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## Learning Evaluation in Mathematics Teaching Degree and the Possible Implications for Teacher Training<sup>1</sup>

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**Abstract:** This study aims to analyze the perceptions of undergraduates in Mathematics Teaching on the evaluation practices of their teachers of specific content subjects and the possible implications of this practice in their training as teachers. It is a qualitative research, expositive and explicative, developed in a Mathematics Teaching degree in a Brazilian Federal University. We used random non-probabilistic sample to select the course and the students. To produce the data, we used: documental analysis, class observation, interviews, group talks, and social networks – Facebook and WhatsApp groups, followed by content analysis. The main intervening which emerged from the data were indications of possible dispositions composing the *habitus* of mathematics teachers. From these dispositions, undergraduates indicated, directly and indirectly, the legitimizing role of the evaluation practices in the subjects of mathematics content as a way of symbolic violence, when mentioning the tension between the bachelor's and the teaching degrees, and criticizing or defending the expositive classes with demonstrations, the rigor of classificatory tests, and the relationship teacher-student with little dialogue. The analysis shows that the students do not clearly see the implications of these evaluation practices on their training as teachers. In this context, they have shown a propensity to incorporate the *habitus* of the mathematics teacher, becoming possible reproducers of a pedagogical practice focused on transmission and traditional evaluation in their future.

**Keywords:** Learning evaluation, Pre-service teacher training, *Habitus*, Mathematics education.

### Introduction

In this study we aim to analyze how undergraduate students on Mathematics Teaching (in Portuguese called *licenciatura*) perceive the evaluation practices of their teachers in subjects of specific mathematics content and the possible implications to their training as teachers.

As stated by D'Ambrósio (1993, p.38), “the research on teachers’ actions show that, in general, teachers teach the way they were taught”. This an important premise, particularly regarding that learning evaluation

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is not a well-explored theme in teacher training and this gap is even larger when considering the formative model of evaluation (Perrenoud, 1989). When advocating in favor of a formative evaluation, Perrenoud (1998) highlights that it is the center of the pedagogical action as it gives teachers qualitative information on students' learning. However, the author highlights that, under this perspective, evaluation is confronted by the structures of the educational system: its process of selection and guidance, the organization of classes, the spaces, the times, among others.

In this sense, we relate this situation to what Bourdieu and Passeron (1982, p. 153) affirm when dealing with the weight, the characteristics, and the roles of exams in the French educational system: "it is very clear that the exams dominate university life, that is, not only the representations and practices of the agents, but also the organization and working of the institution".

Thus, we assume in this work that evaluation is an element integrated to the pedagogical practice, with a formative rule. A process to investigate students' progresses and difficulties in which "learning tasks have to be, at the same time, evaluation tasks, as evaluation is an integral part of the routine of school activities and not a break from it" (Buriasco and Soares, 2008, p. 110).

Similarly, Barlow (2003) highlights the everyday aspect of evaluation as an act of communication, a mirror of action, or feedback. The author emphasizes the relevance that teacher-student interaction has to the efficiency of the evaluation practice. For this strand, the teacher talks not only to show knowledge but also to investigate the quality of students' learning.

Based on this, we question: How do undergraduates on Mathematics Teaching notice the evaluation practice of their subjects of mathematic-content and the possible implications of this practice to their training as teachers?

Researchers as Cunha (2005), d'Ávila (2015), Fischer (2008), Canôas (2015), among others, point that experiences acquired during their formation might influence their future teaching. In this perspective, Cunha (2005, p. 94) affirms: "teachers teach based on their experiences as students, inspired by their former teachers". We take as a reference the study of Canôas (2015), in which the author highlights that the

education of teacher trainers, their awareness, and their commitment are central factors to the pre-service training of mathematics teachers.

These elements indicate the need to reflect on the pedagogical practice, especially learning evaluation, during the process of pre-service training in the Mathematics Teaching degree, mainly the practice of teachers from the subjects of specific-mathematics content because, in these subjects, the levels of retention and dropout are historically high in Brazil.

The study of Silva and Moreira (2019, p. 103) on the curricula of Mathematics Teaching degrees show that they do not incorporate a “qualified discussion on the current evaluation practices nor a deep study on the theoretical viability and practice of alternative tools and formats of learning evaluation”. Given the importance of evaluation within formative processes, here analyzed through students’ perceptions, studies such as these are justified, especially in a national scenario of retention and dropout in this degree and in Mathematics in general. We hope to contribute to understand the role played by evaluation in pre-service teacher training, offering elements to formulate public policies.

## On the research pathways

We opted for a qualitative nature, combined with quantitative aspects, exploratory and explanatory. The field was a Mathematics degree course in a Federal Higher Education Institutions, which offers both Bachelor’s and Teaching modalities. It is a big and traditional institution in the country with an established research field in mathematics.

The subjects were Mathematics Teaching undergraduates in the second half of the course, they were the protagonists who will build their own ways of thinking and acting in their future profession. We have given them fictitious names (based on precious stones) aiming to preserve their anonymity and answer the norms of ethical research.

The institution, the course, and the students were selected by a random non-probabilistic sample.<sup>4</sup> The techniques used to produce the data were documental analysis, class observation, interviews, group talks, and social networks (closed groups on *Facebook* and *WhatsApp*).

For a documental analysis, we used the Pedagogic project of the course, the syllabus of the classes, and the technical reports of the institution.

The class observations took place during 3 consecutive semesters. In the second semester of 2016, we started a pilot observation, for 2 months, in three subjects: Integral and Differential Calculus II, Combinatory Analysis, and Complex Variable, in a total of 42 classes. Later, in the two semesters of 2017, we observed the compulsory subjects for the Teaching degree: Fundaments of flat geography and geometric drawing, Spatial geometry, Complex Variable, and Fundaments of Analysis. These subjects are offered respectively to the 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup>, and 7<sup>th</sup> semesters of the course. We did an “observation as participant” because in this type of observation “the identity of the researcher and the aims of the study are revealed to the researched group since the beginning” (Ludke and André, 1986, p. 29). We opted for the compulsory subjects because it is from the 4<sup>th</sup> semester on that students can choose the Teaching modality. As in the institution the enrollment is done by subject, Bachelor’s students can enroll in the compulsory subjects of the Teaching modality and vice-versa. The classes of compulsory subjects were composed by students from both modalities, though most of Teaching ones.

All students enrolled in the subjects selected were invited to take part in the research. In total, we have identified 67 Teaching undergraduates who attended our established criteria. Out of those, 42 accepted to participate in the study: 12 were interviewed and 16 took part of the group talks – among those, 4 were also interviewed; 18 participated only through *WhatsApp* and/or *Facebook*. It is important to say that many of the interviewees and participants of the group talks were also included in the social network groups.

The students of the Department of Mathematics have created a closed group on *Facebook*, in which they shared information regarding the subjects, the classes, evaluations and, mainly, evaluations on

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<sup>4</sup> All students enrolled in the specific- content subjects and their professors were invited to voluntarily participate in the research, following the ethical protocols in research.

teachers' profiles. At the start of each subjects, students would create a *WhatsApp* group for the class. The insertion of one of the researchers in those groups was extremely valuable, as the virtual dialogues naturally touched issues on teaching, complaints, outbursts, political articulations, and revindications.

To develop a collective reflection with the students, we did a group meeting using the technique Conversation Circle, with participant observation, using as a reference the principles of "Culture circles" (Freire, 2005, p. 115), a group of work and debate, mainly interested in free and critical debate.

We have worked with the concept of perception in the perspective of Poletini (1996), to whom it is especially important the reflection around the experiences during teacher training, that is, perceptions as indicators (introspections) that subjects currently have, the result of a reflective process on their present and past experiences.

To treat the data, we used content analysis trying to analyze the subjects' statements, one by one, to infer their subjective senses. We understand that when analyzing a verbal or non-verbal communication it is possible to understand its symbolic meaning, considering that this sense is not always explicit, and its meaning is not unique (Bardin, 2016).

The category 'perception on the implications of evaluation to teacher training' was defined *a priori*. We chose this theme as a record unity and classified the interlocutors' statements according to a defined category. According to Bardin (2016, p. 135), "the theme is generally used as a record unity to study the motivations of opinions, attitudes, values, beliefs, tendencies, etc.,". To the author "to make a thematic analysis is to discover the 'meaning core' that compose communication and communication and whose presence, or frequency of apparition, can mean something to the chosen analytical object".

The data was individually treated by each instrument to identify the recurrent and excluded elements, a process that resulted on the definition of thematic axis, which will be later discussed.

## Perception of Teaching Undergraduates on the Implications of Evaluation for Teacher Training

Based on the premise that the teacher can use as a reference into future practices the actions experienced with their trainers, collating teaching models and counter-models (d'Ávila, 2015), we will analyze the theme-axes that emerged in the corpus, through which students expressed their perceptions on the evaluation practices of their mathematics teachers and the possible implications of this evaluation to their training as teachers.

### On the tension Bachelor *versus* Teaching degrees

Out of the students researched 54.76% indicated a latent tension between Bachelor's and Teaching students in the course. This tension was evident in a set of actions and situations such as the defense of meritocracy, an appreciation towards the bachelor's degree, the specific contents, and a depreciation of Teaching degree and the pedagogical contents, among others. Bachelor's students are known as "good students", those with a "natural talent", the "gift" to mathematics, due to the easiness they display to learn the specific contents and to get good grades in the tests. The depreciation of Teaching students is often associated to the difficulties to learn specific contents and, consequently, reach the average for approval, creating, then, a sense of inferiority in relation to Bachelor students.

Aiming to understand the causes and the implications of this tension to teacher training, we questioned students on their teaching models. In d'Ávila's (2015) terms, the models, and counter-models of teaching. The model teachers are those that marked the lives of training teachers and active teachers, "it is interesting that the qualities the first ones attribute to their memorable teachers are those that they themselves intend to follow or reproduce during their careers, creating them a certain sense of affiliation" (d'Ávila, 2007, p.229).

The teachers from whom they do not have good references are, according to d'Ávila (2007, p. 229), the counter-models "those teachers from whom students do not have good memories and do not intend to reproduce. They are strong examples of what "not to do" or how "not to be" [...] because they do not correspond to the professional ideals conceived by the students".

The subjects of this study observed their professors, criticized or valued their personal and professional behaviors: “I’m always analyzing the teacher, trying to get out of him what I’d do and what I wouldn’t. Of course, there are some teachers that you look at them and think: I’d nothing [like them]! And there are others that you can get something out of them, you know? [...]” (Rubelita/group talk).

The model professors are cited by the students with enthusiasm and admiration, especially among those that have a friendly teacher-student relationship, and show interest towards students’ learning:

[...]Jade is an example for me, you know? She observes, I want to learn how to observe the [...], see what the student can’t do, that he is trying, that he is making and effort, but that he can’t do it. [...] see what the problem is, see what I can do, so, I want to reach this level, you know?” (Amethyst/Interview)

In several testimonies there are evidences that students notice that their experiences in these subjects can positively or negatively impact their formation, that is, they are aware that they might incorporate models, even the teaching counter-models.

Sphene: I think that the teacher has suffered so much before with his teachers that, now, I think he does the same to us. I think that, before, yeah, his teachers were very hard on him in Mathematics, so now they do the same to use.

Euclase: This is the cycle!

Sphene: Yeah, exactly!

Researcher: Is it the cycle, Euclase?

Jasper: It seems like a cycle!

Euclase: And now we’ll get to school and whack them [students]! (Group talk)

This cycle can be explained by the incorporation of *habitus*, a concept of Bourdiesian theory (1983, p. 65) which is “[...] a system of durable and transposable dispositions that, integrating all past experiences, serve at each moment as a matrix of perceptions, appreciations, and actions” According to Maton (2018, p. 77),

[...] *habitus* focuses our ways of acting, feeling, thinking, and being. It captures how we carry our history within us, how we bring this history to our present circumstances, and then, how we choose certain ways to act and not others

Setton (2002, p. 64), based on Bourdieu states: “most part of social agents’ actions is the product of the meeting between *habitus* and field (conjuncture)”. To explain the relationship *habitus* and field, Maton (2018, p. 77) uses the equation:  $[(habitus) (capital)] + field = practice$ . This means that “our practice is the



result of the relation between our dispositions (*habitus*) and our position in the field (capital), within the current state in this social arena (field)”.

In this equation, we have to analyze the position established by the Teaching degree and, mainly, its undergraduate students, in the mathematics field. The studies on Teaching degrees in general point out a depreciation of these courses in Brazil during the last decades. Aranha and Souza (2013, p.78) consider that this is a multifactorial crisis, which “combines ingredients of various natures, but the key-element to explain it is the low value of a teaching diploma, especially basic education in the markets of economic goods (salary) and the symbolic goods (prestige)”, a crisis caused by inclusion, which was the result of historic struggles to democratize the access to public education, in all educational levels. School then started to receive “[...] the children of rural workers, the people from the urban outskirts, the indigenous, the handicap and, even, a public that was greatly unsubmitive to what school expects from them or wishes for them” (Aranha & Souza, 2013, p. 78).

In this scenario, there are some dilemmas to face in the process of teacher training, as Diniz-Pereira (2007, p. 58) states: “[...] there are some inherent problems on Teaching degrees that are recurrent and, therefore, can be considered persistent ‘dilemmas’, since its origin, with no solution”. Among these dilemmas are the separation and disarticulation between the specific-content subjects and the pedagogical-content ones, one of the causes of the tension between Bachelor’s and Teaching degrees and that may find its explanation on the Bourdiesian thesis (2015) of knowledge stratification.

According to Nogueira and Nogueira (2016), in this thesis there is a hierarchization of subjects in all educational levels, from the canonic subjects (more valued), going through the secondary ones (intermediary), up to the marginal ones (less valued). To Bourdieu (2015), the good performance in the canonic subjects seem to demand from each student an individual talent– the intelligence, the aptitude –, the ideology of the gift, according to which, students’ success or failure are subordinated to the individual characteristics of each person.

In this sense, indicating that he values more the content-specific subjects, Spheue says: “We complain a lot here like Ah! Fundamentals of Analysis is very difficult! But this subject, this subject is mathematics, if

is not the mathematics of didactic. We have to differentiate them, guys!"; Therefore, these subjects "[...] have to be done with a greater rigor, no doubt about that" (Citrine/Group talk).

About this dilemma, Menezes (1987, p. 120) states that: "the Teaching undergraduate is seen in the university as a half-Bachelor with some pedagogic touches". Indicating that she sees this problem, Amethyst says: "It is a course that took the bachelor's degree and adapted to train teachers". The opposite situation is also mentioned. Referring to the possible changes in the Teaching degree, during his interview Citrine says "[...] It will become a Pedagogy course with a focus on mathematics".

Between the lines we can see in these comments the tension that arise from the depreciation of the Teaching degree and the valorization of the Bachelor's degree, reflecting in the relationships established among the students, and between them and the teachers. It is a predisposition of consider bachelor's students more intelligent and underestimate the teaching students; "I fell there is a culture that: those who go to teaching are the ones who couldn't deal with the bachelor's, so who is in teaching, is because they couldn't learn hard mathematics" (Ametrine/Interview).

The tension between Bachelor's and Teaching degrees can be explained through Bourdieu's theory, as a competition to accumulate capitals within the field. The field is a relatively autonomous space, "but that obey social laws more or less specific" (Bourdieu, 2004, p. 20). There is a competition in the field in which "[...] agents confront each other, through different means and ends according to their position in the structure of the forces in the field, contributing then to the conservation or transformation of its structure" (Bourdieu, 2007, p. 50).

What is at stake in the internal competition of the field are advantages to the agents, the accumulation of capitals, that are a process and a product of the field to which they belong. Thompson (2018) defines what are the types of capital:

[...] economic (money and goods); cultural (e.g.: types of knowledge; preferences of taste, aesthetic, and cultural; language, narrative, and voice); social (e.g.: affiliations and networks; family, religious, and cultural heritage); and symbolic (things that represent all other forms of capital and that can be exchanged in other fields, for instance, credentials) [...]" (p. 98)

In the fields, some agents and some institutions occupy dominant positions while others inferior ones. Those in the dominant positions tend to adopt conservative strategies that aim to keep the current structure of the field and the classification criteria of the produced goods that benefit them (Nogueira & Nogueira 2016). Those in the inferior positions can adopt two strategies. The first would be “accepting the current hierarchical structure in the field and, consequently, recognizing the inferiority of their own productions [...]” (Nogueira & Nogueira, 2016, p. 32). “This strategy can be followed or not by an effort to approximate or even convert the patterns of dominant excellence”. According to the authors, the second strategy “refers to the attempts of contesting and subverting the current hierarchical structures in the field”.

Thus, each field would be an arena of dispute between dominant and dominated, related to the “criteria of classification, hierarchization of symbolic goods produced and, indirectly, of the people and institutions that produce them”, as explained by Nogueira and Nogueira (2016, p. 32). To these authors, in this competition

The individuals and the institutions that represent the dominant forms of culture aim to maintain their privileged position, presenting their cultural goods as naturally superior to others. This strategy is on the base of what Bourdieu calls symbolic violence: the imposition of culture (cultural arbitrary) of a group as true or the only existing cultural form. (p. 33)

Using this idea of competition in the mathematics field, it is possible to say that the image of mathematics as an absolutist science – formal content, rigorous, with precise results, and indefectible procedures – is considered superior to other approaches. In D’Ambrósio’s (1993, p. 36) words, “the absolutist image of mathematics creates a dynamic of teaching in which students must accumulate knowledge. This is the force that has been driving our mathematics teaching for many centuries”. This way, the individuals would not normally notice that mathematical knowledge is considered as superior or legitimate, “occupying this position only because they were historically imposed by the dominant groups” (Nogueira & Nogueira, 2016, p. 34).

The agents that support the dominant concept of mathematics can adopt two possible strategies. The first refers to, naturally, recognizing the superiority of this concept and, in some way, aim to get closer or even convert themselves to this perspective. This process consists of the effort that subjects have to make

to appropriate themselves of the mathematical knowledge, what Bourdieu called “cultural goodwill” (Nogueira & Nogueira, 2016, p. 33). In this sense, Citrine says: “Unlucky for us, the Teaching degree has few subjects of real mathematics. [...] about ten, maybe, in the whole course! In total!! [...] imagine that!”

The second possibility would be when the dominated contrapose the dominant hierarchy aiming to alter the positions occupied by the dominant ones. However, as stated by Nogueira and Nogueira (2016, p. 33), Bourdieu seems to be skeptical on the chances of success of this strategy. We can infer that, faced by the obstacles they face in the specific-content subjects, the interlocutors of this study are also skeptical, as Spheue relates when talking about this teachers’ evaluation practices: “Yeah, they are used to this. So, it is over, they want it like that, so not much will change in this sense. So, what is the point of whining, now we must face this”.

Based on this, it is important to analyze the process to access the Teaching degrees, especially, in mathematics. Bourdieu & Passeron explain that “social inequalities show themselves not only on the access to higher education in general, but on the choices between different tracks in this educational level”. (Nogueira & Nogueira, 2015, p. 51).

Then, in this study it is possible to observe what Bourdieu calls “restricted choice” or “forced choice”, The testimonies show that the decision to continue in the Teaching degree was a “forced choice”. It happens as a challenge for a part of freshmen, the result of a “convincing” process during the ‘basic cycle’, that is, during the first three semesters before the choice between bachelor’s and teaching degrees.

The subjects of specific-content that compose the ‘basic cycle’ are those that reprove the most, such as Calculus and Algebra, according to report of the Office of Undergraduate Studies (PROGRAD, 2018) – a body of the central administration of the university which guides the undergraduate courses. After many failures and dropouts, it is common to find students who do not believe in their own ability to learn mathematics or understand that they are not intelligent enough to continue with the Bachelor’s degree and, then, opt for Teaching: “But as we go on with the subjects, you say, no, wait, I can’t follow this subject, so I’ll have to go to Teaching” (Rubelita/Interview).

When admitted in the course, there is a predisposition of the students to go the Bachelor's degrees, according to Rubelita: "I think that everyone who gets here, right in the beginning, say, ah, I'll do the Bachelor's [...]" However, during the semesters, those who did not reach good grades, and fail, fell inferior and turn down.

Doing the Bachelor's degree grants the student an academic recognition. The students feel comfortable with the pedagogical and evaluation practice developed by teachers, as related by Emerald in the group talk: "Like, some classmates feel very at ease because they would always get A in everything! [...] So, they want to keep this system, because for them in some way this...", Sodalite then enters in the debate adding "it feeds their status" to what Emerald agrees:

Yes! [...] They feel privileged with this system and they don't want other people to have the same opportunities as them. So, they want to keep on top, so that they can keep with their privileges [...].

I think that the students adapt to this system, they end up discouraging the others. For example, students that are already used with this competitive evaluation system, as if since a young age, they already have this potential [...], they get here telling us:

- No! That is the way it is, you must accept, period! That is how it works.

And we say:

- No, but I don't agree, no!

- But you don't have to agree, that is how it is, period, you have to do this way!

So they end up sort of trying to shut our voices! [...]

The dialogues above point that there is a peer pressure to accept the pedagogical – and evaluation process as it is currently established. This offers us an explanation to the great dissatisfaction of Teaching students who find no space to change. That is, the pressure also takes place among students themselves.

The *status*, or the recognition, brought by the research subjects, in the terms of Bourdieu (2017), works symbolically as an indication of social position and distinction, a process of differentiation and hierarchization of the individuals. In this case, to reach this recognition the students need to show abilities in the specific-content subjects, obtain high grades to, then, be included in the mathematics field. This process can be understood as an incorporation of the *habitus* of the professor (a Bachelor) of mathematics, which consists of the submission to the norms and to the dominant values of the field.

Although the social institutions in which the individuals take part exert strong influences in the formation of the *habitus*, they are not determinant in the way they are, act, or think. Their incorporation is a key condition to the ‘belonging’ of individuals in the field – in our case, the mathematics field. About this, Bourdieu (2015, p. 250) affirms:

[...] when an institution such as, for example, the education system completely controls its reproduction, it is in the position to attract (or repel) to it – by the consecration it awards –, the individuals better adjusted to the explicit and implicit demands and the more willing to perpetuate it identically.

We identified an intense competition for capitals in the course, indicating some possible dispositions that can compose the *habitus* of the mathematics professor/teacher, that is, of most teachers who teach the specific-content subjects: a classic formalist perspective of mathematics; an affective relation with mathematics; dichotomization research and teaching; traditional pedagogical practice; self-teaching; a relationship teacher-student with little dialogue.

The classic formalist perspective of mathematics, according to Fiorentini (1995, p. 05), is an approach characterized by “the emphasis on the ideas and forms of classical mathematics, especially the Euclidian model and the Platonic concept of mathematics”. To this author, “the Euclidian model is characterized by the logic systematization of mathematical knowledge from root elements (definitions, axioms, postulates). This systematization is expressed through theorems and corollaries deduced from the root elements”.

During the observed classes, teachers’ practices were predominantly classic formalist, a process “acutely bookish, centered on the teachers and their roles as who transmits and exposes the content through lectures or theoretical developments on the blackboard [...]” (Fiorentini, 1995, p. 07).

We use Cunha’s (1994) term ‘affective relationship’ to explain the demonstration of pleasure and exaltation of the beauty of mathematics shown by professors in the classes and on students’ testimonies. The author describes a teacher that, during an explanation, lectures about the beauty and the pleasure felt towards the subject; “You see how Mathematics is beautiful? You see the importance to understand its spirit and not only its formal aspect? It is a treat to work with mathematics!” (Cunha, 1994, p. 150). The

researcher explains that “[...] the pleasure and the study make people value their field of knowledge, get excited with it and this influences students” (1994, p. 109).

Episodes such as the one cited by Cunha were constant in the observed classes and, in them, the teachers showed conviction, enthusiasm, a profound and contagious admiration for mathematics. The reason for these demonstrations, in the terms of Bourdieu (2015, p. 257), “[...] is because pedagogical action should always transmit, beyond the content, the affirmation of the values of this content”. Showing that he had incorporated this possible element of the mathematician *habitus*, Citrine declares “[...] when I finish an exercise of Complex Variable, I reach a certain plenitude, if the exercise was difficult, woah! I fell...good with life, you can see you are prepared, you see you have developed, you know? This is key to me”.

The **dichotomization teaching and research** also appears as cause of tension Bachelor’s *versus* Teaching degrees, the separation, and the valuing of research over teacher training, especially, for K-12 education. As the goal of the Bachelor’s degree is the process to start the researcher’s formation, the focus is on the mastery of specific- contents of Mathematics and, then, the particularities on teacher training are ignored.

The teaching undergraduates notice this dichotomy, as expressed by Emerald: “[...] When the teaching student gets in the Institution, they are faced by teachers who only work with research... they [...] make no distinction...between us”. Overlapping this dichotomy is the valorization of research; a concerning factor as it not only leaves teaching in the background but also does not articulate teaching and research.

Regarding the **pedagogical practice**, we could see in our observations that it is mainly expressed by lectures, with explanations and notes on the blackboard, exercises, and exams. We have noticed that the practice is, consciously or unconsciously, directed towards the bachelor’s students and, therefore, do not pay attention to the specificities of teacher training. The students, regardless if from Bachelor’s or Teaching degrees, need to study by themselves, do many exercises, that is, be **self-taught**. As declared by Larimar; “the good student according to them is that one that doesn’t need them, that opens the book alone, sees the demonstration...Ah! Cool! That is how you solve it [...]”. Under this perspective, the arguments used to

convert students to self-teaching are based on the idea that they need to be dedicated and have persistence, as mathematics is rigorous, difficult.

The crucial issue of the whole academic pathway, mentioned by 59.52% of students researched, is the **relation teacher-student**, as indicated by their testimonies: “[...] I have a teacher [...] he had an arrogant air, you know? This is normal here!” (Jacinth) and “I have seen many teacher humiliating students in class” (Sphene). According to Bourdieu & Passeron (1982), this issue is related to the imposition of authority and professional respect. A way to inculcate and legitimize dominant culture through symbolic coercion, especially an arrogant and pretentious verbal language.

These elements, in a higher or lower degree, interconnect with the pedagogical and evaluation practice so that the contents are shown by the teacher and the students must study alone so to, later, prove in the tests that they have assimilated this knowledge.

We have no intention of creating a taxonomy of the dispositions that compose the *habitus* of the professor/teacher in mathematics. However, the elements mentioned were recurrent in the classes, during the conversation with teachers and students, and between students. The incorporation of these elements and other, in different degrees, together with a good academic performance indicate some dispositions that can make up the *habitus*. It is a possibility of understanding that emerges from this investigation and can open new research fronts.

## On Mathematics and teacher training

The depreciation of the Teaching degree is openly mentioned by 26.19% of the researched subjects. This takes place in different ways, for example, the disdain towards the pedagogical-content subjects, but the key point is the difficulty to learn the mathematical contents and reach the average for approval. According to Rubelita, “Teaching students normally have more difficulties than those of Bachelor’s (in the specific- content subjects)”.

To justify why so many students cannot progress in their learning of specific contents, a common argument used is that those subjects are extremely difficult, demanding more effort and dedication:



[Bachelor's degree] Demands more dedication, like, the subjects really are tougher, there is not much openness, then, there is nothing to discuss, you must follow what is there, and that is it [...]. Even in the teaching subjects that have a bit more of pure mathematics, we can see that [...]. (Euclase/Interview)

Another idea that circulates in the course is that to be a good teacher, one needs to master the specific contents of mathematics. Showing the appropriation of this idea, Citrine affirms:

[...] the mathematics teacher doesn't have to know the classroom mathematics, he has to know more, much, much much more!!! To put himself is a risky situation as this, they have to know how to get away [...]. [...] My exasperation is towards mathematics, the mathematical knowledge a teacher need to teach in K-12, he needs to know mathematics (Interview).

The main idea in Citrine's testimony is that by mastering the specific contents, the future teachers will be ready to face the professional challenges, as Rubelita says in an interview, about a dialogue with a teacher:

- [...] what happens is that in the Teaching, at the streets, at the school itself, after you have been in the Department (of Mathematics), you can do anything out there.
  - So there is no reason why using the Teaching degree in here, it is so easy, out there you'll already use it. So it is easier for you guys to be beaten here, so that out there you'll be already salted, you'll be able to do anything you want.
- They prefer that we get really beaten here, because if we are beaten here [Department of Mathematics] [...] In fact, what she said is not wrong.

The comment "in fact, what she said is not wrong" can be a sign that she is convinced that it is important to master the mathematical content. What was said also shows the convincing power of the specific content teachers, who, on their discourse, put the pedagogical-content in a second level. The explanation for such position, can be found in the beforementioned thesis of school knowledge stratification.

It is also interesting to notice that even the students who are contrary to these arguments show, between the lines, the interiorization of this perspective.

I actually follow that theory, you want to be a teacher, you want to teach this, you do have to know this! [...]. But you have to have this knowing how you are going to that this, and the course doesn't do that, it just throws the content at you, it doesn't give you any idea on how you are going to teach it. (Amethyst/Interview)

However, when asked directly: “In your opinion, is it enough to know a lot of mathematics to be a good teacher?”. The student answers:

No... really, no! (Laughter) No, far from it. No way! I think you need to know much more how to be a teacher than to know mathematics. Because knowing mathematics [...] you make an effort, if you like to go through this, that [...] it is much more [important] wanting to teach, wanting students to learn, that is what makes a teacher, more than knowing mathematics (Amethyst/ Interview)

Amethyst’s testimonies present an apparent contradiction. First, she defends the need to know the mathematical content to teach. After, she affirms that it is more important to know the pedagogical contents. The root of this conflict may be on the depreciation of the Teaching degree and its students what, unconsciously, may lead the student to internalize the *habitus* of the mathematics teacher.

Another frequent argument used is that mathematics has an inherent rigor and formality. This idea is incorporated by many students who defend the way things are and, when some teachers try to soften the teaching-learning process, they understand that the teacher is lowering the education quality:

I know there are teachers who don’t lower the bar, for instance, he made a test, and everyone got zero, he did another test of the same level after. This doesn’t mean that he doesn’t care for the class, this concept has to change, caring for the class doesn’t mean dropping the bar. (Citrine/Interview)

Under this perspective, mathematics is difficult and that is how it is. Underlying this understanding may be the idea that mathematics is for few people, for the intelligent ones, as can be seen in the common sense. It is worth highlighting the emphasis with which some students defend that mathematics teaching should be lead with formality and rigor, showing a possible incorporation of some elements of the *habitus*.

On the subjects observed during this research, Citrine explains:

So, these subjects have to be done with a greater rigor, no doubts about that! And that is why they are considered more difficult, because they are in fact more difficult, they need a higher level of abstraction [...] in all the four subjects I did or am doing, the teachers are rigorous, they do the content on the blackboard” (Interview)

The idea of rigor in mathematics teaching is so predominant that when a teacher tries to establish an articulation between the specific content and teaching strategies, some students affirm that they have not

learned enough mathematical content: “She is an open teacher [...], so, that is why I liked a lot, even though I didn’t take much out of it [learned], I can say it was a useful subject, in the sense that, how can I explain that [...]” (Rubelita/Interview). It is implicit in her statement that, though going through this experience, Rubelita does not seem to notice the need and the possibility of integrating the contents and how to teach in a way that favors teaching formation.

Some teaching students defended, in the group talk, the articulation between the specific and the pedagogical contents: “[...] here we have to learn how to teach, what we are going to teach. This is also missing, you don’t learn how to teach” (Jasper/Group talk). Others disagree. Spheue, talking about Fundament Analysis, says: “[...] when the subject targets the Bachelor’s or the Teaching, like, the subject will be the same, no matter if it’s for those in the Bachelor’s or the Teaching” (Group talk).

### On the formation of Teaching undergraduates and the evaluation process

The evaluation practice in the course analyzed is generally done through three tests during the semester. Some students defend that this evaluation should be fairer and that teachers should consider the specificities of the Teaching degree when evaluating: “[...] I think the evaluation should be fairer for everyone, for the Teaching, for the Bachelor’s, but like...I think that Teaching should be guided towards Teaching” (Coral/Interview).

Submitted to a system of evaluation that aims to rigorously measure the assimilation of mathematical content, the students do not seem to clearly understand the evaluation as a part of the formative process and, consequently, end up using certain strategies to ease their approval.

Regarding the suggestion on how teachers should evaluate the specific-content subjects in Teaching, we have found that, despite the criticisms raised on the practices, students maintained the classification role of evaluation, as a measure and a grade: “ I think that the tests could, many could be done with the material open, they could say, for instance, “each one can make notes and you can check your notes”, I think this would work” (Emerald/Group talk). Though criticizing the conventional test and defending the ‘list of

problems' as a graded activity, "to show that you know", Rubelita states that she is in favor of an evaluation through tests: "I think you should have tests as well, because I'm favor of tests" (Interview).

A great part of students advocates in favor of conventional tests as a faithful and privilege evaluation tool in the content-specific subjects, Sphene in the group talk claims "In my opinion, there shouldn't be any graded activities in the Fundamentals of Analysis. Can it help? Yes, it can, but it is not the same as having a test of Fundamentals of Analysis and an activity, I think the activities don't teach the same way".

Sphene's statement shows that he does not believe in the efficiency of other evaluative instruments, beyond the test. Tests would be the sole possibility of guaranteeing the true measure of learning, thus, advocating in favor of this traditional concept of evaluation. In this perspective, we question: what is the space for the formative role of evaluation - investigation, measurement, and learning construction?

Among the students in the course, there is a naturalized preparation practice on the eves of the tests. This preparation is done through a 'class of problems,' using the 'list of problems' made available by the teachers and, in class, they solve doubts and solve some questions on the blackboard. There is also a pre-test. On this practice, Buriasco and Soares (2008, p. 106) explain: "[...] the aim on the classroom is to train answering the proposed questions and to master the strategies to give the right answers to the questions".

It is common for the pre-test to have similar questions or, often, the same questions as the test, that is why students use the pre-test as a way to prepare themselves for the mathematical-content exams, as can be seen in the following dialogues:

Kyanite (audio): Guys! For goodness sake! We're very dumb! We left no copy of the pre-test to Chrysolite. Now there is a very far possibility that he will do the same test tomorrow. We're screwed! [...]

Rubelita: Hey everyone...does anyone have the photo of tomorrow's test to send me? I couldn't do it.

Iolite: (photo of the test)

There it is @ Rubelita

Rubelita: Thank you! It was quite similar to the pre-test [...]

Citrine: Similar? It was exactly the same... The teacher took it easy. I hope it stays like that. (*WhatsApp*)

The same does not happen with the pedagogical content subjects, in which students understand that evaluation tools must be more flexible, less rigorous: "[...] those subjects at the Education [School], there is no space for test, right? I think that the direction to the Teaching degree, it is directed towards our future

profession” (Euclase). We observed, between the lines, the depreciation of the pedagogical contents, even regarding evaluation.

We observed then two groups of students: those who defended the traditional evaluation and those against and critical to it; however, they all value the test, most have an apparently contradictory discourse defending and criticizing it, showing that, in the perspective of mathematics and training practiced in the course, there is a coherence – “who knows, proves it”.

Questioned on the preparation to evaluate their future K-12 students, 33.33% of future teachers answer that they do not feel prepared, showing some insecurity, as Agate says: “[...] I don’t know what I intend to evaluate, but only the traditional evaluation, I don’t think it’s enough, I don’t know [...], the participation really counts, you know? So, some different way, some different activity, but...”.

The difficulties to a formative evaluation practice appear clearly in the statements of students who already teach, as Sodolite questions in the group talk: “I’m already [teaching] for elementary and high school and it is very hard for me to think other ways to evaluate the student [...] unfortunately, I need to produce a document, I need to give an answer to society, how will I do that?”

When faced by the difficulties of evaluating a big and heterogeneous K-12 class, the teacher-students resort to traditional tests and grades, showing that they are confronted by their lack of experience and theoretical base to support a formative evaluation practice. The perspective of Ametrine shows an apparent contradiction, present in almost all testimonies: “[...] I really like giving them some activities and see how they are doing it, and it is in that moment that they are evaluated. [...] I follow them and, then, there are the tests that they have to naturally do, right? So, this I can’t change” (Interview) Ametrine shows she values the learning process but, however, does not discard the test.

When asked on how they intended to evaluate their future students, some mention their model teachers:

Like I had in high school. I think that evaluating a student as it is in the university would be possible only if I were a university professor. [...]. I’d give the subject the same way and a part of the class would be to solve problems, I’d try the same way, it was the best way I had so far. (Sphene/ Interview)

It is possible to infer that the experiences during their undergraduate studies, mainly in the specific-subjects, can influence – be it through the models or counter-models – the training of future teachers, as Citrine says on his interview: “[...] regarding the evaluation system in K-12 schools...I’d do the same as I’d do here at the university, I’d give a list of problems worth 10% of the evaluation period and the rest in tests”. The aim of evaluation in this traditional perspective, according to Guba & Lincoln (1989), is to give a “seal of approval” considered neutral and objective and to evidence the results and not the process of constructing learning.

Oscillating between a traditional and a formative perspective, the testimonies showed that the Teaching undergraduates are rooted into a traditional concept, mainly on testing and see this tool as indispensable and trustworthy.

Though some students show a concern to look for other ways to evaluate, beyond a classificatory perspective, it is possible to infer the *habitus* of the Mathematics teacher lead them towards an “attachment” to the classificatory approach of evaluation.

We highlight that we have not found in the curriculum of the course any subject in which ‘learning evaluation’ was taken as a content.

## On students’ aspirations when finishing their degrees

Several studies have shown that most Teaching undergraduates come from low-income families. A study done with data from the socioeconomic questionnaire of *Exame Nacional de Cursos* (National Course Exam- ENADE, 2005), encompassing 137,001 individuals, indicate that 50.4% of Teaching students are on the range of family income between 3 and 10 minimum wages. “We can see, however, a clear inflection towards the lowest income range. The percentage of students in the category of family income until 3 minimum wages is significant (39.2%) and the frequency of individuals in the family income level higher than 10 minimum wages is slim”. (Gatti, 2010, p. 1363)

In a research done by Moreira et al (2012, p. 22) in 10 Brazilian states in the years of 2008, 2009, and 2010, with 664 freshmen in the Mathematics Teaching degree, the results indicated that 20% of them had an income between 1 and 2 minimum wages and 45% between 2 and 5 minimum wages.

The subjects of our research follow this pattern: most did their K-12 education in public schools and a significant part of them work. Due to socioeconomic conditions, those who do not have a formal work survive with small jobs, for instance, giving private classes to guarantee their basic needs. Under Bourdieu's perspective, it is possible to infer that students must make a great effort to reach the objectives placed by the academy, that is, to appropriate themselves of the erudite culture. To support themselves in the university, these students

[...] see themselves forced to draw from the pure and empty goodwill that characterizes their relationship with school and the culture of their origin class, visibly expressed on their practices and references, the available resources to compensate the shortages connected to the poverty of cultural capital, through a frequent and arduous work. (Bourdieu, 2015, pp. 259-260)

Under these conditions, the indexes of students who were admitted in the university but cannot progress and drop out are high. Out of the researched subjects 42.85% mentions that the Teaching students are those who were not able to deal with a tougher, more formal, and more rigorous mathematics- the "bachelor's mathematics". After many failures and subject dropouts, students have their self-esteem shaken due to their difficulties to learn the specific mathematical contents.

Disqualified and convinced that they do not have the necessary abilities for mathematics and faced by the need to work to survive, students use different strategies to finish the degrees or to simply "graduate", as expressed by Ametrine; "So, like, what we really want, for better or worse, is to graduate" (Group talk).

The pedagogical practice, the relationships established and, mainly, the evaluation on the specific-content subjects place students into a life of contradictions. Most teachers do not use formative evaluations as they understand that mathematics is a hard science and then, students must learn the content as it is – ready, finished – and show what they have assimilated during the tests. This *habitus* is also elitist, as, in the formative systema and the relations established, the harder the mathematical knowledge, the tougher the evaluation, the more the teacher establishes him/herself as a "good teacher" in the academic field.

In this context, the evaluation practices work as tools to classify (and legitimize) students as “good”, “brilliant” – those gifted with academic recognition, and the “not so good”, “opaque”- those who face difficulties; uninterested; hardworking or dedicated – who, often, when having problems to grasp the contents, opt for the Teaching degree.

Evaluation in this scenario is an instrument to legitimize the difference, especially students’ socioeconomic level, as explained by Emerald:

I believe that they think tests are the best way to evaluate, they think that the quality of education will drop. First because they already think that the inclusion of public-school students, of...black people, mixed-race people, and indigenous, many people think that this has already decreased the level of the university (Interview)

From what we have seen, behind the possible *habitus* elements identifies in this study, may be the fight for power within the field of mathematics. To Bourdieu, the core of the issue is the fight for social recognition. The French sociologist affirms that “there is no worse usurpation, worse deprivation, maybe, than that of those who were beaten in the symbolic fight for recognition, for the access to a socially recognized social being, that is, in a world, to humanity” (Bourdieu, 2001, p. 295).

In this sense, “the social world offers what is rarer, namely, the recognition, the considerations, that is, simply, a reason to be. It is capable of giving meaning to life and to death itself, consecrating it as a supreme sacrifice ” (Bourdieu, 2001, p. 294). To be socially recognized, to be accepted and valued in what you do, i.e., to have social prestige, among other forms of distinction is an eminently human needs, manifestations of social distinctions named by Bourdieu as symbolic capital.

To succeed in the fight to accumulate this capital, people need, in a lower or higher level, to enter a competition around a certain power because this “[...] can only be obtained in the midst of other competitors for the same power, a power above other that derives from the existence of others, their looks, their perceptions, and their appreciation [...]” (Bourdieu, 2001, p. 294). Particularly in the academic environment, the symbolic fight consists of conquering a high academic *status*, that is, the accumulation of symbolic capital – power, respect, and prestige among the peers-competitors.



Often in the academic work, the practices are guided to acquire an academic authority, i.e., prestige, power, recognition, fame, among others. It is what we commonly call an interest for a scientific activity, be it in a subject, a methodology, a theoretical reference, etc., aiming the accumulation of capital (Bourdieu, 1983).

[...] accumulating capital is to make a “name”, a name to yourself, a well-known and recognized name, a brand that immediately distinguishes its carrier, visibly removing him/her from an undistinctive background, unseen, obscure, in which the common man is lost. Undoubtedly, that is the origin of the perceptive metaphors, that the opposition between bright and dull is the paradigm of most school taxonomies” (Bourdieu, 1983, p.11)

It is a symbolic fight accentuated by power and social prestige – symbolic capital - among the peers-competitors in the academic field, that can also be seen in the mathematics field.

## To conclude

Experiencing a context in which professors follow a traditional pedagogical practice, the Teaching undergraduates assume the responsibility for their successes and failures, tending to interiorize and naturalize the traditional concept of evaluation – classificatory and selective – as well as the high levels of dropout and failure in Mathematics. This generally takes place because, in this practice, most professors opt for an evaluation that reinforces the ideology of the gift, the merit, and the personal efforts as the pathway for success and academic and social recognition.

Students are silenced on the issue of formative evaluation – as an investigative activity, that measures difficulties and follow progress, i.e., as an integral part of the teaching-learning process. It is worth highlighting that the evaluation theme, in particular this perspective, is not a content in the syllabus of any subject in the course.

Teaching undergraduates vaguely notice the legitimizing role of evaluation and the evaluation practices in the specific- content subjects, a way to exert a type of symbolic violence according to Bourdieu. This issue appears mainly when they describe the tension between Bachelor’s and Teaching degrees, the rigor of classificatory tests, the relation teacher-student with little space for dialogue, the expositive/demonstrative classes, the lists of problems. Though they had experiences other evaluation forms

in the course, the weight of specific subjects is stronger. That is, the legitimization of the arbitrary power through the imposition and inculcation of a cultural arbitrary – classic mathematics – have a tendency to incorporate and reproduce a possible *habitus* of the teachers/professors who train the future mathematics teachers.

In this context, we are faced by a great challenge. As questioned by Menezes (1987, p. 120): “how can we keep the undergraduates in the classroom, passive, listening to the teacher that fills the blackboard with formulas which they have to learn, solving lists of problems, doing monthly tests, and intend for them to have a different behavior when they become teachers?”. The own author answers, foreseeing the reproduction of selective and excluding practices, the future teachers “will teach Mathematics as they have learned”.

Breaking the reproductive cycle of this training process of the, mathematics teacher means overcoming a complex challenge because when working towards a perspective in which “all students can reach a satisfactory learning level, we are deciding to forego selectiveness and exclusion, what also means renouncing to contribute to the own social selection of a model of social organization of the capital [...]” (Luckesi, 2018, p. 89).

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