

# Teaching Mathematics for blind students: a challenge at the university<sup>1</sup>

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## ABSTRACT

This paper is based on the story of Mara, a student who became blind during a mathematics undergraduate course in a Brazilian university. The data were obtained from interviews with Mara, her mother, university staff, colleagues and her teachers. As no blind student had ever before been at the mathematics faculty in question, the case of Mara took everyone by surprise. The first reaction from teachers was that Mara should take another subject - mathematics would be too difficult for a person who can't see. However, given that Mara did not change her mind, the university staff had to define actions that would allow her to continue studying mathematics. In this article we present more details of teachers' approaches in order to face the challenge and open possibilities that can be considered for teaching mathematics for students with special needs (or special rights) in higher education.

Key words: Mathematics education for blind students; mathematics education at higher education level; mathematics education for students with special needs/rights; mathematics education and inclusion; math braille.

## RESUMO

Este artigo é baseado na história de Mara, uma estudante que ficou cega durante sua graduação em Matemática em uma universidade no Brasil. Os dados foram obtidos a partir de entrevistas realizadas com: Mara, sua mãe, funcionários da universidade, e alguns de seus colegas e professores. Como nenhum aluno cego jamais havia estado no curso de Matemática daquela universidade, o caso de Mara pegou a todos de surpresa. A primeira reação por parte dos professores foi sugerir a Mara que mudasse de curso, para um curso que não envolvesse matemática, pois isso seria muito difícil para uma pessoa que não podia ver. No entanto, como Mara insistiu em permanecer no curso de Matemática, a universidade precisou redefinir ações que permitissem que Mara continuasse seus estudos. Neste artigo apresentaremos com mais detalhes algumas abordagens dos professores visando encarar o desafio e abrir possibilidades que podem ser consideradas para o ensino de matemática para estudantes com necessidades especiais (ou direitos especiais) na educação superior.

Palavras-chave: Educação matemática para estudantes cegos; educação matemática no ensino superior; educação matemática para estudantes com necessidades/direitos.

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## **Presentation**

This paper is based on a research in mathematics education, which took place during the years 2009 and 2010. Here we narrate the experience of a student, called with the pseudonym Mara, who went through a graduate course in mathematics, first as a seer and then as a blind person. After she has already done a part of the graduate course, Mara lost her sight due to health problems. And then, after getting blind, firstly she gave up, but after two years, she changes her mind and so finished her degree.

The results presented here, draw on data from the period where Mara, as blind, after two years away from the university, returned to continue her studies. We interviewed Mara, her mother, university staff, colleagues and her teachers in order to understand the teaching and learning conditions provided for her. We also analysed some documents that bring information about the technical and pedagogical aspects.

When we refer to teaching and learning conditions we are not concerned only with what happened to Mara, but also with teachers and other stakeholders in her educational process, as well as her colleagues.

The choice of respondents was done through a web of people, composed from an initial interview with Mara. The intention was to build a story from different perspectives, beginning with Mara and placing her in the centre, using her report as a roadmap for the following interviews. Initially we conducted a semi-structured interview with Mara, where there were no direct questions. We started asking Mara to speak about what happened, how she lost her sight, which led her to return to the university, and how this process took place, according to her perspective.

Based on this interview, we chose the main characters of her story, thus creating our web of respondents, consisting of five teachers; two coordinators and the secretary of the support centre for students with disabilities at the university (called Centre in this paper); three students who were Mara colleagues in different courses; and Mara's mother. This gave a total of thirteen interviews including Mara. As in the case of the interview with Mara, they were semi-structured, without direct questions, just asking to talk about Mara's case, and keeping the focus on the subject.

The interviews were recorded on video and a document where the participant agreed with the way the interview would be used, was signed. In this document we made it clear that each respondent would have access to their testimony, and could change it as he or she wanted, and then could read the whole narrative where his or her speech was inserted in order to tell whether it was according to the context. Only after this procedure and the signing of the terms by respondents, the story written by us became public.

Each interviewee had the option of choosing the fictitious name, which would be assigned in the narrative. Some chose names of the opposite sex, while others left it to us to choose the pseudonym, but all the names are fictitious, we did not use any real name in our text.

The aim to make such interviews was to obtain data to create a narrative with multiple perspectives, listening to teachers who have dealt with the paperwork and structure of the course, and others who worked directly with Mara in a regular classroom or individually. From the students, we wanted to hear how they saw Mara participation in the classroom, what they thought about the process, and how they interpreted the relationship between Mara and other

students. The coordinators of the Centre had a specialized focus, and contributed with their reports about Mara and her relationship with the Mathematics faculty, and Mara's mother spoke about the perspective outside the University, from a family point of view. Then we produced a text that provides an overview of the case.

Concurrently with the work of interviewing, where documents were mentioned, we were always trying to access them. Some of them were the minutes of official meetings that decided the administrative aspects related to the permanence of Mara at the University. We had access to two minutes, presenting the discussion about the future of Mara at the University the actions and decisions that should be taken.

We did not get permission from the university to have access to the Mara's file, which contained all her school records and all bureaucratic procedures related to her academic life, before losing the vision and until that moment.

We invite the reader to read this story without searching for definitive answers or for a coherent conclusion. It is not a simple account, but nor is it deprived of information. It is an invitation to explore different versions of the same phenomenon, from the speeches of people with different realities, and yet, through our sieve, our lens, hearing such speeches and transforming them into a narrative.

The story is an invitation for reflection – an invitation for a debate on the Mathematics Education and Inclusion, in particular in higher education, focused on students with visual impairments in mathematics courses.

### **Conditions for inclusion**

What to do when a mathematics teacher faces a blind student in the classroom? In case of Brazilian basic school (age from 6 – 18), one can take advantage of Specialized Educational Service Centre (CAEE) and teachers with special education for offering Special Education Service (AEE). According to Mendes et al. (2011), investment in this field has increased much in Brazil during the last decade when the Inclusive Education Program: “Right to Diversity”<sup>2</sup> was launched. This programme aims at developing teaching strategies for diversity. Students with special needs receive support in the opposite time of their classes; for example, who have classes in the afternoon are attended by AEE in the morning. It is a strategy that needs to be better evaluated when compared with attendance during the classes. Another point to be considered is the professional education of those who give the attendance in AEE. In many cases they are not well prepared to support in mathematics, for example.

Even considering the problems one could raise related to the establishments of the CAEEs, they are what it is available at the moment, and it is necessary to construct teaching and learning possibilities, which take advantage of them. With respect to mathematics education one can already find some investigation related to the teaching and learning of elementary mathematics involving Brazilian blind students (FERNANDES & HEALY, 2010; MARCELLY, 2010). However, similar possibilities do not exist for those in higher education. What can a teacher do at this level, in particular, at mathematics faculties, when meeting a blind student? How to proceed? Where can he or she find courseware for this purpose?

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<sup>2</sup> [http://portal.mec.gov.br/index.php?option=com\\_content&view=article&id=17434&Itemid=817](http://portal.mec.gov.br/index.php?option=com_content&view=article&id=17434&Itemid=817)

As mentioned, the CAEEs are designed to attend basic school students. They are not dealing with the teaching of advanced mathematics. In fact, this is not only a Brazilian phenomenon as there is almost no production of teaching resources for this level and no expertise to draw from in the international sphere. Little is known about the demand that a blind student brings to the teaching of mathematics at higher education.

In Brazil, one reason for this lack of research is the fact that, until recently, almost no blind student went to university. This being the case, there was no demand from the teachers. However, the situation is changing and people with disabilities are having greater access to higher education, and the number increases every year. According to Instituto Brasileiro de Geografia e Estatística (IBGE) – responsible for Population Census – the number of students with disability enrolled in higher education has increased 425% in 2008 when compared to the year 2000. This means 11.412 Brazilian students out of 5 millions who reached the university in 2008.

This is an important shift in the educational situation of disabled people. They have more access to higher education, but there is no guarantee of their permanence; and if they continue, there is no guarantee of the quality of their learning conditions. Faculties and universities are simply not prepared for teaching students with special needs. According to Castanho e Freitas (2005):

(...) from inclusion policies it has been noted that there is a greater need for preparation of the academic community to receive these students. Thus, qualified professionals in higher education, who throughout his career as a teacher may be faced with a student who presents any special educational need, requires a preparation that goes beyond the scientific knowledge which is indispensable, but there are practical indeterminate zones, such as uncertainty, uniqueness and value conflicts that are part of academic life, and that the teacher must face.

As being prepared, we refer to both physical and pedagogical structures. However, one cannot offer teacher education related to this topic, without knowing what kind of demand appears due to the presence of those students. Mara's case can reveal some of these demands.

### **Mara at the Mathematics Faculty**

Mara did her basic education in public schools in a small town in Minas Gerais State, Brazil, where she was born. Her family has a low economic status and when she was around 20 years old when, the mother decided to move to a larger city that the children could have better possibilities for working and studying. Mara wanted to become a mathematics teacher and prepared herself for the exam, and she succeeded in getting a position as a student at a public university where she would not have any expense. After a year as regular student, she started experiencing health problems related to hypoglycaemia and starts to lose her visual capacity slowly. After some time, she became blind. As everybody can imagine, this condition caused a profound chock to Mara and her family, and it was necessary for her to interrupt the university studies for two years in order to make medical and psychological treatment and reorganize her life.

Mara was the first blind student at the mathematics faculty, and this caused insecurity for everybody. There was so much doubt that, at first, the coordinators suggested that she moved to any course in the Humanities Faculty, e.g., to study Pedagogy and become an elementary school teacher. The following comment illustrates the coordinators position.

It was offered to Mara, at times, the opportunity to change her course. Why? Because there comes a time, even if we respect the inclusion, that there is a limitation. It is the same as if a blind person wanted to do surgery, wanted to do medicine. Finally, we offered a lot to Mara, and insisted on her moving to another course. Why? As an elementary school teacher she could use a more verbal language than as mathematics teacher. In the elementary school we have many blind students and no qualified teachers. It has Braille teacher, Libras<sup>3</sup> teacher. But I thought it would be great to have an educator there, blind, teaching basic mathematics to those children, because in Brazil, who teaches mathematics to children, between 6 and 10 years old, is a general educator, and not a mathematics teacher. So we did our best trying to convince Mara how she could even make the experience better. (Jessica, pseudonym)

But Mara did not accept the proposal, and insisted on her desire of getting a degree in mathematics that she could become a teacher for secondary or high school.

Facing this situation, that Mara decided not to change her opinion, the Faculty staff had to define approaches to provide learning condition for her to get the degree in mathematics.

Among those approaches, we highlight two. The first was that Mara should make only two courses per year, one at a time, semi-annually. She would therefore need five years to complete the degree in mathematics, as there were ten courses required. Taking this decision meant designing a special set of rules in which the legal deadlines were eliminated. The second approach was that were given courses only for Mara and she would have individual classes in the teacher's office, separated from the other students.

It was not easy to define this formal frame, as it required many meetings and a careful study of the legislation in order to make the bureaucratic rules flexible. It was necessary to study thoroughly the legal structure of the institution, the bylaws, and decide what could be done to make it possible to Mara to finish her course within the regulation.

After defining the plan, the next step was its implementation. One important step was to identify teachers who would be interest in teaching for Mara, because some of them were resistant about this. In what follows we present how some teachers have dealt with the challenge of doing this, what were their strategies for working with Mara.

### **Facing the challenge**

We, teachers, we are unable to deal with this because no one actually has been educated to deal with this kind of situation, with such a special student. How to teach mathematics to someone who does not see, and does not read, and does not write in Braille? One, like me, studies advanced theories, from mathematical point of view, and have never before

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<sup>3</sup> *Libras* is the Brazilian Sign Language, used by deaf people.

discussed about education, and suddenly faces a classroom, with a case like this. (Marcos, pseudonym)

Marcos referred to university mathematics teacher education in Brazil. It is known that most of them have had their graduation and PhD in pure mathematics. This means that they did not take any course in mathematics education in order to be educated as teacher, the task they will perform when they get a position at the university.

Of course, depending on the discipline we knew, we would not have any idea of how visually impaired students would take it. Two-variable calculus, e.g., requires analysis of intersection of surfaces and curve generation. How would Mara see it? This would not be possible, would it? (Pedro, pseudonym)

Pedro referred to the challenge of teaching numerical calculus and differential and integral calculus. He did not know how to teach methods to find primitive integrals without making use of any written record. Furthermore, he wanted to use software such *Matlab* and *Maple* to explore numerical solutions for integrals, and show the graphic construction of the curves, but he did not know how to organize this for Mara. For Pedro, if Mara mastered Braille she would overcome many of the visual barriers to learn mathematics.

As she did not read and write in Braille, the option was to replace the written record by voice record what meant the teacher recording his or her voice during the reading the textbook or the reading the solution for a mathematical problem. This material was given to Mara that she could hear as much as she wanted.

This approach gave more autonomy to her compared to previously where she depended exclusively on somebody reading the textbook for her. At the university there was a group of volunteer students who used to read text for blind students. Thus in other subjects than mathematics, there have been several blind students. They were known as “readers”, and it was expected that they were familiar with the topic to be read. So for Mara it should be expected to have as reader a student from the mathematics faculty or other course like engineering for example, where students had math classes. However, to be mathematics reader requires more than simply being able to see and read the text. In some cases, even the fact of being student from the mathematics faculty was not sufficient because, if for example, the voluntary reader was a first year student, and Mara needed to study a more advanced theory, the reader was not able to recognize many of the symbolic representation.

Even more difficult were the cases of readers from the humanities faculty, which had little or not any familiarity with the mathematical symbols. It made it almost impossible for them to read for Mara, despite their availability. A question raised by Mara was: why there were many more volunteers readers from humanities when compared to mathematics faculty? We have no answer to this question, but we wonder if it could have to do with some idea that blind students have fewer possibilities in mathematics.

As time passed, teachers were mobilized in order to provide the best learning condition for Mara. Sérgio, for example, made contact to the Centre at the university that gave support to students with disabilities, mediating the processes of adapting pedagogical tools as well as of providing accessibility in the buildings. Sérgio asked help from the Centre to discuss possibilities to teach non-euclidean geometry (NEG). There he had the opportunity to learn

more about the work done at the Centre with respect to the inclusion of university students with a disability and therefore, could reflect and plan in advance the course of NEG. Through the Centre he obtained important information about special educational needs of a blind student in a mathematics course, such as the availability of readers, the possibility of producing material in Braille, and the importance of manipulative materials for the study of geometry.

Based on his interaction with the Centre, Sérgio considered a specific didactical approach for Mara. He built a hyperbolic Geoplan (Fig. 1) based on the Poincaré model, and created explanatory cards in Braille (Fig. 2 e Fig. 3). It is important to say that this material can be very useful for the teaching of non-euclidean geometry.

### Hyperbolic Geoplan based on the Poincaré model – Parallels and concurring lines

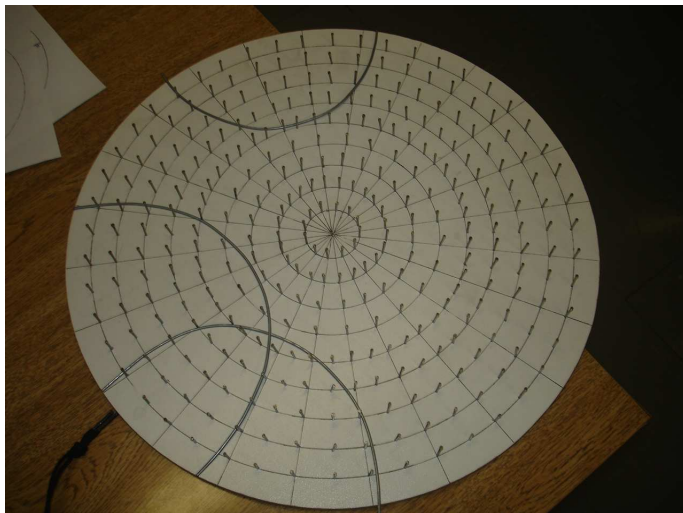


Fig. 1

### Explanatory Cards in Braille and Embossing

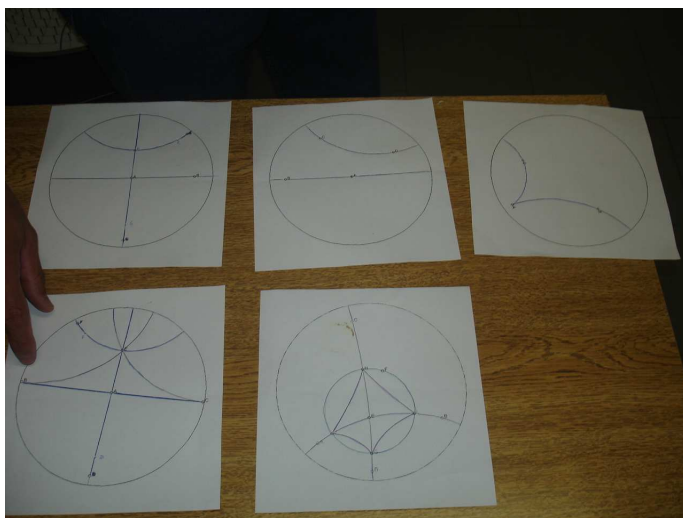


Fig. 2

## Explanatory Cards in Braille and Embossing – detail

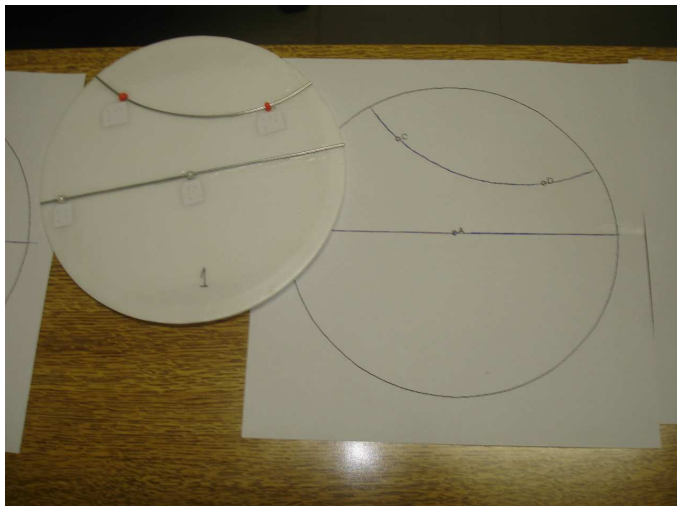


Fig. 3

### Individual classes

Figure 4 is a transcription of part of a *Functions with Complex Variables* (FCV) class, which was given by the teacher Carlos. It is made in colloquial language, without resorting to the mathematical symbols. As the class was intended to a blind student, only what she heard might help her build your knowledge on the subject in that context. Hence our choice of transcribing exactly on the way that she heard, so that the reader can get an idea of how Mara realized the lesson.

### FCV class transcription

**Professor Carlos:** Well, then recalling Mara, what we saw in the last lesson, we went on the Integration, and we defined the integral of a function, so we started initially with a function  $f$  defined on an interval  $ab$ , Real interval,  $ab$ , taking values of  $c$ , complex values, and we defined the Integral. So you have  $f$  of  $t$ ,  $f$  of  $t$ ,  $t$  is a real number and the image is a complex number. Then we want to define the meaning of the integral of  $f$  of  $t$ , along a path, along a curve  $c$ . Then integral  $f$  of  $t$ ,  $c$  along a path  $c$ . Good,  $f$  of  $t$ , i.e., a real part, a  $u T$  plus another imaginary part  $v t i$ , then  $f$  of  $t$  is  $u t$  plus  $v t i$ . So what do we do? We parameterize the curve  $c$ , then we get a parameterization of the curve, then we write  $c$  as a  $a z t$ , is a curve parameter  $z t$ , parameterization of the curve  $c$ ,  $t$  varying in the range of  $a$  to  $b$ ,  $t$  varying in the interval from  $a$  to  $b$ , then we define the integral of  $f$  of  $t dt$  as the integral from  $a$  to  $b$   $u t$  plus  $i$  integral from  $a$  to  $b$   $v t$ , ok? Do you remember it?

**Mara:** Integral of the sum?

**Professor Carlos:** That's right, so, it is the integral of the real part, do you agree? A  $f$  is the  $u$  plus  $iv$  of  $t$ , than will be the integral of the real part plus the imaginary part, ok?

**Mara:** Hm.

**Professor Carlos:** Well, this is for a  $f$  of  $t$ , the  $f$  starting from their domain be a Real interval  $a b$ . Now, we want the integral of a boundary, in fact, we want a  $f$  of  $z$ , where the domain of the function is the complex numbers group. Than is a function  $c$  in  $c$ , of the complexes in the complexes, so you have a  $f$  of  $z$ ,  $z$  is a complex number. Thus, we want to define the integral of  $f$  of  $z$ , in a  $c$  boundary, ok? Do you remember it?

**Mara:** Yeah, I think.



**Fig. 4**

The transcript above looks extremely confusing for any student of mathematics that are not familiar with the matter and try to understand what the text aims to explain. For people with previous experience, that already know FCV, the task can not be that difficult, but we must remember that the material was intended for a blind student, who was having her first contact with the discipline. She would need to base all her study on this audio material, since it is her only educational source at that moment. She could have access to books only with the aid of a reader that do not always had the required availability, and the audio recordings of such books are equally confused, because visual memory is the most privileged in such materials. The principle could be Braille output what means to transcribe the books for Braille, and the student would have to further their studies of writing code, and then be able to access these books independently. However, it is not so simple.

Pedro, one of Mara's teachers, contacted a colleague who had had a similar experience as mathematics teacher of a blind student in another university. Pedro wanted to know how his colleague dealt with the situation and expected to get some practical suggestion. However, this was not possible as it was a different case and he realized that the actions taken in one situation could not produce the expected effect on Mara's case.

The student from the other university was born blind, and had a great knowledge of Braille acquired throughout his life, including Braille for mathematics, which is very specific. This student had already acquired great skill in the use of the machine Perkins, a kind of mechanical typewriter, to write Braille, and have good ability with computers. All these knowledge improved his study conditions but did not free him of difficulties as such the lack of advanced mathematical material in Braille, and the lack of teacher who could read Braille or preparing writing material for the lessons.

Mara's case was different. She was adult when she became blind and she had no familiarity with Braille nor with computer programmes for supporting blind people. Thus Pedro realized that such a case requires much time and dialogue with the student to understand her specific needs.

## **Written material**

Concerning Braille, the most recent version of the Mathematician Unified Code (CMU) used in Brazil was launched in 2006 and contains all the mathematical symbols needed for transcribing into Braille a text at any level. However, it is a very complex system, which cannot be mastered in few months and even if a person managed it, there are so few publication in advanced mathematics available in Braille that he or she could read. Mara had started learning the code, but without much motivation.

One could think of possibilities of transcribing from one to another code, as in Brazil there are specialized centres for doing this. In fact, Instituto Benjamin Constant (IBC) in Rio de Janeiro is a reference centre for education, rehabilitation and specialized medical care for people with visual impairments. The IBC also has free continuing education programs for teaching and learning of blind children in all disciplines for basic education school. However, just a few advanced mathematics books have been transcribed by IBC. Furthermore, even when a teacher has access to such books, the difficulty of written communication with a blind student persists.

How to deal with extra activities and assessments? What kind of written production should be essential for learning mathematics?

One possible solution is to use the software *Braille Fácil*, part of DOSVOX, a free application produced by José Antonio Borges and his colleagues from Centro de Computação Eletrônica da Universidade Federal do Rio de Janeiro (UFRJ). This application allows usual texts to be printed in Braille without the user knowing how to write and read in Braille. But, once more, producing printed materials is more difficult when they have to do with mathematics. In this case, in order to get a good quality, the transcription requires several adjustments before printing which, in turn, require a deep knowledge of Braille, including the CMU.

Undeniably *Braille Fácil* facilitates blind people's access to various texts, since the task of transcribing and adapting becomes faster. But it does not solve the problem of written communication between student and teacher, specifically in the case of the mathematics teacher in higher education, as it is still necessary mastering both Braille and CMU.

As part of his PhD study, one of the authors is addressing this demand by formulating a proposal for producing software that easily transforms mathematics text from a usual symbolic format to Braille. The user would not have to master Braille. This would facilitate very much the written communication between teacher and blind students, and the results of this research will be shown in another future paper.

However, one could say that the difficulty on teaching mathematics for blind people is not just a problem of writing, it is more than that, maybe a blind person has a different concept about the meaning of the mathematics, and if we work on reproducing the same system of mathematics teaching on Braille, this project could fail. We agree with this position but, in the other hand, the blind students need to do tests, make written evaluations to get to universities, get a job, and so on. Then, these students need to develop the ability to write mathematics. Therefore, we have two different issues: teaching mathematics for blind people in an adequate way, and ensure the empowerment that mathematics can offer, and, at least for a while, the blind students need to communicate the mathematics that they learn in some way that everyone can understand. The proposal we defend is to use an electronic translation between CMU and ink written mathematics, but not as a definitive solution, just as a palliative while the researches and public policies can find new ways of doing and communicating mathematics within blind people in a proper way.

## **Concluding remarks**

Facing the challenge of teaching mathematics to Mara made teachers recognize the complexity of the situation and the lack of resources – material and human. Not everyone was satisfied with the result they got from so much effort in adapting the lessons to Mara: “The teacher's work is very complex as it is needed to deal with these kind of frustration, beyond everything else teacher needs to do.” (Laís, pseudonym).

Laís refers to episodes such as what happened to Mara when she attended numerical calculus. The teacher spent so much time preparing audio-recorded material and making sure that a student could meet weekly with Mara and study with her. However, it was not possible to cover all the expected content for this course. For example, numerical resolutions were missing, as Mara could not use the mentioned software. In the final exams, Mara failed, even being evaluated in what she had studied.

Laís refers to frustration, and we consider that there is no single person responsible for this. This has to do with the whole educational system as only recently policy makers consider students with special needs.

Mara's case provoked a reflection on how to teach students with special needs. The quotation below represents this.

There were a lot of people imagining that it was an ideal case, many people had a romantic view of a disabled person. Mara came for breaking it, what helped us to understand that it was necessary to treat her as any other student. We should charge her also. However, we should make adaptations. Because of this, I tape recorded my lessons. This has always been clear to me. Today, I know much more about it and this has to do with the fact that I had Mara as my student. This case needs to be discussed in teacher education programme. Can you prepare yourself in advance? What kind of preparation? Will the discussion stop when Mara gets her degree in this Faculty? This is a big problem for me. And, what to do when another blind student enter the Faculty? It is a huge problem at this University, and it has to do with professional development. (Adailton, pseudonym)

We agree completely with Adailton in the sense that this case has the potential of given new elements for teacher education in higher education level. There is a well-defined legislation about what is necessary to fulfil in order to be a teacher at basic school. This includes courses in pure mathematics, mathematics education and general education. However, nothing similar exists at the university level. To have a PhD in pure mathematics seems to be enough to teach for university students.

This kind of education might have worked years ago, when the university received only elite students. But, certainly, does not succeed to face the proposal of inclusive education in a socio-political context, where university makes part of the democratic institutions in society.

As we emphasised in the introduction, this case is an invitation for reflection and for a debate on the Mathematics Education and Inclusion. Let us try to point out some of the issues that we find to be in need of further reflection.

First, inclusion is considered an ultimate good thing to be aiming for. However, it becomes important to recognise inclusion as most complex issue. Inclusion also has a price. This can be illustrated in the case of Mara when we consider the particular challenges she needs to face: Let us just take a look again at the remark:

Then we want to define the meaning of the integral of  $f$  of  $t$ , along a path, along a curve  $c$ . Then integral  $f$  of  $t$ ,  $c$  along a path  $c$ . Good,  $f$  of  $t$ , i.e., a real part,  $u$   $T$  plus another imaginary part  $v$   $t$   $i$ , then  $f$  of  $t$  is  $u$   $t$  plus  $v$   $t$   $i$ . So what do we do? We parameterize the curve  $c$ , then we get a parameterization of the curve, then we write  $c$  as  $a$   $z$   $t$ , is a curve parameter  $z$   $t$ , parameterization of the curve  $c$ ,  $t$  varying in the range of  $a$  to  $b$ ,  $t$  varying in the interval from  $a$  to  $b$ , then we define the integral of  $f$  of  $t$   $dt$  as the integral from  $a$  to  $b$   $u$   $t$  plus  $i$  integral from  $a$  to  $b$   $v$   $t$ , ok? Do you remember it?

This time, however, we have not made the italics. Putting mathematic symbol in italics is devise for seeing people. It makes it easier to read a text with mathematical symbols. By putting it like here, without italics, we get close to how the text sounds to Mara. "Do you remember it", Mara was asked. It is really important to grasp the challenges of inclusion, and to consider to what

extend some efforts of inclusion reaches beyond some limits and turn into provocations. However, the limits are always changing due to technological development. Conditions of inclusion are ever changing.

Second, inclusion presupposes collaboration. In the case of Mara it was clear that nothing would be possible without a broad collaboration around the process of inclusion. Thus, inclusion is far from referring to set of values about equity. Inclusion is far from being just a political position. Sure, such a position is important, and this could bring processes of inclusion into focus. But inclusion is far from a question of attitude. Inclusion is an organisational challenge. Without organisational initiatives, inclusion cannot take place. And a broad set of cooperation is a way of provides an organisational basis for inclusion.

Third, inclusion means differences. Thus one cannot assume inclusion to be the same in any circumstance. Instead inclusion means assuming new features of similarities and differences. Thus is the case of Mara, there are many different learning obstacles she has faced, meaning that she will get a different set of mathematical competences compared to a seeing mathematics teacher. One need not, however, think of Mara' mathematical competences in terms of any deficit model. There might be things she masters, which seeing mathematics teachers do not "see" so clearly. And to take a simple point: Mara might obtain some capacities important for teaching not only blind students, but also, for instance, a group of both seeing and blind students.

Fourth, inclusion can be addressed with reference to students with special needs. This provides one type of discourse people to be included. However, one can also talk about inclusion with reference to people with special rights. This provides a different discourse around inclusion. In the case of Mara we find special discourses of the special-need type. This provides one perspective of, say, what teachers and the Mathematics Faculty are doing. The special-right discourse provides a different perspective on what is taking place. Thus let us just listen to Jessica again:

It was offered to Mara, at times, the opportunity to change her course. Why? Because there comes a time, even if we respect the inclusion, that there is a limitation. It is the same as if a blind person wanted to do surgery, wanted to do medicine. Finally, we offered a lot to Mara, and insisted on her moving to another course.

This remark is located in a special-need discourse. And one can see many of the teachers' remarks as formulated in this discourse. One could, however, consider how the situation might be formulated in a special-right discourse.

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