em particular, daqueles com deficiência visual a fim de responder à pergunta: quais especificidades na inclusão de estudantes com deficiência visual na escola são reconhecidas pelos professores? Participaram da pesquisa 65 professores de Matemática e 33 de outras disciplinas. A coleta de dados deu-se a partir de um questionário constituído por seis itens. Os resultados apontaram que o entendimento dos professores a respeito do estudante com deficiência, particularmente, daquele com deficiência visual, ainda revelava a existência de estereótipos, baixas expectativas e, por vezes, descrença nas potencialidades desses estudantes, o que se vincula a cenários próprios da exclusão. Nessa perspectiva, ao invés de o estudante ser visto a partir das suas potencialidades e competências, é tido como "todo deficiente". Por outro lado, reconhecem-se o compromisso e a esperança dos professores na inclusão.

Palavras-chave: Personalização Pedagógica da Classe. Equidade. Inclusão Educacional. Co-ensino. Formação Docente.

1 Introduction[1]

People with disabilities have increasingly participated in discussions that seek to ensure and guarantee them better social and educational conditions, including indicating to society how they want to be treated. "The motto 'nothing about us, without us' resonates with the philosophy and history of the disability rights movement that is based on the principle of meaningful participation" (UN, 2018, p. 2). However, this achievement was not gratuitous, on the contrary, it is the result of many struggles that, little by little, have moved towards inclusion. The fact is that, despite facing a lot of resistance, people with disabilities have reached various spaces in work, education, health, housing, access to justice, transportation, architecture, urbanism, security, social security, assistive technology and accessibility in general, especially since the Brazilian Law of Inclusion (Brazil, 2015).

Before that, the education of these people often took place in a residential system, preventing social coexistence and further strengthening society's prejudice. The enrollment of people with disabilities in regular school initiated the process of partial integration, strongly marked by the preparation of students with disabilities, in special classes, to later attend the common classes of Basic Education, an initiative centered on the school and not on the student, who was only responsible for adapting to the curriculum and other conditions of the school. "Such a process, however, prevented the majority of children, young people and adults with special needs from reaching the highest levels of education. In this way, they expanded the list of those excluded from the educational system" (Brazil, 2001, p. 21). Opposing to that, inclusion advocates that everyone should have access to quality education, in accordance with their individualities.

The fact is that students need to be properly welcomed into the school and included in the didactic processes so that they can receive appropriate conditions for their learning, according to their characteristics (Viginheski, Frasson, Silva & Shimazaki, 2014; Landim, Maia & Sousa, 2023). Deaf students must have access to knowledge and curriculum through sign

[1] This article is an excerpt from a doctoral thesis defended at the Graduate Program in Education of the Universidade Federal de Pernambuco, written by the first author, supervised by the second author and co-supervised by the third author.

language and Portuguese. Blind students, through the Braille system, when applicable, and students with cerebral palsy can take advantage of existing computational resources to promote their learning, in the same way that those with autism spectrum disorder usually demand more attention from school and get more involved with activities that awaken their interests and possibilities.

In general, as with all students, there are no paths, recipes or pre-established rules to ensure the learning of anyone, each student is unique. It is essential to understand that each human being learns in his own way, has his own singularities and talents, and there is no disability capable of hiding this reality, but the prejudice of those who insist against the facts. Thus, there is no room for generalizations in this regard. For example, Braille, often used by blind people, cannot be imposed or understood as the most favorable resource for all students who do not have the sense of sight.

Incidentally, there is no one-size-fits-all approach that works for all students, it is the individuality of each person that should be the starting point for a didactic plan that aims to be inclusive. The diversity of learning styles, talents and singularities of each human being requires a dynamic approach, and it is up to the school to seek strategies that lead to the Pedagogical Personalization of the Class (PPC), that is, the planning, execution and evaluation of all pedagogical action cannot ignore the specificities of each student, nor be distracted by adaptations, individualized resources and processes, placing the person with disabilities in a different place from other classmates or offering fewer conditions due to ableist anticipations pre-established by society and the school. PPC requires the study of each student's profile, sincere dialogue, active listening and analysis of the context in order to enhance learning in an equitable way for all students.

In this article, we analyze the expectations of teachers regarding the inclusion of students with disabilities in Mathematics classes, in particular, those with visual impairment in order to answer the question: what specificities in the inclusion of students with visual impairment in school are noted by the teachers? Therefore, the intention was to explain some specificities in the inclusion of visually impaired students in school, based on what was presented by teachers who teach Mathematics in the final years of Elementary School or High School or who work in other subjects. The research data were collected from a questionnaire addressed to 98 Basic Education teachers, 65 from Mathematics and 33 from other areas.

The text is organized into the following sections: Visual impairment and Mathematics Teaching; The practice of the mathematics teacher; Collaborative Mathematics Education; Methodological Procedures; Presentation and Analysis of Results; Final Thoughts and References.

1 Visual Impairment and Mathematics Teaching

In Brazil, around 8.9% of the population aged two years and over has some type of disability, according to the National Household Sample Survey - PNAD (IBGE, 2023). Difficulty in seeing, even with the use of glasses or contact lenses, was the second most frequent, corresponding to 3.1% of the population.

Visual impairment is defined as the total or partial loss of the sense of sight and can be congenital or developed throughout life. A visually impaired person is one who has total (blindness) or partial (low vision) impairment of the sense of sight. Blindness occurs when visual acuity is equal to or less than 0.05 in the better eye, with the best optical correction. Low vision represents visual acuity between 0.3 and 0.05 in the best eye, also with the best optical correction (Brazil, 2004).

> A blind person is one who has total or minimal loss of sight, requiring the Braille method as a means of reading and writing and/or other methods, learning resources and special equipment for the teaching-learning process. A person with low vision is one who has visual remains to a degree that allows them to read texts printed in ink, as long as learning resources and special equipment are used, excluding deficiencies that are easily corrected by the proper use of lenses (Lira & Brandão, 2013, p. 44).

The characterization of low vision is not such a simple activity since vision can be compromised in different ways and at different levels. However, the identification of low vision has used as a condition, the impairment of 70% of vision in the better eye, even with optical correction.

Although legislation guarantees people with disabilities the right to inclusive education, educational practices still reflect attitudes and actions characteristic of exclusion. It is common for these people to be left on the sidelines and not have their specific limitations and needs considered, including in the case of blind students. It is not possible to speak of inclusion if there is no appropriation of the concepts by everyone in the class (Viginheski et al., 2014; Landim, Maia & Sousa, 2023).

Low vision and blindness cannot be considered as obstacles to the learning of any knowledge, let alone of mathematical knowledge; on the contrary, it is necessary to provide adequate stimuli so that visually impaired students use other senses, allowing them to learn like anyone else (Fernandes, 2004). The deficiency does not belong to the individual, but to the school, which is not yet able to communicate with all individuals, especially when it comes to mathematical language.

The "school environment" is limited and inaccessible to students who need to eliminate the barriers and attitudes that compromise the inclusion (Tavares, 2012). In the case of those with visual impairment, given the great appeal to image and visual resources in the educational process, particularly in the teaching of Mathematics, these obstacles seem even more evident. However, there are other possibilities, such as concrete materials, for example, capable of overcoming these difficulties.

> The school contents privilege the visualization in all areas of knowledge, of a universe permeated by graphic symbols, images, letters and numbers. Thus, needs arising from visual limitations should not be ignored, neglected or confused with concessions or fictitious needs (Sá, Campos & Silva, 2007, p. 13).

Access to knowledge has been presented as a problem for blind students, mainly because they have been considered incapable of learning in regular schools for a long time (Viginheski et al., 2014). In view of this difficulty, it is recognized that it is increasingly necessary to develop studies that allow the understanding of the learning process in relation to mathematical knowledge, both by the agents involved and by students with visual impairment.

In that regard, it is also urgent to develop resources that can improve such task. It should also be noted that "Mathematics for students without visual acuity within the normal standards of this school is an especially 'complicated' subject, only compared in degree of difficulty with Physics and Chemistry" (Fernandes & Healy, 2007, p. 66). The fact is that the constraints inherent in the teaching and learning of this subject remain resistant, especially due to the distance between the students' performance and the elaboration of the concepts.

The questions raised here indicate that the teaching and learning of Mathematics still present difficulties that compromise the construction of mathematical concepts within the reach

of the students of this discipline. In the case of students with disabilities, the situation is even more worrisome, because in addition to the skills necessary for teaching action, teachers also need training tailored to the specificities of this group.

Teachers need to consider the intellectual, physical, motor, visual or auditory limitations of students (their level of maturity, the reality they experience outside school, among other aspects), in order to ensure their educational purposes so that the organization in the classroom happens properly. When considering a blind student, the contents should be presented in such a way that all the students in the class are reached. However, this difference cannot imply denial of the right to learn what is provided for in the curriculum; No knowledge should have labels in the sense of pre-establishing who is capable or not of learning it. On the contrary, all students have an equitable and fair right to knowledge, hence the importance that the materials provided are appropriate and accessible for the whole class.

Stereotypes and prejudices are in society and at school and not in knowledge. Hence the importance of eliminating barriers, including the indication of methodological possibilities that reach all students. Society's ignorance cannot continue to stifle the right of historically excluded people to learn and develop. Dias and Santos (2010, p. 106) bring up the discussion about the lack of preparation of teachers in the teaching of Mathematics to students with visual impairment: "blind and low-vision children suffer from the lack of preparation of education professionals".

Lira and Brandão (2013) reinforce that Mathematics is considered one of the most difficult disciplines in relation to the abstraction of concepts by blind students, especially in the comprehension of themes from the subjects of trigonometric or geometric and point out that the knowledge that these students have of their own body can help in learning. As an example, they mention that geometric concepts, such as parallelism, perpendiculars, angles, among others, can be integrated into orientation and mobility techniques, favoring learning.

It is essential to recognize that, in addition to effectively including blind students in the regular school environment, it is crucial to direct investments to public policies aimed at the training of mathematics teachers, paying attention to the specific needs of students and considering successful experiences in this context. The use of tangible resources, such as tangible materials (cardboard, toothpicks, geoplane, among others), proves to be highly beneficial in the learning process of these students in Mathematics classes (Silva, Carvalho & Pessoa, 2016). This is due to the fact that the discipline represents not only a science of significant social relevance, but also an instrument of comprehensive citizenship education.

In the teaching of Mathematics to visually impaired students, in addition to the use of concrete materials, representations in relief map, soroban, technological resources, audio description and other tools that allow the student to access knowledge through the exploration of the remaining senses, such as touch, hearing and smell, as long as their autonomy and characteristics are considered. Audio description is an accessibility feature that is primarily targeted at blind people. Its purpose is to report information that would normally be perceived visually during a presentation (such as images, costumes, subtitles, scenarios, temporal transitions, credits, videos, among others) in order to ensure the understanding of the content addressed, without disadvantages for those with impaired sense of sight. In addition, audio description maintains harmony with the other audio elements in display.

The verbal expressions used by teachers during classes in with visually impaired students should avoid the use of terms that do not reach these students, as is the case, for example, of the expressions: "See this picture here; How much does the surface of this colored part measure?; Look at this chart on the board and answer the question below; How can we

realize that the measurement on this side of the triangle is 2 cm, which is what is missing to complete 12 cm?". Therefore, it is important for the teacher to start from the understanding that all students are different and to consider their singularities in the planning and execution. Otherwise, the school will continue to drop students in its wake. The class in which the content is more important than the person seems destined not to succeed. Educational inclusion requires, among other public policies, formative interventions capable of ensuring the teacher the development of practices that reach all students. Considering this, the following section presents some reflections on the performance of the teacher who teaches Mathematics.

2 The Practice of the Mathematics Teacher

The myth that, in order to be successful in mathematics classes, it is necessary to be "good with numbers" seems to influence the practice of some teachers of this subject. At the other end, students who have not yet developed the skill of repetition, strangely worshipped by the school, are left aside in the classroom. Teachers, family members and even the student himself have few expectations regarding the appropriation of knowledge in Mathematics by the student. (Rodrigues, 2012). The result of this marginalization is still evident and is manifested in the failure and dropout rates also motivated by this discipline (Cruz & Maia, 2006). The situation is even more serious when the students in question are those who belong to the less favored social classes, as is the case with the majority of people with disabilities (Mazzotta, 2005).

School failure often causes students to drop out of school, precisely because they consider themselves incompetent in the face of rules and techniques of the elite sciences, in which Mathematics has occupied a prominent position (Cruz & Maia, 2006). In addition, Mathematics often serves as a reference to define the performance of students in other subjects; it is common for other teachers and pedagogical coordinators to make decisions about whether or not to approve the student based on the opinion of the mathematics teacher. In school and out of it, mathematics still imposes itself as a superior science.

In this regard, Cruz and Maia (2006) reinforce the thesis that Mathematics has legitimized the school life of students, greatly responsible for the failure and dropout rates, especially among students from the most affected social classes, as pointed out. School failure, for a long time, was justified by the student's difficulties, "blaming the student" (Cruz & Maia, 2006, p. 4). Later, it was social inequalities that were to blame.

Mathematics teachers, in some cases, isolate the processes related to their activities, particularizing the didactics of the classroom and its relations with the plurality of students, which undermines the potentialities and seems to reveal forms of exclusion, especially in relation to the working student or the one with disabilities. These results are close to the propositions present in innate theories, which conceive knowledge as innate to the individual and foreign to his condition.

Analyzing the issues of the school routine that influence the pedagogical practice of the mathematics teacher, Bovo (2011) considers that the school's discourse produces real effects in Education, particularly in Mathematics Education. Therefore, the understanding of teachers' actions is only possible from the observation of their work in the classroom and their thoughts, ideals, opinions and speeches.

Kistemann Junior and Silva (2012) argue that the learning of students in the 21st century should be focused on rescuing humanism. Under these conditions, it is up to the teacher to draw on his or her experiences and base his or her actions on doubt, questioning and investigation. A questioning and research-based teaching is a challenge in the sense of "reconciling the

epistemological issue of the forms of production of mathematical knowledge with the social issues in the educational act" (Kistemann Junior & Silva, 2012, p. 95).

The authors point out that the conscious teacher and student analyze not only the problems of Mathematics, but, mainly, they investigate themselves, seeking to understand how the mathematical problems relate to themselves and to the reality of their community. The teaching of Mathematics based on investigation and (re)discovery requires the teacher to develop pertinent problems that can contribute to and encourage learning without neglecting the students' abilities and uniqueness. It is in this way that the teacher's performance ceases to be predictable and becomes provocative. Rather than the expected answer, it matters how students think and what "icons" they are building on what they learn.

The university and the school seem aware that it is necessary to rethink the role of the teacher who teaches Mathematics so that more absolute and content-centered practices and behaviors are left behind. Instead, the expectation is that students, whether with or without disabilities, will have their characteristics considered throughout the educational process.

3 Collaborative Mathematics Education

"Even sadder than seeing children without schools is to see them motionless in rows of desks, in schools airless, wasting time in sterile exercises that are of no value to the formation of man" (Antipoff, 1992, p. 403). It is true that since the Salamanca Declaration (UNESCO, 1948), the boundary between exclusion and the path to educational inclusion, important advances have been identified towards the understanding that all people can learn together (Braun & Marin, 2016).

The transfer of responsibility from the individual to society is the main indication for the re-elaboration of the concept of Inclusive Education. Treating those who are not equal as equals, strengthens exclusion much more than inclusion, perhaps this has been the biggest mistake since the beginning of the search for school universalization. Fortunately, the school has become more colorful and diverse; a space that for almost five centuries, in Brazil, was restricted to the elite, when the school seemed to move in another direction.

The lesson that ignores the characteristics, potentialities or singularities of each student will certainly be doomed to failure. In the case of Mathematics aimed at visually impaired people, for example, this has been an even greater challenge, mainly due to socially established standards of normality (Landim, 2018).

According to Abreu e Silva's (2023) analysis, although Mathematics can be an efficient bridge between curricular content and everyday experiences, some teachers encounter obstacles when articulating students' experiences with this knowledge, which, in turn, can incite disinterest in the subject. For students with disabilities, this limitation tends to accentuate the complexity of the situation, when the school is not able to promote actions that ensure the learning of the whole class, which requires mutual cooperation and engagement.

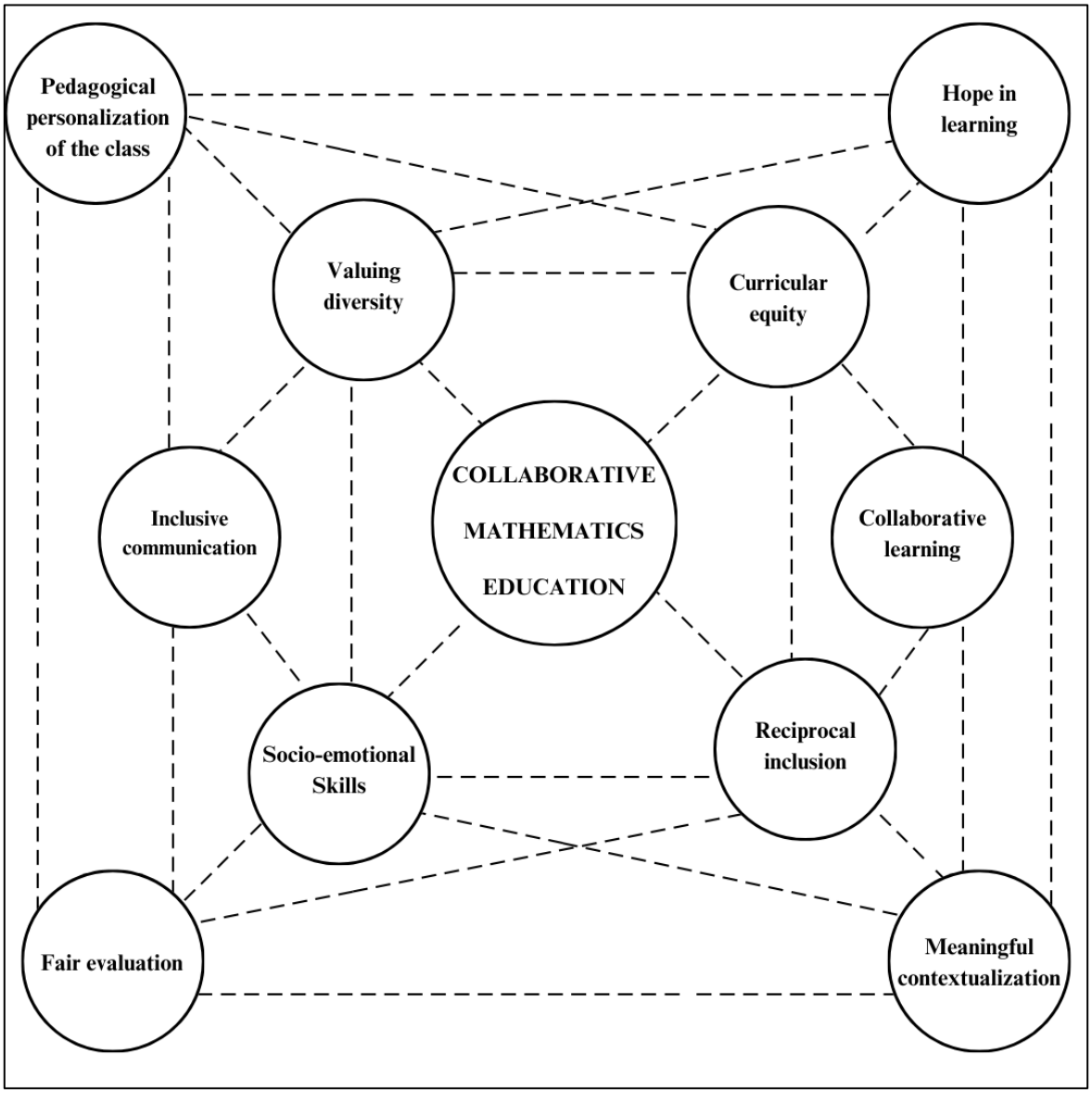
In order to mitigate the lack of cooperation or commitment to the learning of students with disabilities, the perspective of collaborative teaching or co-teaching has been recommended, developed from the advancement of research and reflections focused on Inclusive Education. Collaborative teaching occurs through a partnership between the teachers of the common classroom and the professionals of the Specialized Educational Service (AEE) (Mendes, 2006). In addition to this partnership, it is important that the specificities of each student are also considered by the whole school and the family, which requires rethinking the teacher's performance and training for collaborative practices, including considering factors external to their training (Ribeiro, 2019).

In collaborative teaching, the school shares the responsibility of planning, monitoring and evaluating the learning of a heterogeneous group of students (Mendes, 2006). This model breaks with the notorious transfer of assignments that is often identified in school, especially when it comes to students with disabilities.

Thus, Collaborative Mathematics Education or co-teaching of Mathematics is understood as the set of knowledge, practices, reflections and research undertaken by the school with the objective of promoting the mathematical conceptualization of the student, especially those historically marginalized from the educational process, such as people with disabilities. The expectation is for the fusion of efforts based on the sharing of responsibilities, resources, ideas and experiences, on the part of all those interested in the mathematical development of the student, who, although they play different roles, have a common goal: to ensure equity in the mathematics class in order to promote fair learning.

In Figure 1, some of the necessary assumptions for Mathematics classes from a collaborative perspective are presented:

Figura 1: Assumptions of Collaborative Mathematics Education



Source: Authors' production

The following are ten assumptions or attributes necessary for Collaborative Mathematics Education. When considered simultaneously, these actions have the potential to contribute to the construction of an inclusive mathematics class, capable of providing equitable conditions for learning. The expectation is that the school will share the following ideas:

- Pedagogical personalization of the class: Valuing the idea that school mathematics should not be adapted to the student, but rather developed from their experiences, so that the focus of the class is the student, not the content or mathematics, which are secondary. Instead of the infamous adaptation, the recommendation is for an equitable planning that results in a pedagogical personalization of the class capable of considering the singularities of the students, but, at the same time, not highlighting them;
- Hope in learning: Hope in the student's ability to learn, regardless of the complexity of the content;
- Valuing diversity: Perception that diversity in the classroom is an effective variable for learning, not an impediment or obstacle to be overcome;
- Curricular equity: Guarantee of fair access to all knowledge in the curriculum as a right, regardless of the student's characteristics, and should not be confused with privilege;
- Inclusive communication: Dialogue prior to the differentiation of resources or methodological procedures with the student, avoiding misunderstandings or ableist labels;
- Reciprocal inclusion: Recognition that the student with disabilities in the classroom, as well as all others, learns and teaches, so inclusion is a process of social development and not an individual one;
- Meaningful contextualization: Mathematical objects need to make sense to each student based on their values, beliefs, potentialities and limitations, so that mere description or interpretation in class does not imply in inclusion;
- Collaborative learning: Promotion of activities that encourage collaborative teaching and learning based on problem-solving and knowledge sharing;
- Fair evaluation: Evaluation of the student based on his/her advances, achievements and limitations, avoiding rankings, comparisons with peers or pre-established goals that emphasize quantitative criteria to the detriment of the qualitative development of each person;
- Socio-emotional Skills: Stimulating the development of socio-emotional skills, such as empathy, collaboration and communication, strengthening the learning environment.

4 Methodological Procedures

This article analyzes the expectations of teachers regarding the inclusion of students with disabilities in mathematics classes, particularly those with visual impairment. Data collected from a questionnaire addressed to 98 teachers who worked in Basic Education, of which 33 taught various subjects and 65 taught Mathematics at the time of data collection. The issues discussed here will be presented in the next section.

For the purpose of better understanding, it is clarified that "a questionnaire is a data collection instrument, consisting of an ordered series of questions, which must be answered in writing and without the presence of the interviewer" (Marconi & Lakatos, 2010, p. 184). For the authors, this technique has several advantages, such as: greater freedom in the answers, due to anonymity, less risk of distortion due to the lack of influence of the researcher, and greater uniformity in the evaluation, due to the fact that the instrument is impersonal.

Data analysis was aided by the IRaMuTeQ 0.7 alpha 2 software, developed by Pierre

Ratinaud and it enables different models of textual data analysis: lexicographic analysis, factor analysis, descending hierarchical classification (CHD) method, similarity analysis and word cloud (Camargo & Justo, 2013). In this article, the resources of CHD and similarity analysis were used. The descending hierarchical classification method (also known as the Reinert method) made it possible to organize the answers to the questionnaire into classes, presented by means of a dendrogram with the correlation between them (Figures 6 and 7). While the similarity analysis, based on the Graph Theory, made it possible to identify co-occurrences between expressions or words evoked by the participants and their respective semantic field (Figure 8).

Regarding the profile of the participants, it is noteworthy that among the group formed by teachers of various disciplines - except Mathematics - there were mostly female teachers (73%) over 38 years of age and the majority had as highest degree, the specialization (54%). Half of the participants had more than ten years of experience and 76% of them reported having worked with students with disabilities, with the most common experience being students with hearing impairment (26%). Working with visually impaired students was mentioned by 13% of the teachers.

Among the Mathematics teachers, the majority were female (52%), between 18 and 31 years old (52%). In addition, 38% of the professors had the title of specialist, 43% had less than five years of experience and 59% revealed experience in working with students with disabilities, with more frequent work with students with hearing impairment (23%). About 11% stated that they had already worked with visually impaired students.

It is also worth noting that, among the teachers of different disciplines, there was a greater interaction with students with disabilities, when compared to the other group of participants: 76% of these teachers already had students with disabilities, while among the mathematics teachers this rate was 59%.

5 Presentation and Analysis of Results

In this section, the positioning of teachers of different disciplines and of Mathematics regarding of the phenomenon of disability is presented and discussed. The analysis of the answers takes place concomitantly between the participants of the two groups. However, it is emphasized that it was not the purpose of this study to compare the responses of the two groups, but rather to indicate their expectations regarding the phenomenon investigated.

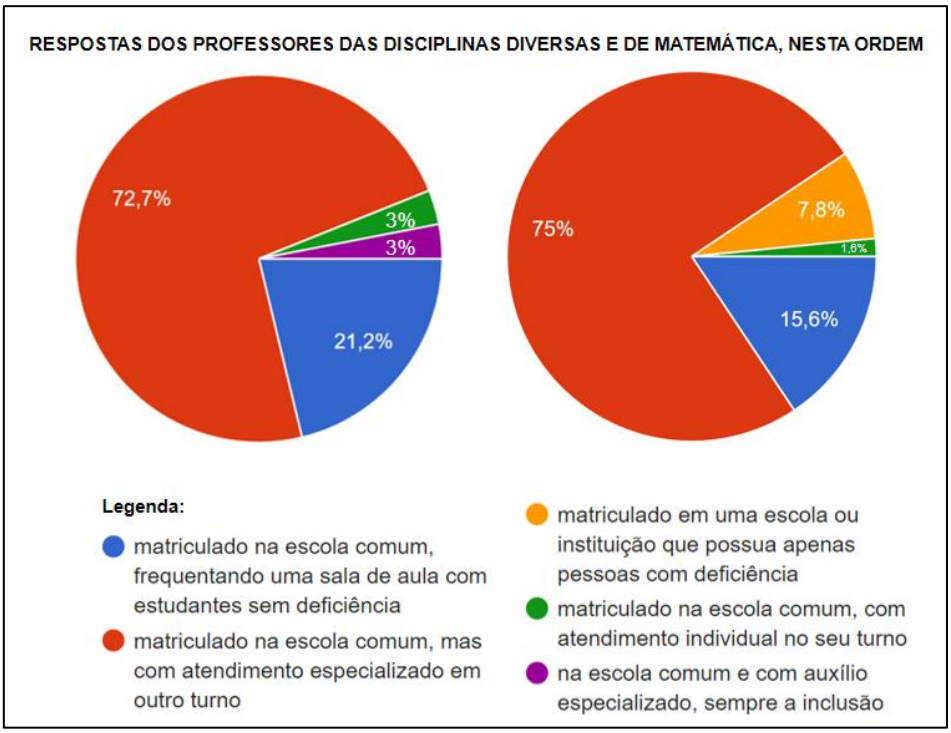
In order to identify the positioning of the teachers in relation to the enrollment of visually impaired students, Question 1 was formulated: "About the appropriate school for the visually impaired student, do you advocate that he should be:".

For most teachers (72.7% in the case of teachers of different subjects and 75% among mathematics teachers), students with visual impairment should be enrolled in the regular school, as long as they have specialized care in another shift in the multifunctional resource room. This condition is a result of the difficulty that teachers say they face in instructing these students, mainly because they reveal that they do not have specific materials for this audience. The issue is that most of the time, there is no dialogue between the regular class teacher and the SEA professionals, nor a collaborative teaching with an emphasis on the Individualized Educational Plan (PEI), according to the assumptions of the Statute of Persons with Disabilities – Law No. 13,146/2015 (Brazil, 2015). As a result, there is sometimes a transfer of responsibility, especially when there is no dialogue and partnership in the school.

On the other hand, there were teachers who unconditionally defended the enrollment of students in the regular classroom (21.2% in the case of teachers of various subjects and 15.6%

among Mathematics teachers). In addition, attention was drawn to the fact that 7.8% of the mathematics teachers advocated the enrollment of visually impaired students in a classroom exclusively for students with disabilities, which, according to the current educational legislation, is not recommended, since, preferably, all students should attend regular school (Brazil, 1996).

Figura 2: Summary of the answers to Question 1, Teachers of various subjects and Mathematics teachers



Source: Survey Data

This finding signaled that the school needs to make great strides in ensuring that all students have the opportunity to learn, according to their characteristics. In the case of blind students, the greatest difficulty pointed out seemed to be related to the scarcity of resources compatible with the language of this public: manipulable materials, Braille writing or other devices typical of assistive technologies (Sá, Campos & Silva, 2007; Silva, Carvalho & Pessoa, 2016). Ensuring fair access to all mathematical knowledge is a student's right that needs to be guaranteed by the school, as pointed out in the assumptions of Collaborative Mathematics Education.

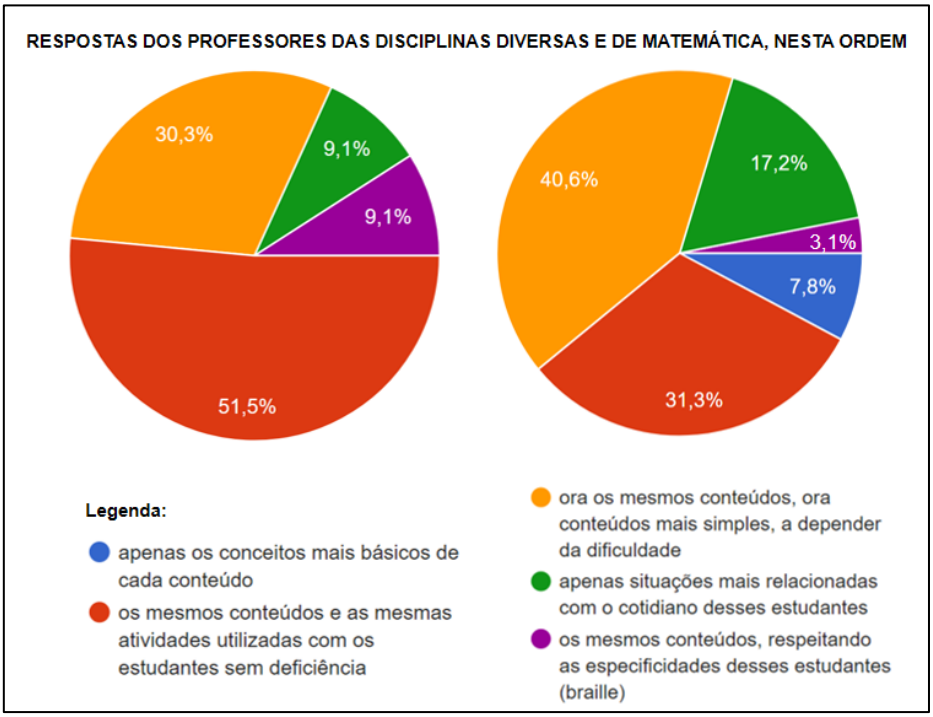
In this sense, the intention of Question 2 was to investigate how teachers would deal with mathematical knowledge with visually impaired students: "About the contents (learning expectations) worked with this student, you would experience:"

The comparison of the answers given by the teachers of the various disciplines and of Mathematics, at first, already reveals certain distances in the understanding of these two groups. Teachers of different disciplines seemed to lean towards a closer understanding of the assumptions of inclusion than those who taught Mathematics, since, as shown in Figure 3, they signaled confidence in a less segregated school. The discourse produced by the school both justifies and legitimizes the teaching action, assuming contours of truth, as recalled by Bovo (2011).

In this context, it was observed that, while 51.5% of the teachers of various disciplines defended addressing all the contents of the curriculum without distinction in the class, regardless of the characteristics or disabilities of the students, only 31.3% of the mathematics

teachers shared this perspective. Another aspect that evidenced a certain discrepancy between the mathematics teachers and the others, is the finding that 40.6% of the teachers of this discipline proposed the approach of the contents with students with visual impairment based on their complexity. This thesis, in turn, was accepted by 30.3% of the professors of the various disciplines. The fact that almost half of the mathematics teachers consider that, sometimes, the most appropriate thing is to select only content with less complexity may signal a certain disbelief in the learning of students with disabilities, that is, there seems to be no hope in the student's learning capacity, regardless of the content, according to the first expectation pointed out by Collaborative Mathematics Education.

Figure 3: Summary of the answers to Question 2, Teachers of various subjects and Mathematics teachers



Source: Survey Data

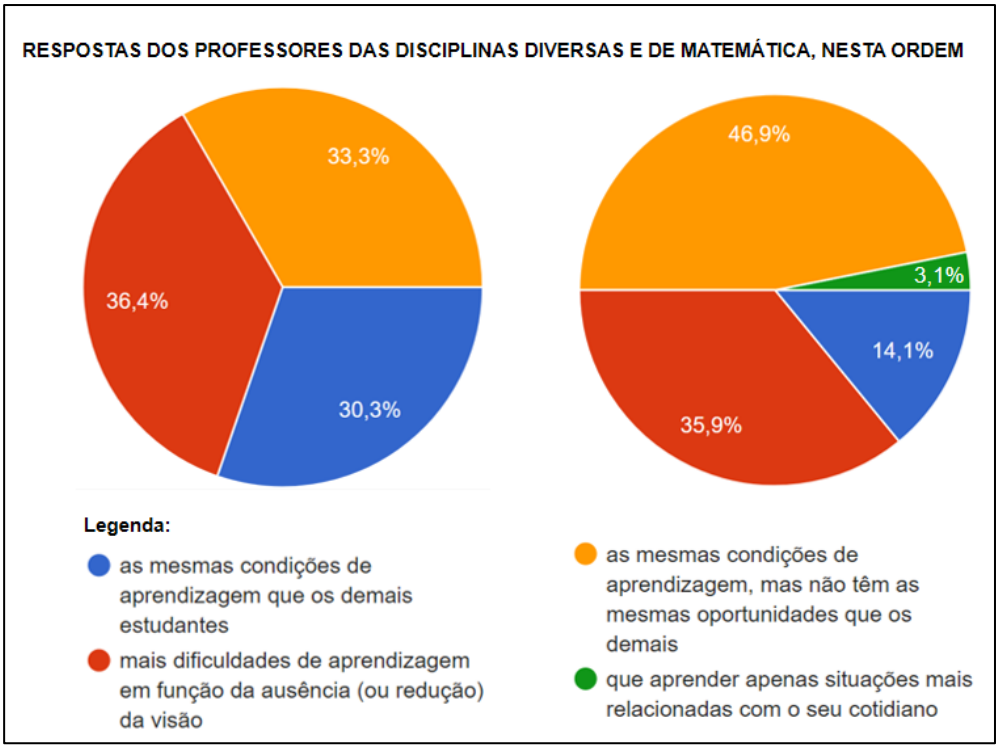
Also, in the same perspective, it was found that 9.1% of the teachers of different disciplines and 17.2% of the teachers of Mathematics ratified the idea of treating, in the classroom, only the most useful topics directly related to the daily lives of students with disabilities. This proposal, of a shorter curriculum for people with disabilities perpetuates stereotypes associated with exclusion and segregation and transfers the responsibility for school failure to the student (Cruz & Maia, 2006). When this occurs, the school isolates the student due to their singularities and diversity; instead of being an effective variable for learning, it becomes an impediment or obstacle to be overcome, which is contrary to Collaborative Mathematics Education.

Equality of educational conditions must be guaranteed to all students and, under no circumstances, can this right be circumvented, even under the pretext of an education limited to the immediate needs of this public. Determining what is conceptually useful to the reality of a group of students, denying them the right to learn according to their characteristics, can reveal the conviction that visually impaired people are incapable of going beyond the context of dependence and limitation in which they live and compromises the development of the whole society, since the right to meaningful participation in part of it is denied (UN, 2018). In fact, Collaborative Mathematics Education proposes that inclusion is a process of social development and not an individual one.

When a person with a disability is denied access to fair learning opportunities, the harm is not just to that person; in fact, all of humanity loses. A teacher, a researcher, an articulator for the promotion of peace and social justice or the developer of a vaccine for a virus that would put the entire population at risk, are having their trajectories interrupted before they even begin; hence, the relevance of Education in the 21st Century being committed to humanism (Kistemann Junior & Silva, 2012). The fact is that there is no inclusion if everyone does not learn (Viginheski et al., 2014).

Question 3 – Regarding the learning of visually impaired students, do you believe they have... – proposed to bring to light what the participants think about the learning possibilities of visually impaired students, including in relation to the cognitive and intellectual conditions of this public.

Figure 4: Summary of the answers to Question 3, Teachers of various subjects and Mathematics teachers



Source: Survey Data

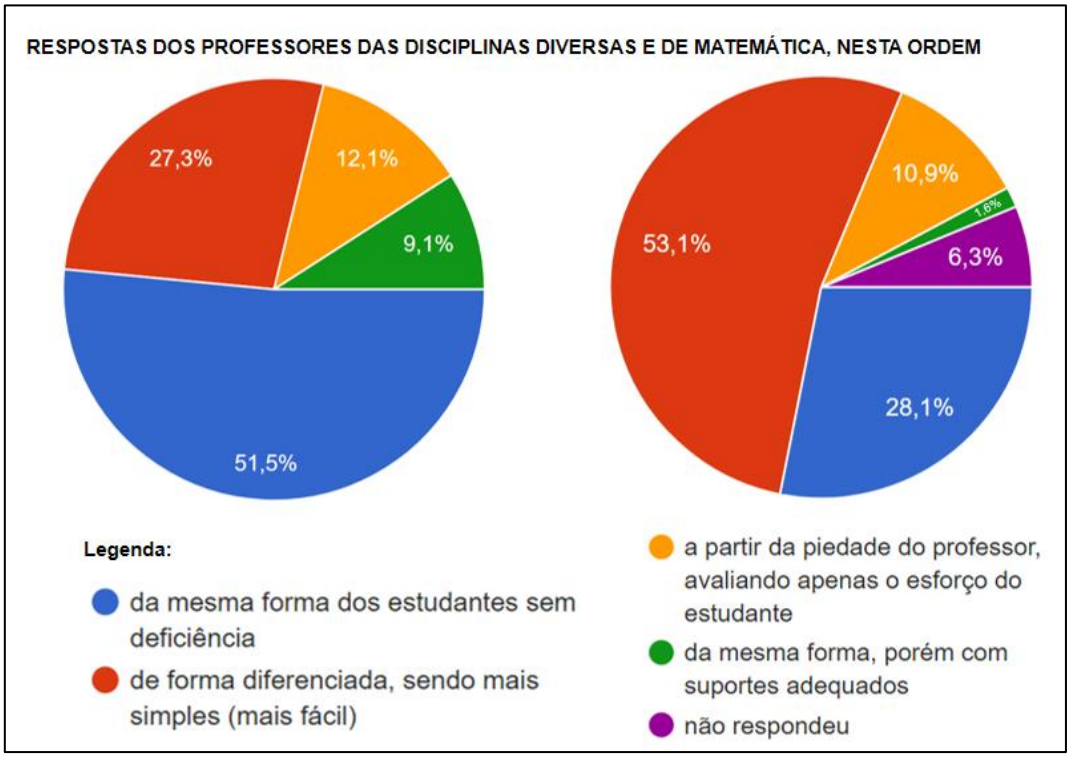
In this case, 36.4% of the teachers of the various disciplines and 35.9% of those who work in the teaching of Mathematics believed that students with visual impairment faced more learning difficulties due to the absence or reduction of vision, compared to other students, which suggests the recognition of teachers on the school's lack of equity in the fair service to all students, that is, the resources compatible with its characteristics are not offered (Landim, Maia & Sousa, 2023). Although pointed out as a student's learning difficulty, the ostensible association between visual impairment and learning difficulty brings to light structural prejudices in relation to people with disabilities. Confronting ableism can be achieved by promoting activities that encourage collaborative teaching and learning.

When the school is capable of understanding that all students have learning characteristics that are particular to them and offers the necessary resources for the development of the whole class, obstacles and difficulties are overcome in a less hostile way. Inclusivist ideals and Collaborative Mathematics Education presuppose that the school is capable of meeting the educational needs of minorities. The data revealed that, for 46.9% of the mathematics teachers, students with visual impairment are recognized as having learning

conditions comparable to those of the others. However, this perception contrasts with the fact that these students do not have access to the same learning opportunities, a finding shared by 33.3% of the professors of various disciplines. The mismatch between the recognition of equality in learning conditions and in comparison, the lack of equity in access, reveals the need for a deeper reflection on inclusion in school, in general, and in the mathematics classroom, in particular (Cruz & Maia, 2006; Lira & Brandão, 2013).

Regarding how the learning of these students is assessed, Question 4 presented the following proposition: "The assessment and approval of students with disabilities usually occurs..."

Figure 5: Summary of the answers to Question 4, Teachers of various subjects and Mathematics teachers



Source: Survey Data

The first finding revealed a significant gap between the perspectives of teachers of different subjects and mathematics teachers. While in the first group, the majority of teachers (51.5%) considered that the evaluation occurred in the same way for all students, in the case of Mathematics teachers, only 28.1% shared this perception. The majority of Mathematics teachers (53.1%) revealed that the evaluation process was simpler, probably marked by attachment to the students' inability to develop the same mathematical skills as their colleagues without disabilities. As a result, they eventually revealed low expectations in the learning of Mathematics by visually impaired students (Rodrigues, 2012). Still, according to Fernandes and Healy (2007), the differential used in this case is not far from favoring the progress of these students. Once again, the lack of hope in the learning capacity of students with disabilities was observed, highlighting the relevance of Collaborative Mathematics Education in order to challenge and overcome ableist representations, when it proposes the evaluation of the student based on their advances, achievements and limitations and opposes rankings, comparisons with peers, billboards and awards for "outstanding students" or pre-established goals that emphasize quantitative criteria to the detriment of the qualitative development of each person.

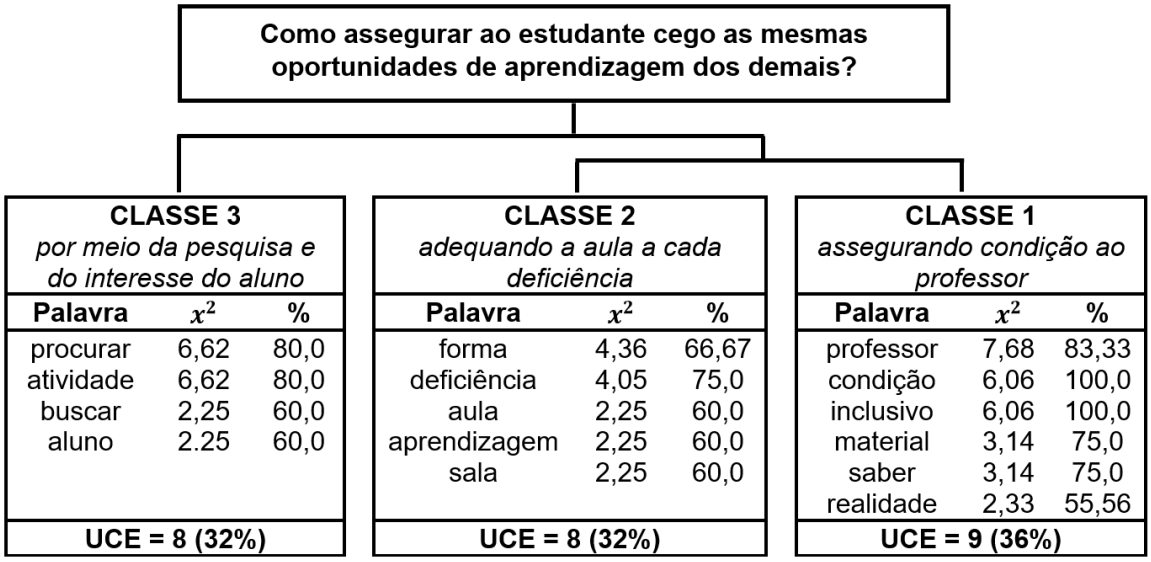
The fact is that, almost always, the school reinforces competitive behaviors that are far

from cooperation; Eventually, the short list of "outstanding students" glosses over the advancements, potentialities, and diverse abilities of all other students; Even with the best of intentions, the stimulus to competition and the desire for a place on the disputed mural or billboard of the school is typical of educational exclusion. While Inclusive Education and Collaborative Mathematics Education propose the promotion of development of socio-emotional skills, such as empathy, collaboration and communication to strengthen the learning environment.

Nevertheless, it seems that Mathematics is a subject even further away from inclusion than the others in the school curriculum. The difficulty of evaluating visually impaired students in the same conditions as others, safeguarding their particularities and using appropriate resources, may be an indication that on a daily basis, especially in the mathematics classroom, equity seems to be a utopia when learning is under analysis (Fernandes, 2004; Cruz & Maia, 2006; Landim, Maia & Sousa, 2023). Regarding equal conditions in the evaluation process, only 9.1% of the teachers of the various subjects and 1.6% of those who worked in the teaching of Mathematics proposed that the evaluation should occur in the same way, using the appropriate supports, such as the evaluation in Braille, embossed or expanded, as long as the students participate in this choice (UN, 2018).

Figure 6 shows the dendrogram prepared from the IRaMuTeQ software with the answers given by the professors of the various disciplines to Question 5.

Figure 6: Classes Dendrogram from the answers to Question 5 by teachers of different disciplines



Source: Research Data. Legend: % - percentage of the word in the class (ST) in relation to the corpus; x^2 – qui-quadrado

The first partition separated Class 3 from the others. Then a new development brought Classes 2 and 1 to the forefront. Class 3 indicated that the provision of adequate conditions for the learning of blind students depends on research and student interest. Class 2, in turn, seemed to reveal an understanding that the class needs to be suitable to the characteristics of this audience, which is aligned with Inclusive Education (Brazil, 2015) and, consequently, with Collaborative Mathematics Education. Class 1 announced the requirement of adequate conditions for teachers, as one of the participants revealed, as an example: "the teacher will not be able to provide learning to that student, unless the state provides support" (History Teacher/Group of different subjects, between five and ten years of experience, over 38 years old, no experience with blind students).

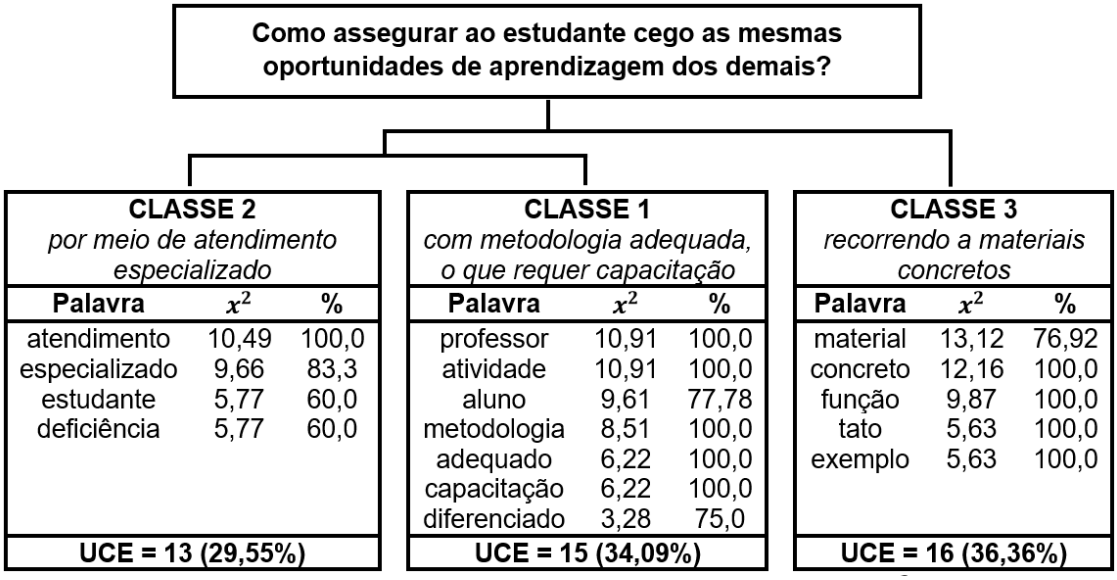
The understanding that seemed to emerge from the participants whose answers were

organized in Class 1 was that the necessary conditions for the inclusion of these students in an adequate way did not constitute a reality. For this group, when the school did not have a structure compatible with the needs of the student with disabilities, the best course of action should be not to receive him, as the Professor says: "First of all, the school has to be inclusive. To have accessibility, trained teachers, because talking about inclusion is easy, it is difficult to give accessibility, to assert rights, to get from paper to reality... We can't receive people with disabilities if we're not prepared to receive them." (Teacher graduated in Social Work/Group of various disciplines, less than five years of experience, over 38 years old, no experience with blind students).

It should be noted that, according to Brazilian legislation, schools are prohibited from rejecting the enrollment of students with any type of disability (Brazil, 2015), even under the pretext that, in another space, the student would receive more appropriate care. Despite the teachers' manifestation that the school does not have the necessary resources and means to promote inclusion, enrollment in the regular school, in addition to being a right, is also a necessity for everyone to progress from the coexistence and appreciation of diversity so that barriers, stereotypes and ableist attitudes can be analyzed and transformed into inclusion.

In the case of the group made up of Mathematics teachers, regarding Question 5, three classes were also arranged by IRaMuTeQ to organize the answers to this question, as follows:

Figure 7: Classes Dendrogram from the answers to Question 5 by mathematics teachers



Source: Research Data. Legend: % - percentage of the word in the class (ST) in relation to the corpus; x^2 – qui-quadrado

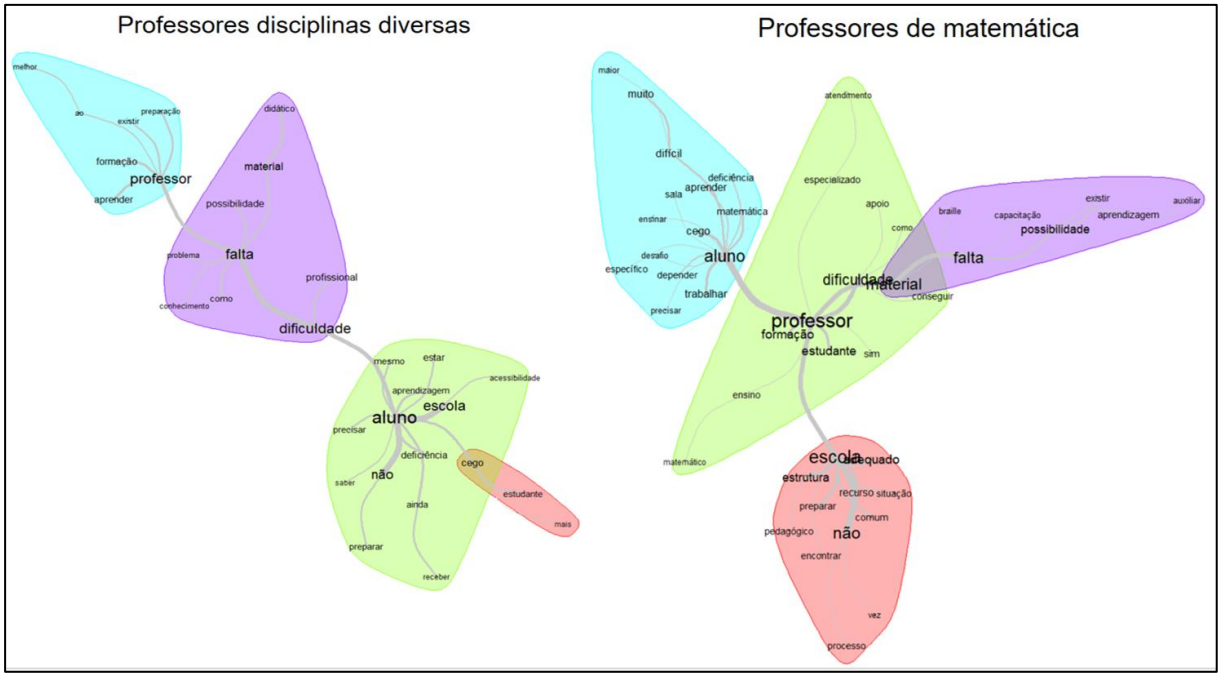
The first partition, generated Class 3 and the second partition, Classes 2 and 1. Class 2 accommodated the answers that pointed to specialized care as a way to guarantee learning, which corresponded to 29.55% of all the text considered by the software in this question. Class 1, complementary to Class 2, was composed of teachers who defended the use of appropriate methodologies based on specific training. Finally, Class 3 indicated the use of concrete materials as a possible learning strategy.

The teachers' answers converge with regard to the need to ensure conditions and support for the teacher and seem to diverge in at least two aspects: the former transfer part of the responsibility for learning to the students themselves, while the mathematics teachers reinforce the relevance of specialized care and the use of appropriate methodologies. Dias and Santos (2010) found that Mathematics teachers were not prepared to work with visually impaired

students, which is clear in this study, mainly from the tendency to outsource responsibility by the participants of the two groups, when they indicate as a condition for learning the interest of the blind student, specialized care, methodological adaptation, teacher training, offering conditions to the teacher and the use of concrete materials, diverging from the expectations of Collaborative Mathematics Education, especially when it suggests a pedagogical personalization based on the promotion of the idea that school Mathematics should not be adapted to the student, but developed from their experiences.

For the analysis of the answers given to Question 6 (In general, how do you evaluate the possibilities of blind students learning in regular schools and what difficulties existing in school can hinder this process?), the IRaMuTeQ similarity analysis was used, since, in this question, the minimum retention of 75% of the text segments was not reached, is as recommended for CHD class analysis (Carmago & Justo, 2013).

Figure 8: Result of the similarity analysis - Question 6



Source: Survey Data

According to the teachers of both groups, the blind student faced many difficulties and obstacles that compromised learning. Among the main complications, the lack of specialized professionals, the lack of material and the scarcity of specific training were highlighted. In both cases, almost all of the co-occurrences reinforced what is missing in the school so that the blind student can be reached more efficiently.

In this regard, the success in Mathematics of visually impaired students seems to be compromised due to the limitations of the school system. The difficulties mentioned by the teachers seemed to point in the direction of the existence of a gap between students with and without disabilities. The fact is that, as already discussed in this study, low vision or blindness cannot be considered obstacles to learning (Fernandes, 2004).

Incidentally, even among students without visual impairment, the learning of mathematical knowledge is already much lower than the minimum expected. Indeed, what can we expect from the mathematical skills of students with disabilities, particularly those with visual impairment, when the scenario described seemed to highlight the ills of an educational system that is far from reaching all students equally? "Some factors hinder this process, for

example, the teacher's academic training, which is not adequate to work with students who have some type of disability, insufficient time to work on the contents, scarce material that does not exist for these people, and so on." (Mathematics teacher, less than five years old, between 18 and 24 years old, has experience with blind students).

This set of adversities that permeated the school, gradually, seem to suffocate even the teachers' belief in relation to the learning of these students. "The possibilities are few due to the lack of training of mathematics teachers to work with this student, lack of appropriate material for the student and the lack of a companion." (Mathematics teacher, between five and ten years of experience, between 25 and 31 years old, has experience with students with physical disabilities).

In summary, it was noted that the teachers' understanding of students with disabilities, particularly those with visual impairment, was still strongly marked by remnants of exclusion. Such people, instead of being seen from the point of view of their potentialities and competences, are seen as "all disabled", it is the crystallization of the view around disability (Tavares, 2012).

The participants' understanding of the limitations and obstacles faced by these students to the detriment of highlighting their competencies seemed to reveal that inclusion is seen as an action of goodwill on the part of the government agencies responsible for what happens in the school. In addition, it demonstrated the complexity of Mathematics to blind students due to the school reality (Fernandes & Healy, 2007). On the other hand, it is important to highlight the understanding of many of the participants about the right to learning and the concern with equal conditions, aligning with the assumptions of inclusion (UN, 2018; Brazil, 2015).

The lack of training, pedagogical resources and skills for the use of an appropriate language was pointed out by teachers as the main difficulties in the inclusive Mathematics class, which had also been found in other investigations (Dias & Santos, 2010; Rodrigues, 2012; Landim, Maia & Sousa, 2023). The teachers' answers to the questionnaire indicate the need for collaborative actions with the school, avoiding the isolation of students with disabilities and the lack of definition of which professional is responsible for their learning (Mendes, 2006). On the other hand, this study recognizes the commitment and hope of teachers in favor of inclusion, also highlighting the need for expansion, renewal and collaboration in public policies aimed at the school. This perspective should provoke, above all, the revision of national laws and guidelines in order to situate and stimulate collaborative education in an explicit way and the prior dialogue of the school in the face of the differentiation of resources or methodological procedures with the visually impaired student, avoiding misconceptions or ableist labels, as expected in Collaborative Mathematics Education.

6 Final Thoughts

This text sought to answer the question: what specificities in the inclusion of visually impaired students in school are recognized by teachers? Data was collected from a questionnaire applied to 65 teachers who taught Mathematics and 33 who taught other subjects.

For the participating teachers, blind students still faced important difficulties in the learning process, especially with regard to the scarcity of specialized professionals, material and specific training. Both the mathematics teachers and the others reinforced the relevance of the school in ensuring conditions and support to the teacher so that they can meet the expectations of Inclusive Education. While teachers of other disciplines pointed out that part of the responsibility for learning lies with the student himself, mathematics teachers reinforce the relevance of specialized care and the use of appropriate methodologies.

Teachers of different disciplines expressed the understanding that people with disabilities should have, as a priority, respect and concern with the guarantee of opportunities, but they also considered the face of exclusion identified in the school scenario, as pointed out. The understanding of the mathematics teachers, in this aspect, indicated a relevant approximation with that of their colleagues from other areas, but they attributed less value to the adversities faced by students with disabilities.

The reading and analysis of the results in the light of the propositions of the literature indicate that the school has not yet been able to ensure in a fair way the learning of all students in the class, especially those with visual impairment due to the attachment to a school tradition that considers Mathematics as absolute knowledge to which the student must be subordinated. Indications of the teacher's exemption from liability with the student with disabilities also come to light. In this way, Collaborative Mathematics Education can be presented as adequate to break the segregation and transfer of roles by the school in the face of the mathematical conceptualization of students (Mendes, 2006; Ribeiro, 2019).

Collaborative Mathematics Education maintains that the mathematics class and learning resources need to be meaningful for each student, considering their values, beliefs, potentialities and limitations. Just describing or interpreting the content in class does not guarantee inclusivity. To achieve this, it is essential to implement public policies aimed at teacher training. The deconstruction of prejudices, the attribution of responsibilities and the pedagogical personalization of the class are only possible when the teacher has access to knowledge and cultivates the hope that everyone is capable of learning any content, as long as fair and equitable conditions are ensured.

The fact is that many questions related to the comprehension and presentation of possibilities that can contribute to the teaching activity remain unanswered. Thus, it is essential to develop other studies in order to shed light on the ills still faced by the school and delay the right to learn of all students in fair and equitable conditions, according to their singularities. In this regard, the development of proposals that favor the use of collaborative practices in the mathematics classroom deserves to be highlighted.

References

Abreu, E. E. & Silva, E. L. (2023). A utilização de jogos como recurso didático no ensino de números racionais na representação fracionária. *Revista Internacional de Pesquisa em Educação Matemática*, *13*(2), 1-17.

Antipoff, H. (1992). Pensamentos de Helena Antipoff. *Fundamentos da Educação*. Belo Horizonte: Imprensa Oficial/Centro de Documentação e Pesquisa Helena Antipoff. (2), 401-3.

Bovo, A. A. (2011). *Abrindo a caixa preta da escola: uma discussão acerca da cultura escolar e da prática pedagógica do professor de Matemática*. Tese (Doutorado em Educação Matemática). Universidade Estadual Paulista, Rio Claro, SP.

Brasil. *Decreto nº 5.296, de 02 de dezembro de 2004* (2004). Regulamenta as Leis nos 10.048, de 8 de novembro de 2000, que dá prioridade de atendimento às pessoas que especifica, e 10.098, de 19 de dezembro de 2000, que estabelece normas gerais e critérios básicos para a promoção da acessibilidade das pessoas portadoras de deficiência ou com mobilidade reduzida, e dá outras providências. Brasília, DF.

Brasil. *Lei nº 13.146, de 06 de julho de 2015* (2015). Institui a Lei Brasileira de Inclusão da Pessoa com Deficiência (Estatuto da Pessoa com Deficiência). Brasília, DF.

Brasil. *Lei nº 9.394, de 20 de dezembro de 1996* (1996). Estabelece as diretrizes e bases da educação nacional. Brasília: MEC.

Brasil. Ministério da Educação. Secretaria de Educação Especial. (2001). *Diretrizes nacionais para a Educação Especial na Educação Básica*. MEC/SEESP. Brasília, DF.

Braun, P. & Marin, M. (2016). Ensino colaborativo: uma possibilidade do Atendimento Educacional Especializado. *Revista Linhas*, *17*(35), 193-215.

Camargo, B. V. & Justo, A. M. (2013). IRAMUTEQ: Um software gratuito para análise de dados textuais. *Temas em Psicologia*, *21*(2), 513-518.

Cruz, F. M. L. & Maia, L. S. L. (2006). O que dizem professores e alunos sobre o fracasso escolar em Matemática: interfaces entre as representações sociais e o desempenho escolar. In *Anais do 1º Simpósio Internacional de Pesquisa em Educação Matemática* (pp. 1-17). UFPE: Programa de Pós-graduação em Educação.

Dias, M. O. & Santos, M. S. (2010). O geoplano como recurso de aprendizagem da geometria plana para deficientes visuais: uma experiência com os alunos do Instituto Benjamin Constant. *Boletim GEPEM*, (56), 105-116.

Fernandes, S. H. A. A. (2004). *Uma análise vygotskiana da apropriação do conceito de simetria por aprendizes sem acuidade visual*. Dissertação (Mestrado em Educação Matemática), Pontifícia Universidade Católica de São Paulo. São Paulo, SP.

Fernandes, S. H. A. A. & Healy, L. (2007). Ensaio sobre a inclusão na Educação Matemática. *UNIÓN: Revista Iberoamericana de Educación Matemática*, (10), 59-76.

Instituto Brasileiro de Geografia e Estatística (IBGE). (2023). *Pnad Contínua 2022*: Pessoas com deficiência. Brasília, DF.

Kistemann Junior, M. A. & Silva, G. H. G. (2012). O professor de Matemática e a investigação em sala de aula quadro a quadro. B*oletim GEPEM*, (60), 93-107.

Landim, E. (2018). *Nenhum a menos na aula de matemática: representações sociais de inclusão de estudantes com deficiência visual e seus impactos na aprendizagem de razões trigonométricas.* Tese (Doutorado em Educação). Universidade Federal de Pernambuco. Recife, PE.

Landim, E.; Maia, L. S. L., & Sousa, W. P. A. (2023). O desenvolvimento de competências em trigonometria por estudantes cegos. *Revista Benjamin Constant*, Rio de Janeiro, *29*(67).

Lira, A. K. M. & Brandão, J. (2013). *Matemática e deficiência visual*. Fortaleza: Edições UFC.

Mantoan, M. T. E. (2002). *A Educação Especial no Brasil:* da exclusão à inclusão escolar. São Paulo: LEPED/UNICAMP.

Marconi, M. A. & Lakatos, E. M. (2010). *Fundamentos de Metodologia Científica*. 7. ed. São Paulo: Atlas.

Mazzotta, M. J. S. (2005). *Educação Especial no Brasil*: História e políticas públicas (5ª ed.). São Paulo: Cortez.

Mendes, E. (2006). Colaboração entre ensino regular e especial: o caminho do desenvolvimento pessoal para a inclusão escolar. In E. J. Manzini, (Org.). *Inclusão e acessibilidade*. Manaus, 29-41.

Organização das Nações Unidas para a Educação, a Ciência e a Cultura (Unesco). (1948). *Declaração Universal dos Direitos Humanos*. Paris, 10 dez. 1948.

Organização das Nações Unidas. (2018). *Convenção sobre os Direitos das Pessoas com Deficiência*. New York, 3 out. 2018.

Ribeiro, R. M. (2019). A prática de colaboração no âmbito do PIBID e sua contribuição para a discussão acerca dos conhecimentos didático-matemáticos para o ensino da Matemática. *Revista Internacional de Pesquisa Em Educação Matemática, 9*(2), 13-29.

Rodrigues, M. C. (2012). *Representações de professores acerca da inclusão de alunos com deficiência visual no ensino regular*. Dissertação (Mestrado em Educação). Universidade Nove de Julho. São Paulo, SP.

Sá, E. D.; Campos, I. M. & Silva, M. B. C. (2007). *Atendimento Educacional Especializado: deficiência visual*. SEESP/SEED/MEC. Brasília, DF.

Silva, M. D.; Carvalho, L. M. T. L. & Pessoa, C. A. S. (2016). Material manipulável de geometria para estudantes cegos: reflexões de professores brailistas. *Revista Paranaense de Educação Matemática*, *5*(9), 176-202.

Tavares, F. S. S. (2012). *Educação não inclusiva: a trajetória das barreiras atitudinais nas dissertações de Educação do Programa de Pós-Graduação em Educação (PPGE/UFPE).* Dissertação (Mestrado em Educação). Universidade Federal de Pernambuco. Recife, PE.

Viginheski, L. V. M.; Frasson, A. C.; Silva, S. C. R. & Shimazaki, E. M. (2014). O sistema Braille e o ensino da Matemática para pessoas cegas. *Ciência & Educação* (Bauru), *20*(4), 903-916.