

Statistical Education in Mathematics Teachers' Qualification: reflections by professors and interns of the Pedagogical Internship Program¹

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ABSTRACT

The present article is part of the dissertation "Didactic-Mathematical Knowledge mobilized by professors and interns of the Pedagogical Internship Program: work proposal for Statistics' teaching". We herein introduce some reflections by participants in one of the meetings whose goal was to discuss and reflect about the role of Statistical Education in Initial Mathematics Teachers Qualification period. The study followed the qualitative approach and the collected data were gathered from audio and video recordings of the qualification meetings. Participants' comments at the meetings have disclosed their fear of working with Statistical Education at the beginning of their careers, because they believe their initial qualification to do so was not enough to make them confident about it. Another remarkable issue highlighted by the present study lied on the relevance of having Education policies capable of opening room for students to reason about their own qualification.

KEYWORDS: Statistical Education; Initial Mathematics Teachers Qualification; Pedagogical Internship Program.

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Educação Estatística na Formação de Professores de Matemática: reflexões de preceptores e residentes do Programa Residência Pedagógica

RESUMO

Este trabalho apresenta algumas reflexões dos participantes em um dos encontros, no qual o objetivo foi discutir e refletir acerca do papel da Educação Estatística na formação inicial de professores de Matemática. É um recorte da dissertação intitulada *Conhecimento Didático-Matemático mobilizado por preceptor e residentes no contexto do Programa de Residência Pedagógica: uma proposta de trabalho para o ensino de Estatística*. Este é um estudo de natureza qualitativa; os dados foram produzidos por meio de registros em áudio e vídeo do encontro de formação. As reflexões dos participantes no encontro revelam receio ao trabalhar com a Educação Estatística no início da carreira, devido a eles sentirem que a formação inicial não foi suficiente para gerar confiança e deixá-los confortáveis para lecionar tal conteúdo. Outra questão evidente desse trabalho foi a importância de políticas educacionais que promovam aos licenciandos espaços para refletirem sobre sua própria formação.

PALAVRAS-CHAVE: Educação Estatística; Formação inicial de professores de Matemática; Programa de Residência Pedagógica.

Educación Estadística en la Formación de Profesores de Matemática: reflexiones de preceptores y residentes del Programa de Residencia Pedagógica

RESUMEN

Este trabajo trae un extracto de la disertación titulada "Conocimiento Didáctico-Matemático movilizados por preceptores y residentes en el contexto del Programa de Residencia Pedagógica: una propuesta de trabajo para la enseñanza de la Estadística". Presentamos algunas reflexiones de los participantes en uno de los encuentros, en que el objetivo fue discutir y reflexionar sobre el papel de la Educación Estadística en la Formación Inicial de profesores de Matemática. Este es un estudio cualitativo, por lo

tanto, los datos fueron producidos a través de grabaciones de audio y video del encuentro de formación. Las reflexiones de los participantes en el encuentro revelan miedo de trabajar con Educación Estadística al inicio de sus carreras, por sentir que la formación inicial no fue suficiente para generar confianza y darles confianza para impartir dicha enseñanza espacio para que los estudiantes reflexionen sobre su propia formación.

PALABRAS CLAVE: Educación Estadística; Formación inicial de profesores de Matemáticas; Programa de Residência Pedagógica.

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Introduction

Oftentimes, every new configuration applied to the educational work leads to positive outcomes, but, every once in a while, it may not be so. These configurations or changes also leave marks on those who are dedicated to implement them, rather than just on Education, itself. Teaching practices can reinforce old concepts or even question them. Depending on the nature of such practices, they can even form new disciplines, new professionals. We can think about Education during the Covid-19 pandemic as an example of it, because it regards an atypical and recent scenario. At that time, most Education professionals did not have experienced distance teaching in their careers. That was a challenging reality, mainly because it depended on matters that were out of teachers' reach, such as access to the internet, to computers or mobiles, for all students to attend the classes, at real time.

Assumingly, teachers, mainly at their initial qualification process, must hold a whole set of knowledge, practices, values, attitudes and representations that, altogether, form the culture that works as the very basis of their identity. Nevertheless, this set of elements is not tight, and the Education context over the pandemic time, although atypical, has proven it. In the last decades, among other changes, we have

observed changes in teachers' repertoires, mainly when it comes to Mathematics teachers. We live in a world surrounded by digital technologies and, more and more, we have been taking into account the relevance of applying them in classroom environment. Along with the need of bringing these technologies in to help qualifying the students, there is also the need of a solid Statistics teaching aimed at reflexively forming these citizens.

From a critical perspective, professors and researchers have made efforts to change Statistics teaching processes at all schooling levels by seeking data investigation and exploration techniques. Scholars' recommendations point toward a work capable of boosting three statistics competences: statistical literacy, thinking and reasoning (Batanero, 2013).

These competences are associated with an Education focused on forming critical citizens through the critical interpretation and understanding of information coming from real data. Accordingly, Campos *et al.* (2011) advocate for a specific concept of Statistics Education, which regards a classroom where teacher and students get aware of social aspects by working with issues linked to individuals' daily lives. It uses attitudes heading to social practices to get involved in their communities in order to turn reflections into action.

This approach demands a new qualification process applied to Mathematics that exceeds the traditional teaching organization, which is supported by a fragmented structure focused on memorization and repetition. According to it, knowing a given content is enough to teach it. Shulman (2014, p. 217), in its turn, points out that

the key to differentiate the very basis of knowledge for teaching lies on the intersection between content and pedagogy, on teachers' skill to change the knowledge someone holds on a given content into powerful pedagogical

procedures and, yet, adjustable to variations in both skills and discipline matrices introduced to students.

According to Shulman (2014), knowing the content is not enough for a teacher, since it must also have pedagogical knowledge about such a content, as well as to be aware of its discipline matrix. This set of knowledge allows articulating Statistics teaching in Mathematics itself, as well as its teaching in other sciences. It is so, because Statistics helps other knowledge fields by providing methods and techniques applicable to data analysis (Samá *et al.*, 2020). Most of all, it is recommended using real data in works developed in several fields to get greater teacher/student and student/student interactions. These interactions boost critical discussions and reflections about the introduced information.

Accordingly, the aim of the present investigation was to discuss and reason about the part played by Statistics Education in the initial qualification of Mathematics teachers. We have emphasized such a discussion at the Pedagogical Internship Program, also known as PRP.

Statistics Education and Mathematics Teachers' Qualification

The sanitary crisis experienced by mankind has highlighted the relevance of science, mainly of Mathematics and Statistics, when it comes to the best understanding of the Covid-19 pandemic (Samá *et al.*, 2020). According to these authors, this scenario has shown the need of breaking the walls of both disciplinary procedures and cross-sectional approaches, rather than just understanding numbers and patterns. It is essential understanding concepts linked to different knowledge fields, their contexts, and the need of developing skills to make critical arguments, to overcome beliefs and attitudes, and to advocate for a Mathematics and Statistics teaching capable of forming teachers ready to teach their specific contents. It must be done in such a fashion to allow the development of competences and skills to make students

question, argue, take positions and make decisions for their own good and for the good of their communities.

Cazorla, Kataoka and Silva (2010, p. 19) have stated that Statistics is a science that

at its early times, was related to organizing and systematizing State information in order to subsidize political, economic and social decisions. It was only in the 20th century that its methods were added to scientific and empirical research given the inferential ability of its techniques, as well as of helping decision-making under uncertainty conditions.

The number of studies on Statistics increased at late 19th and early 20th century. This process has contributed to set the basis of Statistics Education and to broaden the search by institutions seeking to improve the quality of their courses or to use this new methodology in students' assignments (Vilas Bôas; Conti, 2018).

Statistics Education addition to the academic media in Brazil was low and late, "mostly because Statistics (just as Mathematics, itself) is a passed over science to the detriment of literary and legal studies, which are more prestigious and have scholarly tradition" (Santos, 2014, p. 3). The introduction of statistics contents in basic school discipline matrices was late, although it was observed in several contexts of society. This constant presence of Statistics in the world and in citizens' daily lives opened room for its teaching to a growing number of people (Lopes, 2010).

However, although Statistics is nowadays taught at all schooling levels, since this is an essential tool in peoples' personal and professional lives, research has shown that several students, even at higher education, have wrong concepts about it or even have a hard time making proper statistical interpretations (Batanero, 2013). It is partly observed because adding a new discipline to a discipline matrix does not

mean its automatic inclusion or teaching. Mechanical teaching is another element to be considered, since it emphasizes formulas and definitions, without paying attention to interpretation assignments and to the context data were collected from. Thus, it regards a meaningless Statistics that does not take into account its nature as art applied to data collection and analysis, and to make data-based inferences (Batanero, 2019).

It is essential to provide people with the right conditions to make critical readings, of relating data in different research to reality and even of weighing their veracity, rather than just reading graphics and percentages (Lopes, 1998). It is explained by the fact that Statistics teaching has the potential to make students learn its concepts to become citizens aware of the critical part they play in society and in their daily actions.

Lopes (2013) highlight that schools must approach these topics since early schooling. They must be combined to technologies that go from simple calculators to the most updated software. Students tend to interact and learn more when they are encouraged to discuss, reason about and solve problems based on real, contextualized and authentic experiences.

This teaching perspective meets the so-called Critical Education, which focuses on overcoming traditional teaching procedures. It is worth pointing out that traditional teaching is the basis of a positivist discourse whose core lies on both pedagogical techniques and knowledge transmission (Campos *et al.*, 2011).

According to Campos *et al.* (2011), teacher and students are asked to play the role of researchers within a critical classroom. It aims at having them interested in problems linked to the social reality observed in their own lives. They must seek different possibilities to build knowledge and, at the same time, to accomplish intellectual assignments related to investigations, consultations and critiques.

It is in this classroom that, on the one hand, the teacher and its students, by approaching daily issues, get aware of social aspects that they often do not realize about, but that strongly hold them. On the other hand, based on actions focused on social practices, they get involved in a community and turn reflections into action. (Campos *et al.*, 2011, p. 477)

According to the aforementioned authors, it is in this very classroom environment that Statistics Education should be conceived, since it must focus on the development of scholar citizens who are reflexive and critical within a globalized society marked by both information accumulation and constant decision-making.

It is essential understanding what was addressed by Lopes (2013) about Statistics and Mathematics Teachers' qualification: Statistics is a science different from Mathematics, consequently, its study goals are also different. According to her,

Statistics provides the means to deal with data that take into account the ubiquity of variability, which makes it significantly different from both Mathematics and other sciences. Another aspect distancing the statistical thinking from the mathematical one is that the statistics science requires a different kind of reasoning, because data are not just numbers, but numbers within a context (Lopes, 2013, p. 905)

We can understand Statistics as autonomous discipline that has not risen from Mathematics, but from a whole series of sciences supported by Mathematics. The association between Statistics and Mathematics is a 1:1 ratio, because Statistics uses mathematical concepts to develop its methods, and Mathematics does not adopt statistics concepts (Batanero, 2013). Such an understanding has allowed

the emergence of a new study field, the so-called Statistics Teaching, which focuses on Statistics, Probability and Combinatorics' teaching and learning, as well as resources provided by Statistics to scientific research and to develop students' investigative, reflexive and critical attitude towards society Campos *et al.*, 2011).

According to Lopes (2013), understanding the Mathematics theory and statistical procedures is not enough to teach Statistics. It is essential providing students with real backgrounds and knowing how to use them in order to boost their critical skills, at all schooling levels.

Statistics' teaching in Mathematics Schools must be mainly linked to thoughts of "how", rather than just to questions about "what, why, who and when" to teach it. Lopes (2013) addresses a relevant issue to be thought of at Mathematics teachers' qualification scope, when she states that, despite discussions about how the number of studies about how students must learn Statistics has increased in the last few years, we still need to think about how teachers can help their students' learning it.

This same author advocates for a Statistics qualification that allows Mathematics teachers to think statistically and to learn how to develop this same skill in their students, since it exceeds problem solving. Lopes (2013) highlights the need of rearranging the discipline matrices adopted by Mathematics Bachelor Courses, given the need of accomplishing a qualification level capable of allowing the elaboration of propositions to promote Statistics learning based on elements, other than just using techniques. Students must overcome issues highlighted in several studies, such as gaps in teachers' qualification process, conceptual and epistemological issues in didactic books, and lack of flexibility in Bachelor Courses' syllabi.

Another important element regards valuing Statistics teaching and its connection to Mathematics, which remains little observed in school environment and in teachers' qualification courses. Undergraduates and teachers' reports (at their early career stages) have pointed towards

feelings of despair at the time to work with this discipline at Basic Education level. In order to change this educational reality one must seek to elaborate propositions focused on the concept of Statistics as data-analysis science and on being clear about its interface with Mathematics (Lopes, 2013).

Samá *et al.* (2020) advocate that teacher qualification courses and Basic Education must overcome the traditional teaching organization, and its fragmented discipline-matrix structure to head towards an interdisciplinary organization in order to fulfill society's nowadays demands. According to Shulman (2014), teachers have history of personal and professional lives that produce and mobilize knowledge, and it helps them exerting their classroom practice. According to this author, the teaching practice demands teachers' broad knowledge about the disciplines and contents they are expected to teach. Therefore, lack of knowledge about a given content, about pedagogical or discipline-matrix issues, can impair the choice for the best didactic materials and class planning, and, consequently, compromise students' learning process.

Concern with Statistics teaching and learning got more intense when countries decided to add its contents to their Basic Education discipline matrices as a way to overcome a viewpoint centered on training. It was done to provide an Education capable of making citizens able to use statistics knowledge to read the world, the so-called statistics literacy (Samá *et al.*, 2020). In other words, a Statistics teaching focused on a more critical approach. Campos *et al.* (2011) and Batanero (2013) highlight that professors and researchers point towards the development of three important competences: statistical literacy, thinking and reasoning. According to Campos *et al.* (2011):

- Statistical literacy includes basic and relevant skills to help better understanding statistical information, and it also involves the ability to organize data; plot and present charts; work with different data

representations; understand concepts, vocabularies and symbols; and understand probability as uncertainty measurement.

- Statistical thinking is the ability to relate data to concrete situations by assuming variability and uncertainty, i.e., it regards a way of thinking that includes a logical and analytical reasoning.
- The statistical reasoning, in its turn, can be defined as how people think based on statistical ideas and give meaning to statistical information.

According to Campos *et al.* (2011, p. 18), “there is no hierarchy among these skills, but, somehow, there is intrinsic association among them”. Overall, all these concepts are entangled, so they complete each other to help achieving students’ critical formation. Accordingly, we understand that studies and discussions about Statistics Education, mainly about Statistics teaching, have been carried out by professors and researchers, from different viewpoints and perspectives.

Based on Silva and Tinti (2021), it is essential to constantly reason about teachers’ qualification contexts and spaces, either at initial or continuous qualification level. It is also important reflecting about contributions from public policies to innovations available for teachers’ knowledge and practices.

Silva and Tinti (2021) state that it is imperative understanding that teachers are qualified within social, economic, political and cultural contexts. They highlight that actors in these spaces can contribute much to discussions and struggles in Bachelor courses’ institutions.

We chose PRP as public policy coordinated by Coordination for the Improvement of Higher Education Personnel (CAPES) to substantiate our reflection. The experience shared below regards a meeting of researchers, professors and interns from a Post-Graduation Program in Mathematics Education involved in a PRP Mathematics sub-project of a Higher Education Institution in Minas Gerais State. This sub-project regards Statistics Education in Mathematics teachers’ initial qualification.

Methodological path

We made the option to analyze the speeches recorded during qualification meetings scheduled for the data production stage of a Masters' Degree research. In total, three qualification meetings were attended, and the two first ones were scheduled to introduce and discuss an active methodology (Project-Based Learning – PBL). The third meeting aimed at discussing Statistics Educations matters. The selected meeting took place in February 2023, at the *Meet* platform, and it lasted up to 1 hour. This meeting focused on participants' experiences and their perception about the part played by Statistics Education in Mathematics teachers' qualification.

We used resources of the platform itself to register participants' speeches (audio and video shooting). Data were transcribed after the meeting and selected based on the researcher's interpretation, whose sight headed towards speeches highlighting likely reflections that were further analyzed. Due to ethical issues and to preserve participants' identity, they were herein labeled with nicknames, such as Professor, Intern 1 and Intern 2, and so on.

We chose this meeting because it took place when the research was ready to preserve participants' conversations and reasoning about their own qualification as teachers, mainly about their qualification in Statistics teaching. Moreover, this meeting counted on the presence of participants involved in a qualification public policy, the so-called Pedagogical Internship Program, also known as PRP.

PRP is a CAPES program aimed at fostering institutional projects focused on pedagogical internship implemented by Higher Education Institutions (HEI) to help enhancing Basic Education teachers' initial qualification at graduation time. This program aims at

I – providing and deepening undergraduates’ theoretical-practical qualification;

II – contributing to form graduated teachers’ professional identity;

III – linking HEI to teaching networks and teachers’ initial qualification schools;

IV – valuing Basic Education professors’ experience in preparing their undergraduates for their future professional career;

V – inducing collaborative research and academic production based on experiences lived in the classroom. (CAPES, 2022, p. 2)

Accordingly, one finds:

- The *Institutional Project* presented by HEI for the development of pedagogical internship activities.
- The *Sub-projects*, which are sub-divisions of the institutional project. They are organized by knowledge field. These fields encompass Graduation courses recommended by the university in the institutional project to join the program and to form sub-projects that comprises core cells.
- The *Core Cells* are groups of participants in a sub-project, which comprises advisors, professors and interns to develop pedagogical internship activities in the field-school.
- The *Field-school* regards the Basic Education public school where the pedagogical internship activity takes place.

Each actor forming the PRP plays a well-defined part since Ordinance n. 38/2018 was enacted, namely:

- The Institutional Coordinator is a professor from the HEI in charge of conducting the Pedagogical Internship Institutional Project;
- The advisor is a professor from the HEI in charge of planning and guiding the internship activities of its pedagogical internship core cell;

- The professor belongs to the Basic Education school in charge of following-up and advising interns in activities taking place at the field-school;
- The intern is the student enrolled in a graduation course who had already attended 50 % of its Bachelor's degree and who was already working in a field-school under the direct inspection of a professor.

Actors joining PRP are granted with scholarships. Each actor gets a scholarship in compliance with its modality, namely:

I – Intern, R\$ 700.00 (seven hundred reais);

II – Professor, R\$ 1,100.00 (one thousand one hundred reais);

III – Advisor, R\$ 2,000.00 (two thousand reais);

IV – Institutional Coordinator, R\$2,100.00 (two thousand one hundred reais).

According to PRP, interns experience moments of acclimation, observation and teaching, and it reinforces the theory/practice relation. This process qualifies and prepares interns to the real school/classroom context through the welcoming procedures adopted by their professors at field-school scope.

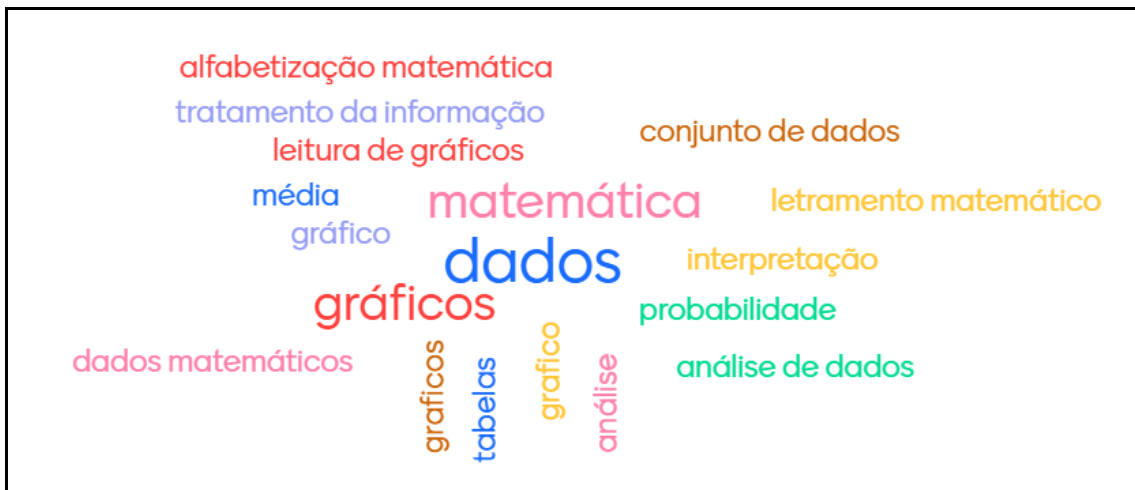
We counted on the participation of 1 professor and 8 interns who also attend the Mathematics sub-project of a HEI in Minas Gerais State. We defined this qualitative approach field work from Goldenberg's (2000) perspective, since, according to him, researchers' concern "is not with the numeric representativeness of the assessed group, but with in-depth understanding of a social group, an organization, an institution and a trajectory, among others" (GOLDENBERG, 2000, p. 14).

Statistics Education in Mathematics Teachers' Initial Qualification: reasoning by interns and their professor

The herein introduced discussions encompass data production of a Masters' Degree research carried out at PRP scope. We have shared reasoning by interns and their professor in a Mathematics Sub-project. Data collection took place during a virtual meeting on *Google Meet* platform about Statistics Education in the initial qualification of Mathematics teachers.

Firstly, participants accessed a link provided by the researcher to access a tool used to set the cloud of words, the so-called Mentimeter. This tool builds a panel of words based on answers given to a certain question, with emphasis on the most frequent ones. The following question was introduced: "What are the three words coming to your mind when you hear the term Statistics Education?". The tool plotted the following image based on participants' answers:

FIGURE 1: Word panel based on the term *Statistics Education*



Source: Elaborated by the authors.

In visual terms, words *Mathematics*, *data* and *graphics* are the most frequent ones, and it shows that they were used in most answers. If one takes into account variation in the word "*graphic*" due to spelling issues (some used it in the singular, others in the plural), it is possible stating that

the tool records such a frequency as different words, rather than as grouped ones. Obviously, participants are referring to the same word, so the term *graphics* turns into a core one on the panel. Words described on the panel allows inferring that, even if participants know that Statistics is not a Mathematics sub-field, their discourses show the opposite, such as the case of students' speeches about Mathematics teachers.

Then, we have the words *Data* and *Mathematics*, which have also stood out. Participants stated that the selected terms mostly refer to the Mathematics field in comparison to Statistics itself, when they discussed their choices for words and their image on the panel.

I realized that there are many things related to Mathematics itself. Now they are related to other topics, such as cross-sectional topics you [professor] talked about, we must know it [...] and it didn't show up much. (Intern 3)

This intern's speech triggers thoughts about the relevance of promoting Statistics Education capable of interacting with other knowledge fields. Yet, it is essential for Statistics to match students' daily issues so they can be ready to understand the world and to make decisions that have impact on their personal and professional lives, as well as on their communities. This process must favor empathy and solidarity to build a fairer society (Samá *et al.*, 2020).

Intern 5 highlights:

I plotted graphics and charts. Every time I see something related to Statistics, there is always a graphic or a chart. And I provided the analysis, because, they are often followed by some sort of analysis.

We can see the meaning of the term Statistics Education, which has different representations from participants' perspectives, by observing the choices made by Intern 5. The professor chose the following words:

mathematics literacy and data analysis. According to her, “Statistics Education exceeds the content, the interpretation of graphics and charts, actually it is related to reading the world based on what is happening on it. I guess, this is what I think of it”.

This professor’s speech about Statistics Education is close to the Critical Education viewpoint, which is a teaching process that breaks school walls and exceeds mere calculations and random assignments. This is actually a knowledge that helps students to both understand the statistical contents and relate them to the context they are inserted in, as well as to interpret and criticize statistical information found in different media. According to Lopes (2013) and Campos *et al.* (2011), our education is related to issues regarding students’ daily experiences.

As for Campos *et al.* (2011), students tend to see Statistics as a sub-field of Mathematics, mostly because it is found in Basic Education’s Mathematics discipline matrices and because it is often taught by Math teachers. Seeing Statistics not just as Mathematics was the factor allowing the development of a new study field known as Statistics Education.

Just as the discussion about the words on the panel, the following questions were also asked by the researcher: “What do you understand and define as Statistics? Is it an Exact or Social Science? Is it a Mathematics field? Is Statistics important? Do you feel ready to work with Statistics in Basic Education?”. Answers given by both the interns and their professor about being prepared to work with Statistics in Basic Education helped us partly understanding the answers given to the other questions. Except for Intern 1, all others have declared themselves unprepared to teach Statistics in Basic Education. The speech by Intern 4 makes such an insecurity clear: “Nooooo [...], I have already attended the Statistics and Probability discipline, but, I mean, I know how to make the calculations, but the meaning of median, mode... these stuff are things in Statistics I don’t remember.” According to the professor, her initial qualification was not adequate and it did not let her comfortable at the beginning of her career:

So, my qualification was not adequate, when I graduated I didn't even have this subject mentioned by Intern 4, Statistics and Probability, in my discipline matrix. My experience comes from working with information treatment, with graphics and tables' interpretation, with fashion, mean and median. But, being properly prepared, no.

They have both pointed out that their initial qualification was not good enough to teach Statistics and this is one of the factors making them feel unprepared to work with these contents in Basic Education. Even the speech by Intern 1, who claims to feel prepared to do so, indicates the idea that it was prepared because it was dedicated to extra studies outside its Major Degree in Mathematics. Just as it was observed for the professor, daily teaching activities provided knowledge that, after a while, ended up helping its practice:

This thing of feeling prepared to work with Statistics Education in Basic Education!? I guess, I am, because I worked sometimes with Statistics, because I teach in a '*cursinho*'. But we don't go too deep in it, because '*cursinhos*' are a little straighter forward. But I believe that by reading some materials I would perform well with this Statistics thing, in the Basic Education field. (Intern 1)

With respect to the other questions, interns have stated that they did not remember the exact definition of Statistics, but that they understood that it was part of Mathematics, that it needs Mathematics to "go forward", "it is not possible working with Statistics without using some Mathematics" (Intern 1). According to them, Statistics is an exact science that works with data and follows important steps, such as data collection, treatment, tabulation and analysis.

They all believed that no doubt Statistics is important and that it must be worked at all schooling levels. Participants have stated that the amount of information presented in a graphic and in tables shown in social media impairs analyses and interpretations capable of setting what is true and relevant. Thus, Statistics Education enables citizens to properly interpret and analyze these datasets.

When it comes to teaching this science at teachers' qualification time, participants also pointed out its extreme relevance at this stage of a Bachelor's course. According to Intern 1, Statistics is essential for Mathematics teachers' qualification, mainly

because, in Basic Education, those who will teach Statistics classes are Math teachers. So, this is a necessary discipline in order for us to have some deeper knowledge in this field, inside the classroom, in getting good ways of explaining the content. Because, sometimes, some of the contents are very difficult for students to understand, and if the teacher is not well qualified in this field, it can be a challenge to overcome students' difficulties. (Intern 1)

After discussing these questions, we made some inferences about the main text: "Reflections about the role of Statistics Education in teachers' qualification in the Covid-19 pandemic context", by Samá *et al.* (2020). This text was sent to participants by the advisor, few days before the meeting in order to be previously read. The researcher asked what participants had understood about the text and what were the elements they saw as relevant and wanted to talk about.

They expressed interest in the topic *Statistics Literacy*, because it was the first time they were reading and learning about this concept:

I had never heard of this term before. Even when I attended this discipline in my Math's Bachelor Course, I don't remember to have ever heard about this term, at all. (Intern 1)

Funny though, I had heard of Mathematics Literacy, but not of Statistics Literacy. Never. It was the first time I saw it, in the text. (Professor)

Based on Samá *et al.* (2020, p. 438), a statistically literate individual who understands the statistics concepts can critically analyze and argue about data quality and reliability. Gal (2002) describes statistics literacy based on two important components: cognitive and effective component. The cognitive component regards citizens' ability to critically interpret and assess statistical information by adopting arguments associated with stochastic data and phenomena found in several contexts. The effective component, in its turn, refers to the ability of discussing or informing reactions to statistical information, as well as of understanding the meaning of a given information, its opinions and the understanding of its meaning. These components must be developed and treated together in order to help students understand situations observed in their daily lives.

Another element pointed out by participants regarded the necessary knowledge teachers must have to teach Statistics. According to Intern 1, elements in the text by Samá *et al.* (2020) made them understand that just knowing the content is not enough to work with Statistics in Basic Education, because "it goes beyond the content itself, the teacher needs discipline matrix pedagogical knowledge, so that it can handle the content to be taught in the classroom." (Intern 1).

All this knowledge was described by Shulman in the 1980s. He suggested a basic professional knowledge for teaching. This basis proposed by Shulman (1986, 1987) mostly derived from observations and analyses carried out by him during his teaching practices about the

content to be taught and its association with pedagogical strategies adopted by teachers. Knowing the specific content means how teachers understand the concepts and processes to produce such a knowledge. Pedagogical knowledge regarding content also involves teachers' ability to turn their knowledge into representations capable of making these concepts understandable by students. Discipline matrix knowledge, in its turn, concerns teachers' awareness about discipline matrix alternatives available for teaching. It comprises two modalities, namely: horizontal, when teachers are familiarized with the assessed discipline matrix contents taught in other disciplines (interdisciplinary actions) in the same school year; and vertical, which regards issues discussed in the previous school year and those approached in the other disciplines (Shulman, 1986).

Statistics teaching, as highlighted by Intern1, given its very nature, requires an interlocution that exceeds specific knowledge, concepts and adjacent mathematical procedures, because knowing the context is essential to the process to give meanings to it (LOPES, 2013). Only specific knowledge about the Statistics content is not enough for a teacher to plan and develop lessons capable of having meaning for students, of wakening their interest and calling their attention. It is essential learning how data were generated, treated and informed within the employed context. Samá *et al.* (2020) highlight that in order to understand Statistics concepts at stages beyond context awareness, we must have mathematical knowledge. Therefore, it is imperative having a Math teachers' qualification to be capable of teaching this Statistics contents in the classroom properly, in a contextualized way, to help students build such a knowledge.

Conclusion

The main aim of the present article was to discuss and reason about the part played by Statistics Education in the initial qualification

of Mathematics teachers. Based on the speeches by both interns and their professor, we could prove our hypothesis. Teachers report not to feel ready to teach Statistics contents in Basic Education. They show limitations to understand the Statistics concepts they are expected to teach to their students. They state to be unprepared, some because they were not taught well, themselves, during their graduation time, others because they were not introduced to these concepts during their Bachelor's degree time.

Although they were not comfortable with the qualification they got to work with Statistics teaching, participants seemed to understand the relevance and the role of Statistics Education in students' formation, in forming critical citizens ready to interpret and analyze information through statistical data presented in different media. They are also aware of the Statistics Education relevance for Mathematics teachers' initial qualification, so that they can teach specific Mathematics and Statistics contents in such a fashion that they can provide their students the opportunity to develop skills to question, argue, collect data, and interpret and analyze them.

Learning the concept of Statistics literacy, so far unknown by both interns and their professor, gave them a new perspective of Statistics teaching, which meets the Critical Education ideas. We reinforce that this education modality aims at forming statistically literate citizens capable of understating Statistics concepts and of critically analyzing data by arguing about their quality and reliability.

We herein also showed some knowledge necessary for a pedagogical action that makes mathematical and statistical concepts understandable by students. Knowing the content to be taught and the structure of the discipline matrix allows teachers to perform an interdisciplinary work by associating statistics contents with its students' context, with society's nowadays demands. It must be done to make them aware of their possibilities as critical citizens. The pedagogical knowledge about the

content is essential, because the way teachers select and organize the didactic material to teach Statistics contents show their knowledge on the discipline matrix.

Although PRP is a relatively new program, the exchange of experiences and the dialogue built during the meetings show traces of likely reflections about teachers' qualification, be them interns or professors. Thus, we could observe that, based on the herein investigated group, despite the small number of meetings, PRP is a space for qualification and it is capable of reinforcing interactions between interns and the professors following them up. Whenever this interaction is effective, the professor tends to play the role of qualifier. It fulfils an important function by reinforcing bonds between university and school.

Finally, we highlight the relevance of having new reflections and investigations about teachers' qualification, and about the need of rethinking Mathematics teachers' initial qualification courses, mainly when it comes to Statistics teaching. We must think about courses aimed at promoting a Statistics qualification focused on statistical literacy, thinking and reasoning. These teachers' work can make students reach these competences in their way to a Critical Statistics Education.

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