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POSSIBILITY FOR TEACHING FIRST GRADE EQUATIONS TO STUDENTS WITH VISUAL IMPAIRMENT[1]

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1. CourseCompletion Work presented to the TCC II discipline

Abstract: This article aims to present a study carried out on the master's work "Inclusive Mathematics Education with the blind: the process of constructing a concrete material for teaching first-degree equations" produced by Luí Fellippe da Silva Bellincantta Mollossi, in the Postgraduate Program -Graduation in Science, Mathematics and Technology Teaching, from ``Universidade Estadual de Santa Catarina`` – UDESC. This was a bibliographic study, which began with an internet search for scientific works that dealt with the history of education for the visually impaired, education for the visually impaired and concrete teaching materials for teaching mathematics to the visually impaired. As a result of the study, it was possible to see that the blind, as well as people with other disabilities, were once very marginalized, but that this has been changing over many centuries; at the turn of the Modern Age to the contemporary Age, the first teaching works for the blind began to appear; in Brazil the first school for the blind dates back to the time of the empire; that in recent decades, interest in education for the visually impaired has increased, with research suggesting pedagogical practices with very efficient results.

Keywords: Education for the visually impaired. History of education for the blind. Concrete material for teaching mathematics to the blind.

INTRODUCTION

When studying the subject Mathematics Education II, of the Mathematics-Degree course at UFMT/Cuiabá, I had the opportunity to carry out a study on Education for the Visually Impaired and visit the Instituto dos Cegos de Mato Grosso, in Cuiabá. It was a work that marked me mainly due to the strength and ability to overcome the blind people I met at the Institute. Since then, I had been thinking about expanding my knowledge on the subject and the Course Completion Project was the opportunity.

A while ago, I found on the internet the master's thesis entitled Inclusive Mathematics Education with the Blind: the process of constructing a concrete material for teaching first degree equations, by Luí Fellippe da Silva Bellincantta Mollossi, defended in 2017, by the Program Postgraduate in Science, Mathematics and Technology Teaching, from ``Universidade Estadual de Santa Catarina`` – UDESC. I really liked the work developed by Mollossi and at first the idea was to reproduce the teaching material created for teaching first-degree equations presented in the aforementioned dissertation and apply it to blind students at the Instituto dos Cegos de Mato Grosso, for an analysis of the results. that would be obtained, comparing them to the results found by Mollossi. But, unfortunately, due to the social distancing imposed by the Covid-19 pandemic, which resulted in the suspension of in-person classes, it was not possible to carry out the activity as planned. We (my advisor and I) decided to do a bibliographical study to learn a little about the history of how the blind were treated over time, how and where the first schools for teaching the blind emerged and how and when the first one emerged in Brazil, ending with the study of Mollossi's master's thesis.

The teaching of mathematics, naturally, already has several barriers to be broken in order to guarantee learning in a classroom in which all students have all their senses "intact". Because of these barriers, mathematics has been marginalized as a subject that almost no one learns.

Studies show that mathematics teaching becomes more "tangible" when connected to visual methods, graphics, diagrams, manipulation of concrete materials and several other variations that help the teacher in teaching classes. In this sense, concrete teaching materials are characterized by important teaching resources at the service of the teacher in the classroom, as they can give more dynamism to classes and also make the content more understandable.

Lorenzato (2006) defines teaching material as being "any instrument useful to the teaching and learning process" and, among these, highlights concrete teaching material that can have two interpretations: "one of them refers to the tangible, manipulable and the other, broader, it also includes graphic images". (LORENZATO, 2006, p. 22-23).

The challenges related to teaching and learning mathematics take on greater proportions when involving students with special needs, such as those who are visually impaired. If even sighted students often have difficulties in mathematics, which is taught using visual representations (graphs, drawings, formulas, solving exercises on the board, among others), it is assumed that for visually impaired students the difficulties are very difficult. older, causing them to lose interest in mathematics. Added to this is the fact that there are few textbooks transcribed into Braille[2], there are few teaching materials for teaching mathematics to the visually impaired and very few (almost non-existent) mathematics teachers qualified to teach blind people.

Thinking about these problems, professor Luí Fellippe da Silva Bellincantta Mollossi developed, in his master's degree, a concrete material called "First Degree Equation Resolution Board" which, as the name suggests, It is a material used to teach first degree equations to Basic Education students.

The material was tested and approved by teachers who are used to teaching students with visual impairments and some of these teachers are even blind and are part of the largest educational institution for the visually impaired, which is the Benjamin Constant Institute – IBC. These teachers have worked with the visually impaired for many years and also develop materials, technologies, writing and many other things, facilitating the experience and especially the learning of the visually impaired.

Throughout this article, important aspects of the history of Education for the Blind will be discussed and a description of the master's work already mentioned.

SOME ASPECTS RELATED TO THE HISTORY OF THE BLIND OVER TIME

It was with the advent of writing (from 4000 BC to 3500 BC) that stories of how disabled people were treated could be recorded, throughout antiquity (3500 BC to 476 AD) to the present day.

Ancient society, due to its culture, contemplated the rejection and, often, the sacrifice of people with disabilities, including the blind. People with disabilities were considered useless for work, thus not meeting the demands of that society. For example:

> In Ancient Greece, aesthetic, bodily and intellectual perfection were the qualities most loved by that civilization [...]
>
> Manly qualities were of fundamental importance for a society that lived on warrior conquest and the maintenance of this status quo through force. Thus, laws and customs reflected the need to produce strong and healthy individuals who could serve their communities and not depend on them to survive. This fact leads to the adoption of discriminatory practices against those who did not present this profile (ANATALINO, 2017).

Because of this, it was the law that children born with a congenital disability were eliminated or abandoned.

In Rome, parents were allowed, by law, to drown their children or abandon them in a

2. Braille is a tactile writing and reading system for blind people.

basket in the Tiber River or in sacred places. This practice was considered a political necessity and also a type of social prophylaxis. Those born with a disability that prevented them from working and fulfilling their obligations were eliminated (ANATALINO, 2017). However, the emergence of Christianity brought a new doctrine focused on charity and love and combatted the practices of eliminating those born with some type of disability.

In the Middle Ages (476 AD to 1453), the general population saw people with disabilities as punishment from God, or with special powers, or as sorcerers. Disabled people were ridiculed and many were used to entertain the wealthier. In the Modern Age (14th century to 18th century), which corresponded to the period in which philosophical, moral and aesthetic ideas valued the human being, new ways of thinking emerged (GUGEL, 2007). It was during this period that Geralamo Cardomo (1501-1576) lived, who created a code to teach deaf people to read and write and who ended up influencing the Benedictine monk Pedro Ponce de Leon (1520-1584) to develop an education method aimed at people with hearing impairment, through signs. John Bulwer (1600 to 1650), argued that sign language was essential in the education of the deaf and developed a method of communication between hearing and deaf people. And, also in the Modern Age, with the advancement of science, visual impairment began to be understood as a pathology, as well as the first educational concerns regarding blind people emerged, permeating the following centuries until the present day (BENAZZI, undated).

EDUCATION FOR THE VISUALLY IMPAIRED

In 1784, the final years of the Modern Age, practically the beginning of the Contemporary Age, Valentin Haüy created the first school for the blind, the Royal Institute of the Young Blind of Paris in France, which aimed to remove blind young people from the condition of beggars and prepare them for them professionally. Haüy was convinced that blind people were capable of reading through touch. In addition to teaching writing through raised letters, the Institute included subjects such as arithmetic, geography and music in its curriculum. This Institute served as inspiration for the creation of other schools in cities such as: Liverpool, London, Vienna, Amsterdam, Berlin, Zurich, Boston and New York (BENAZZI, undated).

A French officer, Charles Barbier, created a writing code, expressed by prominent dots, to be read at night by soldiers on the battlefield. This code inspired Louis Braille to create the standard writing system for the visually impaired still used today, known as the Braille System. This system uses a "cell" made up of six raised points, which allow 63 different combinations. Such combinations make it possible to represent not only letters, graphic and punctuation marks, but also numbers, phonetic, mathematical, physical, chemical symbols and musical notation. With Braille, the blind could learn the same things that everyone had access to, not just the Portuguese language, but also all the others that use the Western alphabet, including the blind student in the educational system (BENAZZI, no date).

In Brazil, education for the blind began with the creation of the Benjamin Constant Institute, in Rio de Janeiro, which was born from the dream of a blind teenager named José Álvares de Azevedo who, in 1850, decided to work on behalf of people destined to exclusion. social because they don't see it. Azevedo was blind from birth, the son of a wealthy family in Rio de Janeiro, he studied at the Royal Institute of Blind Children in Paris in France, where he learned the Braille System. In addition to pioneering the Braille System in Brazil, he was also the first blind professor in the country. But, unfortunately, in 1854, when the Benjamin Constant Institute was inaugurated, its creator Azevedo had already died, a victim of tuberculosis, at the age of 20.

Currently, the Institute is a national reference in the education and professional training of blind people or people with other disabilities associated with visual impairment (MINISTRY OF EDUCATION, 2020). And so, education for the visually impaired began in Brazil.

CONCRETE MATERIAL FOR TEACHING FIRST DEGREE EQUATIONS

The material that will be presented was designed by Mollossi (2017) and used in his master's research "Inclusive Mathematics Education with the Blind: the process of building a concrete material for teaching first-degree equations". It was after witnessing, in a school, the difficulty of a blind student taking a test on the subject with the help of an assistant teacher, that the idea of concrete teaching material emerged, with which, through touch, blind students could perceive what the mathematical representation of a first-degree equation is like, as well as understanding the basic concepts necessary for its resolution, such as: equality; equation; terms; members; universe set; solution set; roots; additive and multiplicative principle and, finally, solving first degree equations. With the use of the material.

As Mollossi (2017) explains, the objective of the material would be

> [...] promote the inclusion of the blind, enabling autonomy in solving first degree equations, and that in addition to being used by them, it could also be used by sighted people who did not have knowledge of the Braille System. To this end, all information contained in this system must be in ink, also facilitating the teacher's correction process, who could check, without difficulty, the steps in solving the equation made by the student.

When creating the first version of the material, it was tested by: two blind teachers from the Joinvilense Association for the Integration of the Visually Impaired (AJIDEVI; five mathematics teachers from the Benjamin Constant Institute – IBC, specialists in teaching the blind; two blind students from 8th grade year and four from the 7th year, also, from the IBC. After testing the material, these participants were interviewed by the researcher Mollossi, who found that in the participants' perception of the created material it can facilitate the teaching of first-degree equation. And, he also received suggestions on how the material could become more suitable for handling blind students. Based on the information obtained from the testing, the First Grade Equation Resolution Board was created, consisting of three parts: an organizing box; a metal plate and parts with a magnet blanket.

The organizing box (Figure 1) was built with the following dimensions: 32 cm long, 32.5 cm wide and 5 cm thick. Afterwards, its interior was divided into 24 compartments in which the magnetized parts are stored, according to their type. For example: a compartment will be used to store all the magnetized pieces with the representation of the number one; another compartment will be used to store all the magnetized parts with the plus sign representation and so on.

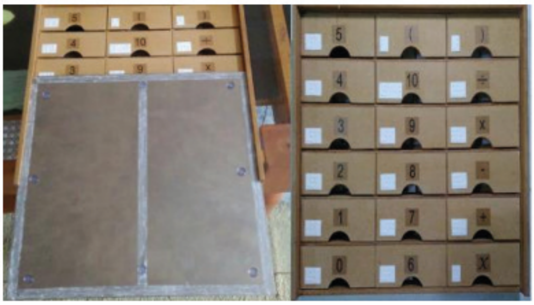

Figure 1: Organizer box

Source: Mollossi (2017)

The metal plate (Figure 2), on which the resolutions of the first-degree equations are recorded, was constructed and was 30.5 cm long, 31.5 cm wide and 0.1 cm thick. Its surface was divided by lines in high relief, initially forming nine spaces (rectangles represented horizontally); then two vertical lines (close to each other) were made in high relief, dividing each horizontal rectangular region into three other rectangular regions, with the symbol of mathematics equality being placed in the middle.

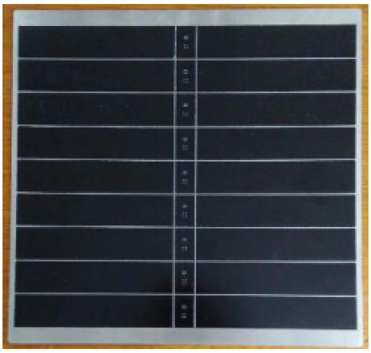

Figure 2: Metal plate

Source: Mollossi (2017)

The pieces with magnet blanket (Figure 3) were made of acrylic measuring 2 cm long, 2 cm wide and 1 cm thick. The following mathematical symbols are engraved in Braille and in ink on these pieces: the numbers from 0 to 9, parentheses, the four basic operations (+, -, x, :) and the letter x representing the unknown. There are several pieces representing the same symbol.

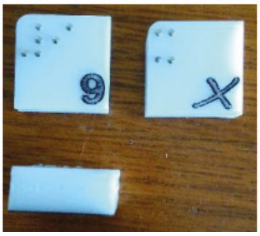

Figure 3: Parts with magnet blanket

Source: Mollossi (2017)

Blind students can use the metal plate. With the magnetized pieces, represent and solve first degree equations, in a similar way to that done on paper by sighted students. Another interesting feature is that, because the magnetized pieces have mathematical symbols engraved in Braille and ink, all students (from blind to sighted) can use it and work collectively. This, in addition to accelerating the inclusion process in the classroom, allows students to discuss the resolutions presented. Another important aspect is that, even though the teacher does not have knowledge or mastery of writing in Baile, he will be able to interact with blind students, and these are not left solely to the assistant teacher, who often does not have mastery of the content taught.

Figure 4 illustrates the resolution of the equation X + 2 = 9.

Figure 4: Solving the equation x + 2 = 9

Source: Mollossi (2017)

POTENTIAL OF THE FIRST-DEGREE EQUATION SOLVING BOARD

In his work, Mollossi (2017) mentions that to teach the content in question it is necessary for students to already have some concepts formed, such as: equality; equation; terms; members; universe set; solution set; roots; additive and multiplicative principle.

> Through this content, the student is introduced to the field of algebra, which deals with abstractions and generalizations, and through the development of algebraic thinking, the student is given the opportunity to "think analytically and establish relationships between variable quantities (MOLLOSSI, 2017).

To introduce the unknown x, the researcher suggests initially making explanations with unknown numbers, with questions such as: What number added to five results in seven? What number subtracted from five results in six? What number multiplied by five results in fifteen; etc

Next, he suggests that I do similar exercises, with representations on the metal plate, so that students complete the sentence on the next line, as shown in figure 5, indicating the value of the gap left.

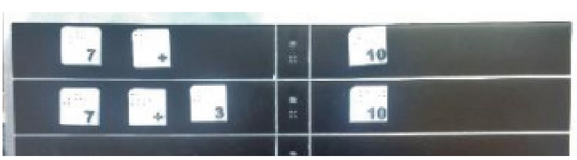

Figure 5: Finding the unknown value

Source: Mollossi (2017)

Then it must be explained to students that the gap, the unknown number, can be replaced by x, which is called the unknown. And, the additive and multiplicative principle of equality is also explained, making an analogy to the principle of a two-pan scale and exemplifying the resolution of an equation through representations on the First-Degree Equation Resolution Board, as illustrated in figure 6.

Figure 6: Solving the equation x + 1 = 9

Source: Mollossi (2017)

Once this is done, the researcher believes that students will be able, using the material produced, to solve first degree equations, gradually increasing the level of difficulty.

FINAL CONSIDERATIONS

Teaching mathematics presupposes the use of representations, such as graphs, figures, organization and algorithm development, writing on the board, among others, and we know that many visual students have great difficulty learning mathematics and say they do not understand the explanations in the teacher on the board, not understanding the organization of algorithms and their resolutions, not being able to analyze the behavior of a graph or the data in a table, among many other examples that could be cited. This leads us to think how difficult it must be for a blind student to learn mathematics, as they do not have this very important sense, which is vision.

But, visiting the ``Instituto dos Cegos de Mato Grosso`` some time ago, I was able to see that blind people are endowed with intelligence like any other human being, they have a love for life, seek recognition as capable people and have a great desire to learn. On the other hand, it is known that the vast majority of teachers do not have adequate training to deal with blind students in the classroom and they often think that it is impossible to teach any mathematical content beyond basic operations to a blind person.

However, in recent decades, concern about education for the visually impaired has grown and there are already interesting works, with suggestions for materials or strategies for teaching some mathematical content to the blind, with positive learning results.

The work of researcher Luí Fellippe da Silva Bellincantta Mollossi is an example of this. The teaching material "Board for solving first degree equations", designed and produced by him, is very simple and easy to make, and can even be made with other simpler and cheaper materials. What he defends in his research is that the blind student is capable of understanding, using touch, important mathematical concepts, representing and solving first-degree equations in the same organization/arrangement of data made by a sighted person. Furthermore, sighted students can also benefit from the material, which is very didactic and can help them to better understand the content.

There is much debate about the importance and need to promote the inclusion of students with special needs in schools and classrooms. The use of materials such as the one presented here has enormous potential to accelerate the process of including blind and sighted students (often excluded) with collaborative work in the classroom.

To finish:

> The main objective of education is to create men who are capable of doing new things, not simply repeating what other generations have done.
> Jean Piaget

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