Experience Report

# (Mathematical) Social Practices for the production of a financial plan in the training of Indigenous teachers

## Práticas sociais (matemáticas) de produção de um planejamento financeiro na formação de educadores indígenas

**Vanessa Sena Tomaz[1], Ilaine da Silva Campos[2]**

Universidade Federal de Minas Gerais, UFMG, Belo Horizonte - MG, Brasil

## Abstract

The article discusses social practices in a classroom in which one notices evidences of mathematical learning, during activities on financial planning, using a debit and credit spreadsheet. These activities were developed with a group of indigenous students from the Intercultural Education Undergraduate Course for Indigenous Teachers with emphasis in Mathematics Education offered at Universidade Federal de Minas Gerais – Brazil with two objectives: supply the demand for mathematical formation to the teachers in-training and support them in the control of their scholarship. We used the classroom intervention methodology, which produced empirical data, composed of video records of classes, notes, and interviews. Using the concepts of social practice theory, we identified the relations established by students in and between the practices that highlighted potential mathematical learning, when they used and/or reflected on the calculation procedures and on the mathematical language used to fill the spreadsheet and create graphics. We observed that the participation on these practices generated tensions between individual actions and collective actions, when they were demanded to act in a different logic of life to access and use the scholarship money. We also perceived that the indigenous students began to make the self-control over their spending. We argue that the financial management of the scholarship became a broad intercultural phenomenon that considered the individual and collective uses and necessities. The reflection about this experience points to some specific demands to indigenous teachers' intercultural education, in view of the public policies to guarantee their right of access and permanence in higher education.
Keywords: Indigenous teachers. Financial planning. Scholarship. Mathematical learning.

## Resumo

O artigo discute práticas sociais em sala de aula em que se percebem indícios de aprendizagens da matemática, ao se propor um planejamento financeiro para autogestão de uma bolsa de estudos, utilizando-se uma planilha de débito e crédito. As atividades foram desenvolvidas na Licenciatura Intercultural para Educadores Indígenas da Universidade Federal de Minas Gerais – habilitação Matemática –, com dois propósitos: atender à demanda de formação matemática dos licenciandos e subsidiá-los na autogestão da bolsa de estudos destinada ao custeio de sua permanência no curso. Foram desenvolvidas atividades pedagógicas que geraram os dados, coletados em vídeos de aulas, entrevistas e trabalhos dos estudantes. Adotando-se os conceitos da teoria da prática social, identificamos

1 Doctor in Education from Universidade Federal de Minas Gerais (UFMG). Professor and coordinator of Intercultural Education Undergraduate Course for Indigenous Teachers (FIEI) – Mathematics Education - of UFMG. E-mail: vanessastomaz@gmail.com.

2 Doctor in Education from Universidade Federal de Minas Gerais (UFMG). Fellow in the Mathematics course of the Intercultural Education Undergraduate Course for Indigenous Teachers (FIEI), UFMG. E-mail: ila_scampos@yahoo.com.br

relações estabelecidas pelos estudantes entre e nas práticas que evidenciam aprendizagens matemáticas, quando eles usaram e/ou refletiram sobre os procedimentos de cálculo e sobre a linguagem matemática no preenchimento da planilha e na confecção de gráficos. Observou-se ainda que o engajamento nessas práticas gerou tensões entre ações individuais e coletivas, pois os estudantes são demandados a atuarem em diferentes lógicas econômicas, para acessar e utilizar os recursos de uma bolsa de estudos. Percebe-se que os estudantes indígenas passaram a fazer o controle de seus gastos. Em alguma medida, a gestão financeira da bolsa se tornou um amplo fenômeno intercultural que considerou usos e necessidades individuais e coletivas. A reflexão sobre essa experiência aponta demandas específicas da formação intercultural para professores indígenas, na área de Educação Matemática, frente às políticas públicas de acesso e de permanência dos indígenas na Educação Superior.
**Palavras-chave**: Professores Indígenas. Planejamento Financeiro. Bolsa Permanência. Aprendizagem Matemática.

## Introduction

In this article[3], we discuss the potential of classroom activities to broaden the repertoire of practices in which one *talks* about and *uses* Mathematics and the possibility of learning in the context of Indigenous teacher education. The activities were developed with Indigenous students in the Intercultural Education Undergraduate Course for Indigenous teachers (FIEI), Mathematics Emphasis- in the Universidade Federal de Minas Gerais (UFMG) aiming to teach them how to financially manage their scholarships.

The right to a specialized school, guaranteed in the Constitution pf 1988, is one of the conquests of the Indigenous movement that has been on the forefront of a broad debate on Indigenous school education policies. This debate is strengthened by the demand of the National Committee of Indigenous School Education- Comissão Nacional de Educação Escolar Indígena (CONEEI) - and local organizations of Indigenous teachers. In this context, the intercultural teaching undergraduate courses are an alternative to qualified offer of Indigenous school education. Together with this offer, specific actions were taken to guarantee the access and permanence of the Indigenous in higher education. The Program Permanence Scholarship - Programa de Bolsa Permanência (PBP)[4] – which is the base of this article, is one of such actions.

This program gives financial support to students enrolled in federal higher education institutions that are in vulnerable socioeconomic conditions as well as Indigenous and Quilombola[5] students. For the later, they have just to prove their ethnic identity to receive the support, which is deposited directly to each student through a bank account. The dynamic of access and use of the scholarship requires abilities of financial management, including mathematical knowledge aligned to the capitalist economic logic of the surrounding society[6] which, at times, shocks with the

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4 The rules for the Program Permanence Scholarship were established by the Education Ministry on May, 9th 2013, number 389 based on the Federal law 12.711/2012, also known as the Law of Quotas in Higher Education.

5 Translator's note: communities formed by African-descendants of former slaves who sought refugee

6 We are referring to the Market economy guided by the capitalistic system.

Indigenous economic model, based on the principle of reciprocity, re-signified to the contemporary economy of the Indigenous.

Faced by the complexity of managing the scholarship, considering the ethnic-cultural differences within the group of students, the teachers and the students developed classroom activities to reach a specific objective of mathematics education and guide students on how to control their money. During all activities, we reflected on their formative potential in two aspects: first, aiming the autonomy of the Indigenous student, regarding the financial management of their scholarship; second, the focus of this article, dealing with the practices that are involved in the use of Mathematics which take place in the frontiers between different cultures, a place where those students live.

Specifically in the field of Mathematics Education, several researches in Ethnomathematics (FERREIRA, 2006) approach the theme of this article regarding the different ways the Indigenous count, measure, classify, and order, which are different from the Eurocentric culture of the colonizers. Other works, such as Corrêa (2006) and Mendes (2005), problematize the relation between Ethnomathematics and Indigenous School Education, approaching the school practices and Indigenous teacher education, pointing out the curricular possibilities and the connections of Mathematics Education and the processes of reaffirmation and revitalization of a cultural identity. Regarding specifically the use of money, Bonamigo (2006) discusses how the Mbya-Guarani from the Cotinga island demand exchanges with the non-Indigenous, involving the sale of handcrafts, the purchase of industrialized goods, the struggle for money, and for Indigenous rights. The author concludes that, when buying or exchanging objects produced by non-Indigenous, these items are inserted in the circulation of kinship and reciprocity of the Mbya-Guarani, showing the change of meaning that takes place in these economic relations.

Outside the field of Mathematics Education, this study dialogues with works that discuss the insertion and permanence of Indigenous in higher education (BOTELHO; SECCHI, 2015; GALDINO; AMARAL, 2016). These authors highlight the challenges of education policies to tackle the diversity of Brazilian Indigenous peoples, recognizing the specificities of each culture, as well as the challenges faced by the higher education institutes to make the academic environment more welcoming to the Indigenous.

The dialogue with the articles above is necessary, as we also discuss mathematical practices in the education of Indigenous students and problematize actions that target their access and permanence in higher education. Mainly, we reflect on the formative role of these activities, proposed with the goal of allowing students to participate in practices of financial management of their scholarship. During the activities, we introduced mathematical notions, as part of the intercultural teacher education.

However, differently from those works, because of our interest in discussing the learning that takes place in formation practices in which Indigenous from different cultures and non-Indigenous teachers participate, we based our work in the studies of Jean Lave (2011; 2015) who use the field of anthropology to draw and enrich the concepts of learning *as* and *in* social practice. Given the singularities in the relations between learning and culture in the context studied, this reference allows us to identify evidences of learning in practices that take place independently or not of intentional teaching actions.

## Issues that permeate the activities proposed and their context

The group of students with which we developed the activities enrolled in the course in 2014 in the class of Mathematics teaching. This group was composed by 34 students of 5 Indigenous peoples that live in different Brazilian states, forming a multiple sociolinguistic scenario: Guarani, from the state of Espírito Santo and Rio de Janeiro; Pataxó, from Bahia and Minas Gerais; Pataxó Hã-Hã-Hãe, from Bahia; Maxakali and Xakriabá, from Minas Gerais.

Since 2009, UFMG offers a 4-year long Intercultural Education Undergraduate Course for Indigenous teachers (FIEI) with emphasis in Mathematics Education. The academic activities of the course are concentrated in two phases each semester: an intensive period, lasting 5 weeks in UFMG[7]; and another, lasting from 7 to 10 days, in the Indigenous communities. In the breaks of these phases, other activities are continuously done in contact with the Indigenous communities.

Until 2013, there was not a policy of student assistance specific for Indigenous students in UFMG to ease the impact of the expenses derived from their permanence in the course. In that year, this gap was filled by the implementation of the Program Permanence Scholarship of the Federal Government, which students of FIEI started to participate.

The access to this benefit can only happen after the approval of a register done in the Education Ministry online platform, done after the student starts frequenting the course and the approval of this register by an internal commission, in which Indigenous leaders take part. When granted the scholarship, the students are then individually responsible for all the expenses referring to their permanence in the course (accommodation, food, transport, didactic material, etc.).

The Mathematics class already had the scholarship in the start of the course. Since the first days of class, we identified cases of students who used the money to immediate expenses and/or others who spent excessively, without considering future expenses. The group also did not seem to be familiar with the bank transactions needed to manage the scholarship. There was an extreme case of a Maxakali student who only spoke his Indigenous language and had little autonomy on managing his money, considering the procedures needed to do so.

Even though the Indigenous live with the market economy, due to the increasing monetarization of the relations between Indigenous and non-Indigenous (PISSOLATO, 2016), it is worth highlighting that, at first, the situations of scholarship use called our attention and challenged us to understand the different Indigenous economies[8] that were in contact in those activities and how they operated in the different ways of life that compose the group. We also noticed that it would be important to discuss the dilemmas lived by students when participating of economic practices that have money and commerce as the center, mainly those that are mediated by bank transactions.

In fact, we identified at least two problems that could hinder the management of the scholarship: a) the resource is paid in monthly instalments, while the students' expenses are mainly concentrated in the intensive phases of the course. Therefore,

7 The Faculty of Education, where the intensive period takes place, is located in the city of Belo Horizonte, the capital of the state of Minas Gerais. The city has approximately 2.5 million inhabitants and is th 6th largest in the country.

8 According to Luciano (2006), Indigenous economy refers to issues involving subsistence and the sustainable development of Indigenous people, in the perspective of economic autonomy.

the students seem to have problems to plan their expenses, especially in the intensive part in the university- leading to a lack of money to cover their expenses, compromising their permanence in the course; b) to access the scholarship money, the program demanded that students had an individual bank account and did the necessary transactions. However, some of them had no familiarity with the language used and the necessary transactions.

The realization of these problems made us propose activities of mathematics education, using a credit/debit spreadsheet to guide the elaboration of a financial planning; so that the students themselves could manage the resource they were given. Our approach tried to not be imposing or to neutralize the students' ability to act, trying to understand the possibilities of mathematical learning raised in the formation process.

Next, we will detail aspects of our work that made it possible to describe some practices in which mathematics is talked about and used, be it through the choices made by teachers, be it in the relations established by students between school and everyday practices and the knowledge in them. To characterize and analyze the practices, we used data collected in class, video recordings, students' works, and interviews recorded in video. The data selected were transcribed and organized.

## Financial planning as a mathematical activity in teacher education

The first activity proposed was the creation of a financial planning, which took place in the second semester of 2014, in the Indigenous territories. In this occasion, we used texts to discuss the economic models, the impact of those models in Indigenous cultures, and the basic procedures needed to do the electronic register in the ministry and to make the bank transaction, a requisite to access the money. We also introduced a monthly spreadsheet of credit/debit (Figure 1), so as to guide students in registering the resource and control their balance. To subsidize the management of the money that would be received in the next 6 months, we distributed to each student spreadsheets in which they should make monthly logs of their expenses and balance.

| Scholarship Monthly Expenses | | Current month: | |
|---|---|---|---|
| Student Name : | | | |
| Date | Description of Expenses | Price (R$) | |
| | | Credit/Revenue | Debit/Expense |
| | | | |
| | | | |
| | | | |
| | Monthly Total | | |
| Summary of current month | Last month's balance | | |
| | (+) Total revenue | + | |
| | (=) Intermediate balance | = | |
| | (-) Total debit | - | |
| | (=) Final balance | = | |

**Figure 1** Credit/debit spreadsheet created by the teachers

Source: Authors' archive

The second activity was proposed in August 2015, consisting of a second set of spreadsheets to compare with the expenses of the previous semester. This work was motivated by our realization that some students, even after the filling of the first set,

still had problems to manage the money, what could compromise their participation in the course.

To help visualize the expenses in each semester, we proposed two other activities using the sets of spreadsheets: a categorization of expenses and two graphic representations a pie chart and another of a square divided in 100 equal smaller squares. We also proposed the comparison of the expenses in the two semesters 1/2015 and 2/2015. To do so, the students used the divided square, having as a reference the total of R$ 5,400.00 and R$ 4,500.00, respectively.

## Filling the spreadsheet

To introduce the first set of spreadsheets and prepare students to fill it, we asked them to list their expenses in the first intensive phase of the course. The list made visible the specificities of Indigenous students' expenses when they enter the university, especially when they are away from their communities: several means of transport to cover the distance- including going to the bank for the necessary bank transactions; accommodation in Belo Horizonte; food; didactic material; cost of hygiene, medicine, coats, clothes, blankets, shoes, suitcase, etc.; pay for the costs of those who will take care of the children and for the substitute teacher in the village; credit for the cellphone to talk with the relatives and Indigenous leaders in the communities; among others. The list also indicated an approximate total cost to stay out of their communities.

When analyzing the video records of the classes and the first set of filled spreadsheets, we confirmed the doubts they had and that we had noticed in the first class. In another encounter, aiming to clarify the identified doubts, we started by reading the directives of the spreadsheet, as the technical vocabulary hindered the manipulation of data and the correct register of the numbers in the language needed. A recurrent doubt was on how to sum the amounts on the spreadsheet and to transfer the final balance from one month to the next, that is, how to fill the part referring to the monthly balance (Figure 1). The teachers emphasized the meaning of the terms used, while explaining step-by-step how to fill the spreadsheet. A part of this filling process was the monthly balance: first, to calculate the total of revenues and expenses in the month; then, include the previous balance and calculate the partial balance so as to get the final monthly balance. To do so, the student needed to understand the meaning of the word *balance* and the different types of balance asked in the spreadsheet.

As the students seemed to still have doubts, the teachers resumed the explanation on monthly totals and balances, projecting the spreadsheet in the board and filling it with real data from one of the students (Figure 2).

| | | | |
|---|---|---|---|
| Summary of current month | Monthly Total | 900,00 | 1138,00 |
| | Balance of last month | 75,00 + | |
| | (+) Total revenue | 900,00 + | |
| | (=) Partial balance of the current month | 975,00 + | |
| | (-) Total debt | 1138,00 - | |
| | (=) Monthly Final Balance | **163,00 -** | |

**Figure 2** Filling of monthly total with real student data

Source: Authors' archive

In this example, what was not expected by the teachers, the final balance was negative (Figure 2):

1. **Vanessa**[9]: [...] ...he got R$75 from the previous month...it was left there... then...he received nine hundred [registers the monthly total] and in the list that he spent here [showing the column expenses]...a thousand and thirty eight, is that right?
2. **Students:** yes
3. **Vanessa**: ok...he wrote here that there were seventy five reais left...it is positive...so let's put one more here...now we see..."total of addition"...how much did he get?
4. **Students**: nine hundred [teacher writes in the spreadsheet R$900,00]
5. **Vanessa**: then there is the partial monthly balance
6. **Students**: nine hundred and...

   (...)
7. **Vanessa**: the questions is "what is the monthly final balance?" Final balance is what is left....but this can be positive or negative.
8. **Students**: negative...
9. **Student**: a hundred seventy reais negative
10. **Elisa**: two hundred and ... two hundred thirty two negative...
11. **Vanessa**: how are we going to calculate this...if what he spend is more than what he had...do we add? Do we subtract? What do we do?
12. **Student**: subtract...but it will be negative
13. **Vanessa:** Ah...subtract...but the answer is negative...so I'll do 1138-975... let's remember this.
14. **Ronaldo**: negative....
15. [writes the algorithm and revises with students the steps to calculate using the algorithm of subtraction] so 163 reais...
16. **Vanessa**: but it isn't debit? He owes 163 [registers in the spreadsheet only the number without the negative symbol] (...) what is missing here so that Warley can show government that his money is not enough?
17. **Luiz**: the negative sign
18. **Vanessa**: or you put here [negative sign after the number] or here [ erases the sign that was after the number and writes it in front of it]...But the language of contability...they don't use this negative sign...the use a D... have you ever seen a bank statement...here are some that are more or less and other that use D and C and there are other accounting codes...so you can put a little D there...

The excerpt, transcribed above, exemplifies how the discussion on the registry of a negative monthly balance took place and, consequently, the introduction of the notion of negative number, the mathematical symbols that represent this type of

9 We used fictitious names so as to preserve students' privacy, except the names of the authors/teachers. When we could not identify the student, we opted for the word "Student". To transcribe the conversation, we adopted the following conventions:: **(...)** = longer pause or sentence was not finished; **...** = pause; **[ ]** = explanation of the transcript; **::** = vowel or consonant extension.

number, and the ways to calculate it, when applied to a financial context. The filling of the spreadsheet also demanded the use of numbers with different functions; for example, numbers to write the dates of purchases and amounts of money. We noticed that the students did not use the conventional school rules to represent the monetary values in the spreadsheet. They used a dot to separate the full value from the decimals, instead of a comma[10] (325.50); when recording an amount of money, they did not use symbols to indicate the amount, if the amount had no value in cents (400 or 400,0 and not 400,00) or used the comma to separate the full value from the decimal (1,2000, 00); they used the money symbol after the number (47.95 R$) and others.

Our expectation was that the filling of the spreadsheets would help the elaboration of a financial planning so that students could manage their own scholarships. However, the instrument used did not help to visualize the expenses and, consequently, the projection of future expenses. Therefore, we looked for new instruments that would allow the visualization of expenses, opting to categorize and represent them graphically.

## Categorization and graphic production

The elaboration of a financial planning requires reflecting on the possibilities to optimize the use of the resource; however, as said before, the heterogeneity of the expenses and the filling of the spreadsheet, month after month, did not contribute to the visualization of the distribution of expenses. On the other hand, the discussion on how to record the information on the spreadsheet allowed us to see what expenses could be assembled in categories. Other expenses that appeared in different proportions in the spreadsheet and were not part of the previously established categories were later defined, in consensus with the students, as "personal expenses".

The organization of the categories and the creation of graphics allowed the visualization of the distribution of expenses, as the new way to organize and represent the data gave a more collective dimension to the expenses. It is noteworthy that the definition of the categories demanded a long negotiation between the students and the teachers, mainly to reach the consensus on the category "personal expenses", as the students were initially resistant to show how they were using the scholarship money. However, it was still not possible to group all the expenses in the set of defined categories. The diversity of expenses registered in the spreadsheets showed that students' needs were different, considering the way of life of each people and the position that money occupies in each Indigenous people. Nevertheless, the categories food, transport, didactic material, accommodation, and personal expenses were common to all.

After the definition of categories, the students removed from the spreadsheet the items that referred to each of them and calculated the values spent in the considered period. However, they were not certain neither on the magnitude of each category in the total of their expenses, nor the fact that they could not simply copy them in any category. The comparison of expenses by category was possible after the creation of a pie chart with the distribution of the scholarship money. The definition of categories and the comparison of expenses in each category were important practices to make

10 Translator's note: In Brazilian Portuguese the thousands are separated by the hundreds by a full-stop and the hundreds by the cents with a comma, for instance R$ 1.345,29.

students reflect on the managing of the resource as they had to analyze their expenses and think about each one and how they could control the money per category.

To create the chart[11] the students had to distribute the total amount received into circular sectors, respecting the proportionality of the amounts that corresponded to each category and the final balance; to make numerical operations; and to know what is a balance. Many forgot to include the final balance as a part of the total received and were not able to fill the total are of the chart. Based on the doubts of some students, we resumed the calculations to clarify that if the total spend was not exactly the same as the received value, what was left, in that case, was a positive balance (Figure 3). This was another good moment in the practice of creating the chart continuing the discussion on the meaning of the word balance in the practice, as the amount left was the total balance of the last month. However, when the final balance was negative, the chart could not be done and, unfortunately, we could not deepen the discussion.

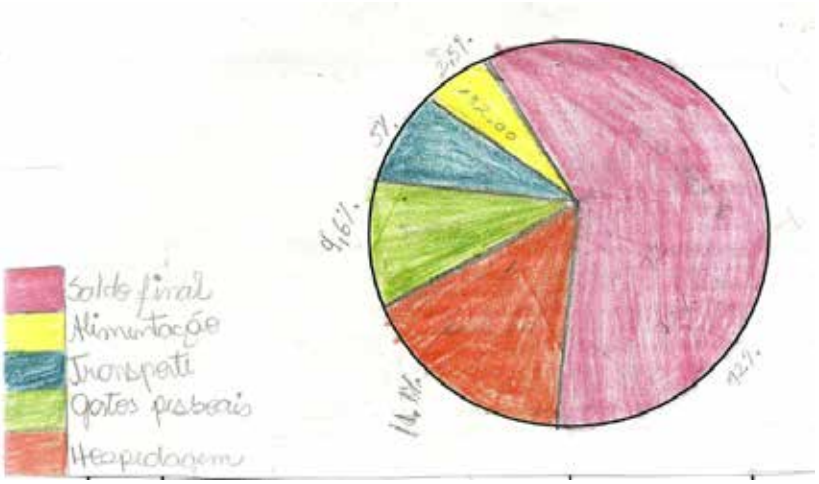


**Figure 3** Pie chart made by a student whose total was R$5,400.00

Source: Authors' archive

## Calculating percentages

When following the creation of the graphic, we noticed how the Indigenous students used mathematical language to visually represent the distribution of resources. Some used the percentage to quantify the areas in circular sector (Figure 3), however, there is no evidence that the students understood the relation between the area of the circle and the percentage it represented. Such finding reinforced the proposal of a new visual representation of the expenses in categories, from a square divided into 100 smaller squares. This opened the way to a new practice of mathematics use which would introduce the study of decimal fractions and percentages.

We explained students that they could consider the total amount received in the first semester of 2015 (R$ 5,400.00) as 100 small squares and, from that, they had to calculate the value of each square (R$ 54.00). After that, we discussed the relation between the value of each square and the fraction 1/100 and the relation between this fraction and the representation in percentage (1%). Established these

11 Each student received the drawing of a circle so as to create the pie chart.

relations, the students created a new visual representation of resource distribution, attributing colors to the total of unitary squares that corresponded to each category and using the fractioned and percentage representation (Figure 4 - Table A). To use the representation in fraction, we also had to discuss ideas that involved the meaning of fraction, as this was the first time that some students dealt with this type of numeric representation. Besides this, many of them were using fractioned numbers (14.4/100). During the second semester of 2015, when filling a new set of spreadsheets and making its visual representation using the checked square (Figure 4 - Table B), the students were asked to organize the expenses following the same categories of the previous semester and compare them. To do so, they had to work with fractions or percentages, as the total absolute values taken as a reference were different – R$ 5,400.00 in one semester and R$ 4,500.00 in another. This was another opportunity for students to participate in mathematical practices involving decimal fractions, the calculation of percentages, and the meaning of both.

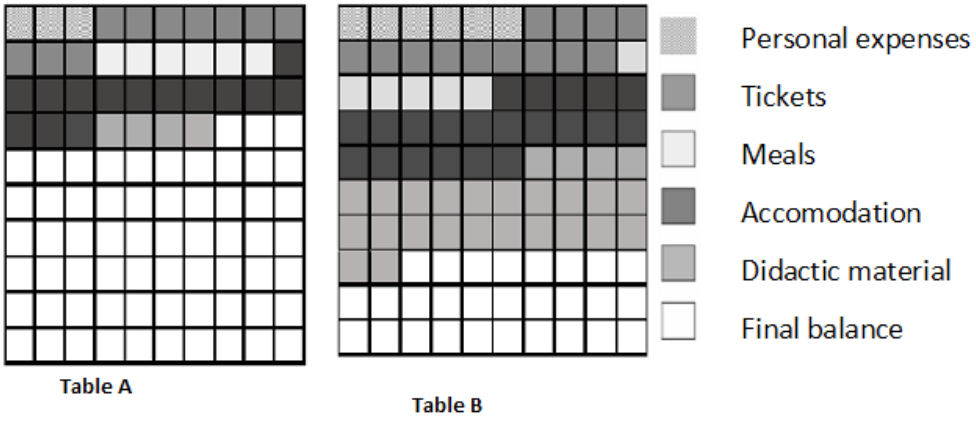


**Figure 4** Reproduction done by the authors of the comparative checked squares done by a student in both semesters. To the left (a), the square refers to a total of R$ 5,400.00 and to the right (b), a total of R$ 4,500.00

Source: Authors' archive

In the example above, 6% of the total amount was spent in food in both semesters. Regarding accommodation, while in the first semester, the student spent 14%, in the second it was 21%. There was also an increase in the percentage spent in the category didactic material that went from 4% to 26%. About the final balance, in the first semester, it represented 63% of the amount receive, in the second semester, this number dropped to 28%. Even if there was a drop from one semester to the other, the final balance did not seem to portray the expenses demands of the students, as the recording still did not correspond to the real expenses. Later, during the interviews, they clarified that they feared the use of the spreadsheet after it was shared with the teachers. At first, many students saw the spreadsheet as a strategy from teachers to control the use of their money, so, they omitted some expenses. Apart the resistance of some students, some of them also did not register future expenses, even if the payment was done during the same semester. The insistence of the teachers on those records was an attempt to make students think about the possibilities of savings, future expenses prediction, and prioritizing one expense over the other. However, this demand seemed to shock the different world views

that came in contact during these activities. The lack of understanding is evident in the excerpt bellow when a student during a class alerted us on the need to better understand this difficulty:

> **Luzia**: My difficulty was the cell phone plan...I tried every plan which I could pay cheaper...then I chose one of R$ 6.90 by week...but I don't want to insert here [in spreadsheet] the total for all weeks...because I don't know ...I want to insert only what I am using...
>
> **Vanessa:** But... you could calculate the monthly value and insert it as a future expense
>
> **Luzia**: But ...the future... I don't know ....I wouldn't spend with this ...I would change to another plan

The comparison of expenses in the two semesters through the representation in percentage allowed us to emphasize the relation between absolute value and the percentage it represented in the total amount taken as a reference. For instance, the percent value of the category food was the same in both semesters, but corresponded to two different absolute values.

## Broadening the repertoire of mathematical practices: the relation between learning and culture

In this section, we will deepen the reflection focusing in the relation between learning and culture in the context of intercultural education for Indigenous teachers. Lave (2001;2015) illuminates us to dislocate the approaches that support a concept of learning that places school as a privileged place to cultural transmission to another conceptualization, in which learning is structured through the *relations* between people and the environment, in activities. According to this reference, learning is collective, situated in social practice, in which individuals take part. In this perspective, "things are constituted through, and constituted as, their relations; thus, cultural production is learning, that is also cultural production" (LAVE, 2015, p.40). Another important aspect of this theory is its relational character because, according to Lave (2015) "every activity (including learning) is situated in- done through and part of – the relations between people and contexts" (p.40). This means that people's actions, thoughts, and attitudes are located in a space, in a time, and in the social roles that they occupy. School is one of those spaces.

From this relational point of view, one cannot affirm that there is a transfer of meanings from one practice to the other, as the notion of situated activity, in Lave's (2001) perspective, assumes that the objects, subjects, and the multiple contexts lived are made of relations. Learners are engaged in daily practices, participating of different ways of being.

Then, considering the different Indigenous cultures that enter in contact in the formation practices analyzed in this study; the intercultural education for Indigenous teachers in UFMG is one of the contexts in the lives of these students. In this context the self-management of their scholarship is forged *in* and *through* practices in which they *talk* about and *use* mathematics. However, one cannot lose sight of the entanglement of practices that permeate the stay of Indigenous in the course, mainly the relation among the practices guided by the use of the

spreadsheet and those using language and school mathematical procedures in the filling of the spreadsheet.

It is worthy highlighting that these students had already participated in commercial practices, be them based on reciprocity principles, in their culture, or based on the economic market of the society that surrounds them, in the different daily contexts they take part on. Thus, the management of the scholarship becomes one more component in the set of practices that includes mathematical practices.

In the practices used to manage the scholarship, i.e., the filling of the spreadsheet, the arithmetical operations, the numerical records using standard financial language, and the graphic representations, can be seen as something secondary, however, they are essential to the *creation of quantitative relations* (LAVE, 2011). There are, thus, the tools used to mediate the actions of the students, considering the ways the different Indigenous peoples deal with money.

This way, differently from the mathematic school problems, the solution of the problems within these practices of scholarship self-management are marked by tensions as they can result in interpretations that do not express the students way of living. For example, the logistic demanded to reach the closest bank to withdraw the money entails transport expenses that can reach up to 27% of the one scholarship installment[12]. We also cannot ignore that the conditions given to access and use the financial resource are structured in a way of life that is very differently from some Indigenous peoples. Considering this, a first analysis of the final spreadsheet balances, according to the parameters of a market economy, can lead to the conclusion that the annual amount given is excessive. We cannot forget, however, that the scholarship resource, when used by an Indigenous becomes part of a reciprocity circuit. It is re-contextualized by the Indigenous reality. Therefore, the money that each student receives – that can be used by the nuclear family or participate of a more extended family economy- will be part of the way each ethnic group organize their productive practices and consume; hence, this money will hardly be used individually. The fact that the use of the resources that enter in the community through each member is extended to the community was highlighted by a student, when questioned about the expenses in the spreadsheet:

> **Vanessa:** in his community, you are there, your brother arrives, your brother's children need something. You have money. Do you buy it?
>
> **Luciano:** Then I help. We are not like the non-indigenous. We help the relatives that need. For example, the things he really needs, we have to help.

The excerpt above reinforces the conditions to consider the analysis of the resource managing by the students. Many Indigenous peoples, whose lives are not based on an individual perspective, live economic dynamics guided by the principle of reciprocity within their communities. The commitment of this student to stay in the course presupposes keeping the extended family relations; therefore there is no place for the accumulation of resources.

So, if the mathematical practices can be reflection tools to manage the scholarship, what can we say about the mathematical practices that take place in it?

12 One of the rules of the scholarship program is that the revenue that was not withdrew after three months, from the day of the deposit, would be returned by the bank to the Education Ministry. Because of this, the student cannot stay longer than this period without withdrawing the money, even if they have no need for the resource at the moment.

## Mathematical learnings *as* and *in* practice of managing the Permanence Scholarship

As defended by Lave (2011), the issue of how learning happens cannot be exclusively directed to the school educational context, which, in these cases, involves mathematical practices. The Indigenous students are moving participants, engaged in daily practices in multiple contexts, including the teacher education one. Learning to self-manage this scholarship implies changes in the social practices in which they participate, even on the perception of dominant culture imperatives, overlapped by the procedures of access and use of standard financial language that uses mathematical language to impose itself.

According to Lave (2015), when we consider the issue of learning as relational, one needs to consider the entanglement of historical struggles and disputes in the political-economic life. In the case of this article, learning some mathematical notions can alter the power relations between those traditionally taken as "dominant" (public, economic, and financial agents of capital) and the "dominated" (Indigenous student recipient of the scholarship). However, considering the mathematical learnings that take place in these practices requires a dialectical analysis in the cultural, historical, and relational production of these students' daily lives, trying to notice the different ways of engagement in the self-management of the scholarship, which are constantly changing.

Thus, we do not consider that the practices described in the previous section are the only ones that determine students' learning and, much less, that there was a knowledge transmission which resulted in learning. We believe, as announce by Lave (2015), that the students were incited to participate of practices that involved something that was already part of their daily lives: using an amount of money to pay their survival expenses. However, changes happed in these practices, given the cultural and historical moment in which they took place.

Hence, guided by the social practice theory in the version proposed by Lave (2011) we analyzed the way students participate in the formation practices of managing the scholarship and the changes in these practices, evidenced in the discussions about the filling of the spreadsheet and their reflection on their participation in these practices. After, we presented the evidences of learning that we captured, when analyzing the classes and the students' interviews, regarding: filling the spreadsheet; controlling the expenses and operating with the bank system interfaces; record the numbers and use mathematic symbols; and make arithmetic calculations, percentages, and graphics.

### Filling the spreadsheet; controlling the expenses and operating with the bank system interfaces.

When confronted with the records in her spreadsheet, the student Tatiana emphasizes the information that was essential to fill the spreadsheet and what it shows regarding the money movement. She also shows the understanding on the use that will be done of the spreadsheet, i.e., to control what she spends and receives. When establishing the relation between the rules to fill the spreadsheet and its function to explicit the expenses and revenue, we identify the learnings arisen by the practice.

> **Ilaine:** What new things did you learn with this activity, Tatiana?
>
> **Tatiana:** First, to make a spreadsheet, right? And also, like, I had never dealt with one, you know, then I learned everything really, to put the date here [spreadsheet], day there, the description of movement, what we are buying, what we received, what we spent. Like, money comes and goes, right?

The student Luciano also highlights how, after the work done with the spreadsheet, he could measure the total amount needed to covers his expenses in Belo Horizonte:

> **Vanessa:** Do you think that after studying here with the spreadsheet, has it helped you on something?
>
> **Luciano:** Yes...for example, I am telling you.... "there are a thousand and something left"....there is something left...I'm relaxed. But if it was seventy I would be worried, because this money is not enough...not even to buy the ticket...
>
> **Vanessa:** So, doing these calculations let's you more relaxed because you already know ...
>
> **Luciano:** yes, because I saw on the screen [saw the balance on the ATM screen] and thought "That is enough, I can relax". Then I relax and think about other things.
>
> **Vanessa**: But did you know how to do it before? Or did you learned it when you started using a bank account?
>
> **Luciano:** no, because I know already. Before I knew [ the student uses the verb in the past "sabia", but he does not master Portuguese very well, the verb tense not always corresponds to the time he is referring. In this case, when using the past he might want to refer to the present "sei"] If it was seven hundred, but if I, for example, If I am close to...for example Santa Helena [town close to the village], it is near, isn't it? If it was seven hundred to work in Santa Helena is enough...I relax...because it is enough, another thing is I have...for example, I stay there at house to go to Santa Helena to study, then I am relaxed.
>
> **Vanessa:** If it were seven hundred?
>
> **Luciano:** yes, if it was seven hundred, around five hundred, or around four hundred....I'm ok...because I can get a ride...
>
> **Vanessa:** But what if in Belo Horizonte? Is seven hundred enough?
>
> **Luciano:** In Belo Horizonte... seven hundred is not enough, because I have to take a taxi, to pay bus, to pay the inn, to pay food, not enough.

Luciano's excerpt suggests that how he broadened his participation in social practices that demand dealing with money in the city. According to his report, the entry of money in this community is done, basically, through governmental social grants, what has led to difficulties, as they have little autonomy to make the bank transactions demanded to access the resources. After the study with the spreadsheet, he says he can now estimate the values that are in the thousands or hundreds when reading a bank statement. After accessing the scholarship, he also learned how to deal with the interface technology to access the bank statement, a type of text that includes numbers. Reading the balance allowed him to conclude that, having an amount in the thousands, he could pay the expenses in the intensive periods of the course. As we have seen, it is not only calculating the revenue and the expenses to know the balance and record it in the spreadsheet, he also needs to know if what is left will allow him to survive in Belo Horizonte. As affirmed by Lave (2011), when taking part of a practice, thinking, knowing, and recognizing is always part of a *praxis*, captured

through notions of identity, personal and collective, regarding the various social arrangements. The student's speech evidences how he learned that in the city the "white-people" rules are used and, therefore, he needs to work with them.

We understand that, when the student makes explicit how he estimates the amount needed to stay in Belo Horizonte and compares this value with his statement, he establishes *relations* between the practices of filling the spreadsheet- that, on its turn, demanded recording money, calculate revenues, expenses, and balance - and the practices of money to cover the study expenses. These were introduced in his daily life after entering the course.

This way, when estimating amounts, comparing numbers of different orders, and reading virtual texts, expressed in mathematic language, this Indigenous student engages in social practices that include predicting expenses that, one way or another, can lead to saving money for a future expense. This is a change in the practice involving money use and numbers. Changes in the practice, according to Lave (2011), characterize learning *as* and *in* social practice.

In the case of this student, however, the procedures he uses do not, necessarily, reproduce the classroom mathematical practices used when filling the spreadsheet. He re-elaborates these procedures and attributed to them the meaning that answer a contingencial need, which appears when he needs to take part in social practices to guarantee the stay out of his community. We can say that there are evidences that this amount, estimated by him when checking his bank statement, is taken as a reference to control his expenses.

Generally, the students Lucia and Gabriela also emphasized the changes in the perception of use and control of money from the participation in the practices of spreadsheet filling. That is, they changed the way they participated in the practices of money use, learning *in* and *with* the practice (Lave, 2011) they have participated:

> **Lucia:** You could spend...
> **Lucia e Gabriela:** but not spend everything...
> **Lucia:** to save it, so I could have money.
> **Gabriela:** Yeah, so that we weren't in need at the end of the module. Because in the beginning, we spent a lot.
> **Lucia:** and still spend (laughter)
> **Gabriela:** Yeah, we continue, but we think more...
> **Lucia:** yeah, we think more...

The students' reflections show that the world view within a more collective organization will also structure the way the Indigenous student controls the money they receive. However, we cannot forget that, as learners, these students transit through different daily practices, including those forged in contemporary Indigenous economic practices – guided by market economy as well as reciprocity principles.

## Registering the numbers and using mathematic symbols

The recording of the numbers in the first spreadsheets show that the grammar used by the students do not translate the conventional rules of a school mathematical text, but they fulfill the role of informing a numeric data. The practice of

filling the spreadsheet however led students to learn the rules to register numbers in a school practice, forged by the life logic of the society that surrounds them, as explicated by some students:

> **Tatiana:** [...] also, like, then I learned everything really, to calculate numbers... there were different numbers each spreadsheet...to put the date here [spreadsheet], day there, the description of movement, what we are buying, what we received, what we spent.
>
> **Ilaine:** What did you learn about this type of representation from working with the spreadsheet?
>
> **Tatiana:** From this that I put like that? [pointing to her representation 47,50 R$] ... It was right to me, I don't know if it is right.
>
> **Ilaine:** Today, how would you represent it?
>
> **Tatiana:** the correct way, you put this two here in front [pointing to the symbols R$- *reais*. [In this moment she is looking at the spreadsheet that she filled]

The student Tatiane had developed a peculiar record to the monetary unit (Real) by using the conventional symbol put placing it after the number. Such record fulfilled the role to inform that that number represented a monetary value, suggesting *relations* that she had established with the school practice of filling the spreadsheet and other daily practices in which she saw or had to register an amount of money. When this particular record used in the school practice is questioned by the teachers, it creates a tension in the practice. This tension is softened when the students start to use the authorized school register and makes it explicit, during the interview, that she noticed there was a "*correct way"* of registering a monetary value, in that type of practice.

In some cases, registering the numbers in the spreadsheet demanded that the students assumed cultural practices that were different from theirs, as not all of them have in their communities' practices that use large amounts or demand registering them in the numerical decimal system, as explained by Luciano:

> **Vanessa**: What about in the communities....when you need to deal with very high numbers? For example...a million, ten millions....
>
> **Luciano:** A big number like this...millions.... we don›t have....we don›t use... (....) for example...there, one counts... for example....money....he just counts money...one thousand....two thousands....three thousands...four thousands.... but he can't add up....in the community...the older ones, you know....now the younger ones are studying...the oldest only count...they don't add...they don't write down...just in their heads.
>
> **Vanessa:** ok. Another thing, since you've entered in the course, we've been studying this spreadsheet. To do this to control the money. Understand what is spent, what is left, etc. Do you think you've learned something, since you've started to study about money here?
>
> **Luciano:** I learned money, right? Because money ....the numbers of money are different, for example, there is zero, comma. For example, I calculate easily, but money is different. For example, there is comma, then zero, zero

When participating of the practice of filling the spreadsheet which involved operating and registering numbers in the order of thousands, Luciano takes part of social practices that use bigger values, establishing *relations* between quantification

practices in this community and those needed to manage his scholarship, in a school context. The participation of a school practice that involved recording monetary amounts opened the opportunity for him to learn what are the rules to record a value in the spreadsheet: *"but money is different. For example, there is comma, then zero, zero"*.

When we analyzed the record of numbers done by students, based on Fonseca (2010), we recognized that to do so, the Indigenous students used *numeracy* practices[13]. The social dimension of this mathematical action is related to these students' frontier position: between the rules of mathematical school writing and their own ways of dealing with numbers in their Indigenous daily lives. However, the contingencies of mathematical school learning practices and other social practices allowed them to access and use the resources of the scholarship involving the "dilemmas, interpretations, values, choices, and confrontations" (FONSECA, 2010, p. 329) the students are faced. School practices put into action are marked by power relations established in graphocentric societies, so the use of school symbology of numbers by Indigenous students becomes an important component to their autonomy in managing their financial resources.

## Make arithmetical calculations, percentages, and graphics

Initially, when the students had to sum the expenses per category, the use of school procedures did not ignite much tension. However, the balance that resulted in a negative number created tensions because, as we did not access the balance directly in the bank or at an ATM, the only alternative left was to determine this value through an arithmetic operation, mentally or manually, with the support (or not) of a calculator. As shown by the excerpt of the classroom situation transcribed above (Figure 2), the use of a calculator was rejected, distancing the school practices to daily ones. The use of this instrument, in this case, allowed that when typing the numbers and the signs in the order they were registered in the spreadsheet (975 – 1138 = - 163), the result would appear negative at the calculator screen and the student would simply have to write it on the spreadsheet.

Thus, the teacher opted to use a typical school procedure, i.e. the algorithm of subtraction, as many already work as teachers and teach this to their students. However, only the result of this operation would not describe the solution of the problem, requiring the analysis of the number found to the problem-situation at hand. In fact, the difference expressed in the algorithm was not a negative number. The discussion of the calculation of a negative balance became a school practice in which students established *relations* between the practices to solve numerical problems to fill the spreadsheet and the practices of using negative numbers to express monetary numbers. Other *relations* were also established in this practice between the negative numbers and the meanings associated to them, as well as the ways to register them. When we noticed the *relations* established by the students in this school practice, we identified evidences of learning about negative numbers, as seen in Tatiane's interview, for example:

13 The practices of numeracy, according to Fonseca (2010), are characterized as such because they involve quantification, measure, orientation in space, ordering and classification, and present *relations* between people, groups, and the knowledge associated with Mathematics. These practices are marked by the concepts of and about mathematics, including the values attributed to mathematics in the data of specific use contexts, as well as "knowledge, records, abilities and follow-ups of mathematical procedures, be them oral or written" (FONSECA, 2010, p. 329).

> **Ilaine**: What mathematical content did you learn with this activity?
>
> **Tatiana**: I learned fraction. Even, like, I learn more all the other operation that have it, you know: Sometimes we even got lost with subtraction, addition. I learned to deal with graphics, percentage as well, the difference between one and the other, and also the numbers there, sometimes there is a total in which we are negative, right? I remember this as well, I learned these negative and positive numbers.
>
> **Ilaine**: yes. In your case, was there any moment with a negative balance?
>
> **Tatiana**: No
>
> **Ilaine:** What does a negative balance mean to you?
>
> **Tatiana:** That I owe, that I've spent too much, so that in the end of the month..

We do not see here a simple manipulation of numbers, it is about exploring calculation strategies that amplify practices, that is, *the creation of quantitative relations* (LAVE, 2011): the result of a subtraction is the difference between the expenses and the revenue, which, in this case, would result in a negative balance. The student also established a *relation* between school practice in the introduction of negative numbers and the management of the scholarship, what evidences how and what she had learned when participating of these practices.

Similarly, the creation of a graphic was a school activity that was part of a set of practices about the self-management of the scholarship, in the context of Indigenous teacher education. To make it, they needed to sum not only the categories but also to include the balance, as the total of the expenses plus the balance would correspond to the total amount received in the period. In this situation, we worked with the pie chart and the percentages through a social practice in which students were the subjects, even if the reference was a culture distinct to them.

Therefore, using the chart and percentages to analyze the expenses and, through that, take decisions on the best way to manage their scholarship, demanded that students transited between social practices that can, at times, led them to rethink daily life assumptions:

> **Elisa:** in this activity? I've learned a lot. I learned, like, what is interest, what is debit, what enters, what leaves. I learned, we learned a lot about percentage, didn't we: The issue of percentage was something like, with the spreadsheet, today if I get a spreadsheet I know how to do the percentage correctly, even the review we had that day, I had no problems with it...those little squares are worthy this much and this much...and the activity brought me...the issue of more, of adding, subtracting.

Through Elisa's opinion, we can see that the filling of the spreadsheet and the discussion on the use of the scholarship had a relevant role to introduce concepts and learn about mathematical procedures. New artifacts, such as the graphic representations, were introduced in the students' social practice of using numbers and the ways to represent them. This lead to changes in the ways they dealt with and between the contexts in which mathematics is used, "contexts that work to influence, split and connect, or on the contrary, to mold (their) daily lives" (LAVE, 2015, p.42).

## Final remarks

Our lenses in this article was focused on the reflections around the possibilities of mathematical learning when identifying the *relations* established by Indigenous students between the different social practices in which they tool part, as part of their teaching formation, while managing their scholarship.

The management of the resource received by the scholarship, when analyzed from a *relational* perspective (LAVE, 2011; 2015), allowed us to talk about Indigenous students' changing participation in an entanglement of daily interconnected practices. The participation of students in these practices allows the learning of knowledge related to financial management of the scholarship, including the control of expenses and the use of interfaces to access the bank system.

In this sense, the activities developed aiming to discuss the management of the scholarship demanded that students transited among different practices as if they were always acting in a frontier line. As there was a fog of doubt on the reason of the spreadsheet- considering that the students were not immediately convinced that it was a school text- the records of the numbers expressed this ambivalence: it was not a merely school activity with pre-established rules, pre-defined contents, but the initial reference a school model.

Likewise, more than teaching contents, the discussion on the scholarship management presented evidences of different learnings, particularly, mathematical learnings related to the rules of filling the spreadsheet, including the use of mathematical symbology to register the numbers; the procedures and mathematical representations that contribute to calculate balances and compare different sorts of expenses (categories, graphics, fractions, percentages). The contingency of the practices in which these learnings took place makes mathematics an analytical tool that can help the Indigenous student to systematize and project the expenses, thus making decisions on the management of the resource, so as not to compromise the permanence in the course. As such, school mathematical procedures are not worked as an end in itself based on pre-defined arithmetical problems.

Nevertheless, we cannot disregard that making a financial plan introduced a practice of regulation on the use of the scholarship and, thus, imposed a shock between individual and collective actions. The spreadsheet acted as a powerful artifact to adjust students' actions when acting within the imperatives that guide capitalistic economic practices in the surrounding society. On the other hand, even if the students admitted that the use of the spreadsheet helped them to understand the importance of managing the scholarship, we cannot say that they have abandoned the traditional economic practices of their people, which privilege reciprocity, in favor of an economic individualization imposed by the rules of the student assistance program.

The practices also showed to the teachers of the course that, as affirmed by Tomaz (2015), the objects of teaching and learning in an intercultural formation to Indigenous teachers are unstable and resist to any attempt of control and standardization, as they are a relatively new practice. Each new activity proposal required a long process of negotiation with the students, aiming to break with the conventional practices, marked by the impositions of the surrounding society and the deepening of Indigenous' submissiveness. We were interested in the activities that the students did to self-manage their scholarship.

Because of all this, we agree with Luciano (2010) when he affirms that the Indigenous aim a teaching formation that answers to the perspectives of "continuity of the particular and specific processes in the life of each Indigenous people, as well as to new perspectives to access knowledge, techniques, and ways of being and living in modern societies" (p.70). Therefore, we defend that an intercultural formation to Indigenous teachers cannot only discuss practices related to Indigenous traditions and their relation with school practices, neither ignore them. Also, the formation is not justified only by the approach of contents traditionally present in the curricula of Mathematic teaching degrees, be them connected to Basic education or to pure or applied Mathematics. We understand that one needs to observe the demands of Indigenous teacher formation in the context of the surrounding society. This is needed even if these demands are not mathematical contents in basic Indigenous school or even part of the specific contents of school mathematics formation, so as to guarantee them the right to access and permanence in the course without imposing them the abandonment of their own culture.

Finally, we highlight that, in this formation, the financial planning of the expenses of the scholarship became a broad intercultural phenomenon that took into account the uses and the collective needs. This led us to reflect on the dynamic (especially the rules) of implementation of student assistance programs, which need to be able to guarantee the rights of historically excluded groups, and the contradictions they hold, when considering the surrounding society.

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