



Teaching mathematics and inclusion of people with visual impairments:

Teaching mathematics and inclusion of visually impaired people^{two}

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Submitted on: 01/20/2023

Approved on: 01/21/2023

Published on: 01/25/2023 DOI

10.51473/ed.al.v3i1.475

SUMMARY

This work discusses the process of including students with visual impairments in regular classrooms, especially for teaching Mathematics. **Goal:** reflect on the importance of teacher training to teach mathematics to students with total or partial visual impairment in order to guarantee school inclusion. **Methodology:** This is a bibliographic review study, whose scientific production survey was carried out in theses and dissertations published in Portuguese without a defined period. The searches were carried out in the Scielo database and in the Public Domain. Regarding data analysis, bibliographic material was first selected based on previously established parameters. The next stage consisted of analyzing this information, considering mainly the content of the statements contained in the selected texts. The data were analyzed based on qualitative procedures in which it was possible to compose an explanatory analysis. **Results and discussions:** Despite the scarcity of materials found in the literature on the subject, they affirm the importance of training teachers to teach mathematics to visually impaired people and emphasize the need to develop research that contributes to the training of mathematics teachers, aiming to enable them to teach a student with visual impairment in their classroom. **Final considerations:** It is necessary to have a humanized look at the real needs of all students, at all levels of education, so that participants in the teaching-learning process are imbued with the same spirit: the construction and development of the human being.

Key words: Inclusion - visual impairment - Mathematics - training

ABSTRACT

This paper discusses the process of inclusion of students with visual disabilities in regular classrooms, for the teaching of Mathematics. **Objective:** To reflect on the importance of teacher training for teaching mathematics to students with full or partial visual impairment in order to ensure school inclusion. **Methodology:** This is bibliographic review, whose scientific production survey was conducted of published theses and dissertations in English without a defined period. The surveys were conducted in the Scielo database and the Public Domain. Regarding data analysis, first you selected the bibliographic material from the previously established parameters. The next step was the analysis of this information, considering mainly the content of the statements contained in the selected texts. The data was analyzed based on qualitative procedures in which it was possible to write an explanatory analysis. **Results and discussion:** Despite the shortage of materials found in the literature on the subject, affirms the importance of teacher training for the teaching of mathematics to visually impaired and underscores the need for further research, to contribute to the training of mathematics teachers, aimed at training these to teach a student with visual impairment in their classroom. **Final Thoughts:** It is necessary to have a humanized look at the real needs of all students, at all levels of education, so that the participants in the teaching-learning process are imbued with the same spirit: the construction and development of the human being.

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1. INTRODUCTION

According to article 205 of the 1988 Federal Constitution, "Education, the right of all and the duty of the State and the family, will be promoted and encouraged with the collaboration of society, aiming at the full

¹Article presented to the Specialization in Teaching program in Higher Education at Faculdades Metropolitanas, as a final requirement to obtain the title of Specialist. **Advisor:** Prof. Ms. Janaína Maria Ralo.

^{two}Article presented to the Specialization program in Teaching in Higher Education of metropolitan colleges, as a final requirement to obtain the title of Specialist. **Advisor:** Prof. Ms. Janaína Maria Ralo.



development of the person, their preparation for the exercise of citizenship and their qualification for work" (BRASIL, 1988).

Therefore, all individuals must be aware that society must be structured to serve all citizens, including those with special educational needs.

According to the Ministry of Education and Culture, the number of people with disabilities enrolled in the regular basic education network in 1998 was 200 thousand, in 2014 there were approximately 900 thousand (MEC, 2015).

The Department of Special Education classifies students who require special education as follows: those with mental, visual, hearing, physical or multiple disabilities, those with typical behavior (conduct problems) and those with giftedness (SEESP/MEC - 1994) .

According to data from the 2014 INEP/MEC School Census, the number of enrollments in Inclusive Education, that is, the number of students with disabilities enrolled in regular schools has increased in recent years. In 2008 there were 507,971 students enrolled, in 2014, 1,074,543.

Inclusive Education has been growing in the country, albeit slowly, as there are laws that define it such as the Law of Guidelines and Bases of National Education - Law nº 4,024/61 and Law nº 9,394/96, Law 5,692/71, the Statute of Children and Adolescents – ECA, Law No. 8069/90, Decree-Law 3298/99 and Law 13,005/2014 that establishes the National Education Plan.

Currently, people with disabilities circulate in any and all public spaces, but many actions are necessary in the health field so that the principles set out in law actually occur. The Convention on the Rights of Persons with Disabilities, in its article 4, paragraph i, encourages the promotion and training of professionals and teams that work with people with disabilities, in order to be able to provide better assistance and services ensuring such rights. In article 25 of this Convention, it is stipulated that health professionals provide care with the same standard and quality as that provided to people without disabilities.

Law No. 13,146 of July 6, 2015 (Brazilian Law for the Inclusion of Persons with Disabilities), in its article 2, considers that a person with a disability is one who has a long-term impairment of a physical, mental, intellectual or sensory nature, which, in interaction with one or more barriers, can obstruct their full and effective participation in society on equal terms with other people. The law is intended to ensure and promote, under conditions of equality, the exercise of fundamental rights and freedoms for people with disabilities, aiming at their social inclusion and citizenship (BRASIL, 2015).

The International Classification of Functioning (ICF) distinguishes disability from disability from following way:

- "Disability: Any loss or abnormality of a psychological, physiological or temporary or permanent anatomical.
- Disability: Restriction resulting from a deficiency in the ability to perform an activity considered normal that arises as a direct consequence or response of the individual to a disability" (CIF, 2003, p. 267)

The understanding that disability is a condition that involves the entire society, brings the proposition of eliminating physical and social barriers, in order to favor social interaction. In this way it becomes

two It is imperative to extend the discussion on inclusion to all curricular components, and not just limit it to literacy.

Regarding the theme of this study, Decree No. 5,296 of December 2, 2004 defines that the visual efficiency occurs when the person's visual acuity is equal to or less than 20/200 in the better eye, after the best correction, or a visual field less than 20° (Snellen table), or simultaneous occurrence of both situations (BRASIL, 2004) .

To create an adequate school inclusion process, it is necessary to offer teachers humanistic training, which addresses situations of disability and the special needs of each person. The legislation ensures the inclusion of people with disabilities in the regular education network and provides specialized educational assistance (BRASIL, 2011). However, despite the changes made by the new curricular guidelines, the truth is that teacher training, for the most part, still does not delve into the topic and institutions have curricula and programs that are not very flexible.

Education systems need to provide the necessary support for teacher qualification, placing them in a social context in which science and new technologies can bring knowledge that needs to be socialized. Inclusive schools must not only enroll students with disabilities, but also provide all students with education that helps them develop. In this context, the teacher has a necessary and indispensable role for a real and effective inclusion process.

Teaching strategies for each type of disability must be worked on during teacher training, so that they are able to develop individual projects that can be worked on by the entire group in a classroom. , the student's pace and way of learning, considering their special needs.

In the case of visually impaired people, it is possible for them to learn about objects in the world and theories through equations, chemical formulas and even experiments. The knowledge of these people develops through mental processes associated with experiences linked to the other senses: hearing, smell, touch, taste.

Inclusion is still a new topic for Mathematics Education and still little researched, with little work and research completed (GASPAR, 2013; ARAUJO, 2005).

Regarding visual impairment, teaching mathematics becomes even more challenging, as it is necessary to show the student geometric shapes, representations of numbers, for example. However, for visually impaired people, especially those with congenital disabilities, the learning process ends up being difficult, since they do not have visual memory. However, it is necessary to develop methods through the other senses, creating associations so that they can identify the figures and solve problems.

According to the 2010 Census of the Brazilian Institute of Geography and Statistics, there were approximately 506 thousand people in Brazil who declared a total inability to see (IBGE, 2010).

And according to the 2005 INEP/MEC School Census, Brazil had around 63,000 students with visual acuity outside normal standards enrolled in Special or Regular Schools.

However, despite the lack of research on the subject, there are researchers who have proposed initiatives, such as IT applications, to address the needs of each student in regular classrooms. The Mathematics Teacher's knowledge of these new practices is defended by the Towards Inclusive Mathematics Education project team, which brought together researchers, teachers and students to develop inclusive scenarios for mathematical learning, such as:

- MATRIZMAT: Tool designed to offer different sensory stimuli for learners with visual impairments in inclusive classes, in order to facilitate access to the mathematical concept of matrices (SILVA,2012)
- RHYTHMATIC: Microworld in which the student can work mathematically with sound and/or with visual and dynamic images to explore ideas related to ratio and proportion. The starting point for its design was the use of rhythms and polyrhythms as mathematical expressions. (CARRILHO,2013)

Despite being scarce, there are initiatives to enable learning for students with visual impairments to



the teaching of mathematics, following the example of the experiences mentioned above, however, the question arises: how have teachers been trained so that they can teach mathematics to students with visual impairments?

In view of the above, the objective of this article is to reflect on the importance of teacher training for teaching mathematics to students with total or partial visual impairment in order to guarantee school inclusion.

2 METHODOLOGY

This is a bibliographical review study, whose survey of scientific production was carried out in theses and dissertations published in Portuguese without a defined period, that is, all publications available in the literature will be included in the study, since there is a significant lack of studies in relation to the topic. The searches were carried out in the SCielo database and in the Public Domain.

The terms used for the search were: Inclusion, Inclusive Education, Inclusive Mathematics, Disability visual.

Regarding data analysis, bibliographic material was first selected based on previously established parameters, taking into account the following selection criteria: studies that addressed the importance of training teachers to the teaching and learning of mathematics to students with total or partial visual impairment, enabling educational inclusion.

The next stage consisted of analyzing this information, considering mainly the content of the statements contained in the selected texts. Finally, the last stage resulted in the analysis and reflection of documents related to the understanding of the problem, with a view to identifying possible solutions considering the objective of the study. Afterwards, a synthesis of each article was carried out, containing authors/year; goals; results and conclusions. The data were analyzed based on qualitative procedures in which it was possible to compose an explanatory analysis.

3 RESULTS AND DISCUSSIONS

In a search in the SCielo databases and in the Public Domain, 12 publications were found that dealt with school inclusion of people with visual impairments, between 2005 and 2015. Among them, the results of 5 scientific articles were analyzed (ARAÚJO, 2005; FERNANDES E HEALY, 2010; RODRIGUES, 2010; GASPAR et. al, 2013; OLIVEIRA, 2015), 1 master's thesis (SILVA, 2012) and 1 doctoral thesis (FERNANDES, 2008), since only these met the criteria inclusion of the study.

Most of the studies indicated the effectiveness of using teaching resources such as Soroban, Multiplano, boards with geometric figures, and even magnetized plastic boxes. (ARAÚJO, 2005; FERNANDES AND HEALY, 2010; GASPAR et. al., 2013; OLIVEIRA, 2015; SILVA, 2012).

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Gaspar et. al. (2013) in a study whose objective was to teach geometry to students with visual impairments through the integration of Multiplano³, found that its use provided the visually impaired student with a more consistent geometric vision, and also made it possible to overcome obstacles in solving the calculation of perimeter and area of flat figures, and the volume of geometric solids.

As an example, we can cite the calculation of the area and volume of a geometric solid (cube), presenting to the student with disabilities only the total sum of the edges of this solid. Without the help of Multiplano, the student quickly answered on paper that he did not know the answer, on the other hand, having the tool at his disposal through the 3Multiplano is a tool that enables visually impaired people to understand mathematical concepts through touch.



tact made it possible for him to assemble the figure, which helped him build the reasoning to arrive at the answer. It can be seen, therefore, that the resource is powerful, but if the student is not equipped to use it, they will maintain the answer about not knowing; hence the need for the teacher to know the resource and teach the student how to use it.

Araújo (2005), in research on teaching mathematics to people with visual impairments, confirms the importance of training mathematics teachers to enable them to know how to deal with the special needs of each student. The research carried out in the Federal District found that citizens with visual impairments are offered, from preschool onwards, a specialized school with teachers who are - or should be - trained, as the State Government offers interested professionals courses for this training. Material and psychological support is also offered by the Department of Education to the visually impaired for the dynamic learning of subjects such as Mathematics, which requires the use of concrete material for understanding, both for students with visual needs and for students who have other needs. educational (ARAÚJO, 2005).

Although the initiative described above is very relevant, it is observed that spaces of exclusion are still created for people with disabilities, such as the specialized school described by the author, to the detriment of the inclusion of this group in the regular education network.

The challenge of inclusion is set out in the Brazilian Constitution in its article 208, which proposes that it is the State's duty to guarantee «specialized educational assistance to people with disabilities, preferably in the regular education network». Because, legislation requires schools to have regular education teachers prepared to help students with special needs to integrate into regular classes. In other words, a child with a disability has the right to access education in the regular education network and it is the teachers' duty to develop and implement activities that take their specific needs into account by offering training to them.

Oliveira (2015) talks about the inclusion of blind students in the Brazilian school system and the importance of Braille Codes and Soroban⁴ in classes, especially in Mathematics. This article reviews the history of the use of Soroban in Brazil. For students with visual impairments, using Soroban is a great advance in mathematical learning. Taking advantage of an instrument for calculating the four fundamental mathematical operations (addition, subtraction, multiplication, division) that develops essential skills for understanding basic Mathematics concepts is a huge gain that even affects sighted students, as the work using Soroban in the classroom is equally effective for both sighted and visually impaired students (OLIVEIRA, 2015).

This is inclusion, being able to teach within the same classroom, taking into account the uniqueness of each student, without the need for all students to use the same tools. At the same time, it is observed that the use of these tools by all students, sighted and visually impaired, contributed so that the process of teaching and learning mathematics.

In a study on teaching mathematical concepts such as area, perimeter and volume for people with congenital visual impairment, they developed materials that allow the tactile exploration of geometric figures. Wooden plates were made with EVA by the authors, cutting out geometric figures (squares and rectangles), as well as smaller cubes (1 cm on the edge) to be placed inside the cutouts. Realized-
5 After feeling the cutouts and using the small cubes as a reference, it was possible for the students to correctly construct the concept of area and perimeter of each figure (FERNANDES; HEALY, 2010).

Silva (2012), in his thesis, identified that the use of MATRIZMAT enabled students with visual impairments to understand the concept of matrix, its importance and how to perform addition and subtraction operations. Plastic boxes are used that can be filled with any type of parts (buttons,

⁴The Soroban is an object used for many years by Japanese people to perform mathematical calculations in schools, banks, engineering professionals and others. It is a simple object to handle and makes calculations more concrete.



numbers in EVA, or numbers in Braille). The boxes are magnetized, which allows the construction of matrices of any order. (SILVA, 2012)

The use of low-cost materials that are within everyone's reach involves the teacher's creativity in making materials that can enable the learning of different mathematical concepts (geometry, algebra, etc.), and thus meet the needs of each student, but to achieve this You must have had training to support the creation of materials.

Nowadays, there are many tools for teaching concepts and operations. themes for students with visual impairments. The results presented in the works cited demonstrate the importance of using tools that allow these students to explore the most acute sense: touch.

Tactile exploration becomes the best method of teaching and learning mathematics for them, and for sighted students, which facilitates the inclusion of students with disabilities and favors interaction between teachers and sighted students.

Most of the articles highlight the need to develop research that contributes to the training of mathematics teachers, aiming to enable them to teach a student with visual impairment in their classroom. It is noteworthy that it is also up to teachers to promote reflections on special education, particularly on visually impaired people, seeking to offer them equal opportunities to those without disabilities.

Therefore, it is essential that teachers are trained and updated on studies and tools necessary for the school inclusion of students with partial or total visual impairment, enabling them to learn mathematics.

FINAL CONSIDERATIONS

The study allowed us to understand the importance of training teachers to work with the needs of their students in the classroom. The articles allowed us to reflect that it is up to us teachers to seek the necessary training for teaching mathematics, and also to promote reflections at a national level on the provision of courses that prepare teachers to teach students with partial or total visual impairment, preferably in schools regular.

However, we are faced with a problem in this area, as not all teachers are qualified to deal with the different educational needs of their students in the classroom. There is no knowledge on the part of teachers about what inclusion really is, and even more so, what tools exist and how they work. And this lack of knowledge, in some cases, is due to the lack of search for the necessary information by the teachers themselves, and in other cases due to the lack of specific training in our higher education institutions that can train their teaching staff to develop inclusive practices in classrooms. of class.

It is necessary to have a humanized look at the real needs of all students, at all levels of education, so that participants in the teaching-learning process are imbued with the same spirit: the construction and development of the human being.

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