

**Shared reflections in an investigation of personal practice: learning trajectory of a teacher involving exploratory statistics teaching**

**Reflexões compartilhadas em uma investigação sobre a própria prática: trajetória de aprendizagem de uma professora envolvendo ensino exploratório de estatística**

**Reflexiones compartidas en una investigación de la propia práctica: trayectoria de aprendizaje de una docente que involucra la enseñanza exploratoria de la estadística**

**Réflexions partagées dans une enquête sur la pratique personnelle : trajectoire d'apprentissage d'un enseignant impliquant un enseignement exploratoire de la statistique**

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**Abstract**

This paper discusses a first teaching experience in which a Basic Education teacher investigates her own practice, and it aims at investigating learnings that made her reflections evident, which are shared with a research group in which she participates, while performing and analyzing her practice based on exploratory statistics teaching. Data analyzed consider audio recording transcription of this first teaching experience, and video recording of interactions with the research group from episodes and comments intentionally selected by the research-teacher. The episodes analyzed make evident learnings which emerge from the implementation of lessons based on the exploratory statistics teaching, which reveals this complex path marked by the importance of individual and collective reflection in sharing and contraposition context, expanding the teacher-researcher perceptions and professional strengthening based on a previously carried out planning. Investigation of the own practice, despite requiring courage and public exposition, when performed in an honest and responsible way, demonstrates its

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relevance for the teacher's professional learning. The experience also has allowed noticing out the exploratory teaching perspective as able to promote students' reasoning in complex situations, such problematization in this practice, revealing itself as possible and promising for teaching in Basic Education.

**Keywords:** Exploratory task, Statistics teaching, Mathematics education, Exploratory teaching.

### **Resumo**

Este artigo discute uma primeira experiência de ensino em que uma professora da Educação Básica realiza uma pesquisa sobre a própria prática e tem por objetivo investigar aprendizagens que se evidenciam em suas reflexões, as quais são compartilhadas com um grupo de pesquisa do qual participa, quando realiza e analisa uma prática assente no Ensino Exploratório de Estatística. Os dados analisados consideram as transcrições de gravações em áudio dessa primeira experiência de ensino e das gravações em vídeos de interações com o grupo de pesquisa, a partir de episódios e considerações intencionalmente selecionados pela professora-pesquisadora. Os episódios analisados evidenciam as aprendizagens emergentes a partir da implementação de uma aula assente no Ensino Exploratório de Estatística, revelando a complexidade dessa trajetória marcada pela importância da reflexão individual e coletiva em um contexto de compartilhamento e contraposição de ideias, ampliação das percepções e fortalecimento profissional da professora-pesquisadora, valendo-se de um planejamento anteriormente realizado. A investigação da própria prática, apesar de exigir coragem e exposição pública, quando realizada de forma honesta e responsável, mostra-se pertinente para a aprendizagem profissional do professor. A experiência permitiu, ainda, perceber que a perspectiva do ensino exploratório é capaz de promover o raciocínio dos alunos em situações complexas, como a problematizada nessa prática, revelando-se possível e promissora ao ensino na Educação Básica.

**Palavras-chave:** Tarefa exploratória, Ensino de estatística, Educação matemática, Ensino exploratório.

### **Resumen**

Este artículo discute una primera experiencia de enseñanza en la que una docente de la Educación Básica investiga sobre su propia práctica, y tiene el objetivo de investigar aprendizajes que se hacen evidentes en sus reflexiones, las que son compartidas con un grupo

de investigación del que participa, cuando realiza y analiza una práctica basada en la Enseñanza Exploratoria de la Estadística. Los datos analizados consideran transcripciones de grabaciones en audio de esa primera experiencia de enseñanza y de grabaciones en videos de interacciones con el grupo de investigación, desde episodios y consideraciones intencionalmente seleccionados por la docente-investigadora. Los episodios analizados hacen evidentes aprendizajes emergentes desde la implementación de un aula basada en la Enseñanza Exploratoria de la Estadística, revelando la complejidad de esa trayectoria marcada por la importancia de reflexionar individual y colectivamente en un contexto de compartir y contraponer ideas, ampliando las percepciones y fortaleciendo profesionalmente la docente-investigadora desde un planeamiento anteriormente realizado. La investigación de la propia práctica, a pesar de exigir coraje y exposición pública, cuándo realizada de forma honesta y responsable, muestra su pertinencia para el aprendizaje profesional del docente. La experiencia aun ha permitido percibir que la perspectiva de la enseñanza exploratoria es capaz de promover el raciocinio de los alumnos em situaciones complejas, como la que es problematizada en esa práctica, revelando ser posible y promisoro para la enseñanza en la Educación Básica.

**Palabras clave:** Tarea exploratoria, Enseñanza de la estadística, Matemática educativa, Enseñanza exploratoria.

### Résumé

Cet article traite d'une première expérience d'enseignement dans laquelle une enseignante de l'éducation de base enquête sur la pratique personnelle, et il vise à enquêter sur les apprentissages qui ont rendu ses réflexions évidentes, qui sont partagées avec un groupe de recherche auquel elle participe, tout en exécutant et en analysant sa pratique basée sur enseignement exploratoire de la statistique. Les données analysées tiennent compte de l'enregistrement audio de la transcription de cette première expérience d'enseignement et de l'enregistrement vidéo des interactions avec le groupe de recherche à partir d'épisodes et de commentaires volontairement sélectionnés par l'enseignant-chercheur. Les épisodes analysés font apparaître des apprentissages évidents qui se dégagent de la mise en œuvre d'enseignements basés sur l'enseignement exploratoire de la statistique, qui révèle ce parcours complexe marqué par l'importance de la réflexion individuelle et collective dans un contexte de partage et de contraposition, élargissant les perceptions des enseignants-chercheurs et le renforcement professionnel basé sur un planning préalablement réalisé. L'investigation de la pratique personnelle, bien qu'exigeant du courage et une exposition publique, lorsqu'elle est

effectuée de manière honnête et responsable, démontre sa pertinence pour l'apprentissage professionnel de l'enseignant. L'expérience a également permis de remarquer la perspective de l'enseignement exploratoire comme capable de favoriser le raisonnement des élèves dans des situations complexes, telle la problématisation de cette pratique, se révélant possible et prometteuse pour l'enseignement en Éducation de Base.

**Mots-clés :** Tâche exploratoire, Enseignement de la statistique, Enseignement des mathématiques, Enseignement exploratoire.

## **Shared reflections in an investigation of personal practice: learning trajectory of a teacher involving exploratory statistics teaching**

Teaching demands constant investigation on the teacher's practice, which must figure in constant evaluation and reformulation through experimenting ways of working that contribute for students to reach the desired objectives (Ponte, 2002). It is necessary for the teacher to take on the task of investigating to understand which knowledges are being mobilized and/or (re)framed in his/her pedagogical practice, especially when one is being challenged to teach in a different manner than they taught (Lima & Nacarato, 2009). For Chapman and Heater (2010), teacher that are involved in planned investigations on their own practice must include reflection, collaboration, and communication as substantial aspects for the promotion of their learning.

We thus take on the notion by Cochran-Smith and Lytle (1999), who defend that teachers learn when they create knowledge based on the intentional investigation of their own classrooms, supported by the investigation community in which they are inserted. For these authors, teacher learning happens throughout time, and not in isolated moments once it demands opportunities to link previous knowledge to new understandings. In this sense, we see teachers as active agents of their professional learning process and recognize that the development of knowledges, experiences and reflections, by contrasting theory and practice, is in line with the idea of professional development (Estevam & Cyrino, 2016).

Regarding specifically Statistics teaching, studies indicate difficulties faced by teachers in Basic Education related to misunderstandings in face of certain statistic contents, especially concerning conceptual aspects that are frequently reduced to formal expositions, focused on calculation procedures (Estevam & Cyrino, 2016; Batanero, 2019). Examples of these difficulties permeate the misunderstanding of measures of central tendency, with focus to simple arithmetic mean and weighted arithmetic mean (Estevam, Cyrino & Oliveira, 2018; 2021).

Considering that, the importance of searching for pedagogical alternatives that contribute to the promotion of Statistics teaching, valuing the development of statistical literacy and thinking, is noticeable. The exploratory teaching converges to this proposal once, in it, "students are able to watch the appearance of mathematical procedures with meaning and, at the same time, to develop mathematical skills such as problem solving, mathematical thinking, and mathematical communication" (Canavarro, 2011, p. 11). "In the specific field of statistics, exploratory teaching favors the development of the students' ability to analyze,

criticize, communicate, and represent fundamental skills identified in the models of statistical thinking and statistical literacy” (Estevam & Cyrino, 2015, p. 5). The authors also highlight that these practices contribute to developing statistical argumentation, but this aspect demands the teacher to be available and skilled in listening, understanding and operating students’ ideas and strategies without directing it.

In this sense, this work aims to investigate the learning evinced in the reflections of a teacher-researcher (TR) investigating her own practice in Basic Education, while conducting and analyzing a lesson based on the Exploratory Statistics Teaching involving simple and weighted arithmetic mean. This happens in a shared manner, involving interactions with a research group of which the TR participates.

### **Mathematics exploratory teaching and the mobilization of statistical literacy**

The perspective of Mathematics Exploratory Teaching falls within a teaching perspective based on inquiry (Oliveira & Cyrino, 2013), taking on a student-focused exploratory and investigative characteristic, in which communication, reflection and collaboration have a key role (Chapman & Heater, 2010). Cyrino and Oliveira (2016), based on Wells (2004), consider inquiry-based teaching as a dialogical perspective of the knowledge built among teachers and students in collaboration. For these authors, inquiring “integrates the action in cooperation with others and the reflection on what was learned during this process” (Cyrino & Oliveira, 2016, p. 22). The inquiry, collaboration and reflection are thus considered fundamental dimensions for the exploratory teaching perspective (Cyrino & Oliveira, 2016).

In the exploratory approach, the role of teachers is to mediate teaching and learning processes (Stein et al., 2008) and their actions are defined based on two different, but interconnected, objectives: i) to promote student mathematical learning; and ii) to manage students, the group, and the functioning of the class (Cyrino & Teixeira, 2016). Thus, choosing challenging tasks that value communication and social interaction between teachers and students and among students is considered a key element for a class based on this perspective, once

communication and social interaction, through language, have also a central role in Exploratory Teaching, since they are the main means of teaching and learning processes. They mediate knowledge and are important for the development of individual autonomy, acting abilities, collaborative work, and of learning through processes of negotiating meanings. In the Exploratory Teaching, knowledge is treated under a situated and dialogical perspective, which integrates action in cooperation with others and the reflection on what was learned during this process. The focus must be on

students and on the conditions that favor their participation in inquiring activities, collaboratively and individually (Estevam, Cyrino & Oliveira, 2015, p. 168).

Thus, the principles that underpin Mathematics Exploratory Teaching show this perspective's potential also for mathematical and statistical learning, especially regarding the individuals' statistical literacy. Statistical literacy is related to the minimum domain of formal knowledge of basic statistical concepts and procedures, having as its main components:

(a) people's ability to *critically interpret and evaluate* statistical information, provide arguments related to data or stochastic phenomena, which they may find in diverse contexts; (b) the ability to *discuss or communicate* their reaction in face of statistical information, as well as their understanding of the meaning of that information, their opinions on its implications, or concerns regarding the acceptability of the given conclusions (Gal, 2002, p. 2-3).

Mathematics and Statistics educators have been making efforts to face the challenges related to Statistics and Probability teaching aiming to contribute to advance and improve teaching in these areas (Costa Junior, 2019). Estevam and Cyrino (2016, p. 117) report that many teachers face difficulties related to statistics and statistical didactical-pedagogical knowledge, which affect on their practices that are sometimes based on calculation and technical aspects to the detriment of conceptual and analytical ones. "Examples of these difficulties permeate the misunderstanding of mean and median, the design and interpretation of graphics, the understanding of variance and standard deviation, among others" (Estevam, Cyrino & Oliveira, 2015, p. 167). Brandão (2012) observes that the problems related to Statistics learning stem from the teaching practice of prioritizing technical rationality, based on didactical activities guided by mathematical methods and exercise solving, supported by the application of formulas with no discussion of conceptual meanings.

These observations suggest that teachers in Basic Education still have difficulties/gaps related to statistical literacy in the context of measures of central tendency, and simple and weighted arithmetic means, "be it due to insufficient qualification or to misconceptions in the construction of their professional knowledge" (Estevam, Cyrino & Oliveira, 2015, p. 172).

Therefore, Exploratory Statistics Teaching emerges as a promising teaching perspective for Basic Education teachers who seek to investigate their own practices aiming to improve teaching, learning, and professional development processes. This type of investigation gains momentum when supported by peers involved and united in a joint reflection process, which may lead to collective learning.

## The importance of a shared reflection process in teaching practice

Teachers who aim to investigate their own practice must be committed determined, besides taking on inquiring and reflexive attitude in their actions (Ponte, 2022). For John Dewey<sup>3</sup>, cited by Ponte (2002, p. 8), “to reflect implies a careful and active consideration of what one believes in or practices in light of the motives that justify it and the consequences arising from it”.

Schön (1983) points out that the reflection on practice has been playing a fundamental role, bringing improvements to teaching actions. Reflection on the practice allows teachers to review events and, thus, change their practice, which demands discussing and clarifying aspects related to the term, not losing sight of the “idea of reflection associated with the emancipatory power of teachers” (Oliveira & Serrazina, 2002, p. 30).

Schön (1983) suggests that teachers can develop an attitude of looking at their practice analyzing, adapting and challenging their own presuppositions. Reflection allows professionals to assess, understand and learn through their experiences. It is a personal process, which usually leads to some shifts in perspective and may enable new learnings. It all starts with personal experiences and, if applied to practice, may result on improvements.

Thus,

Teachers must be able to think systematically about their practice and learn from experience. They must be able to critically examine their practice, seek the advice of others, and draw on educational research to deepen their knowledge, sharpen their judgment, and adapt their teaching to new findings and ideas (National Commission on Teaching and America’s Future, 1996 cited by Rodgers, 2002, p. 843).

Rodgers (2002), however, highlights that systematic reflection is different from other kinds of thinking. For that, he refers to four criteria, characterized by Dewey, on the purposes considered in the process of reflexive thinking:

1. Reflection is a meaning-making process that moves a learner from one experience into the next with deeper understanding of its relationships with and connections to other experiences and ideas. It is the thread that makes continuity of learning possible, and ensures the progress of the individual and, ultimately, society. It is a means to essentially moral ends.
2. Reflection is a systematic, rigorous, disciplined way of thinking, with its roots in scientific inquiry.
3. Reflection needs to happen in community, in interaction with others.
4. Reflection requires attitudes that value the personal and intellectual growth of oneself and of others. (Rodgers, 2002, p. 845).

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<sup>3</sup> Ponte (2002) does not mention any specific work by this author.



For Dewey (1938), cited by Rodgers (2002), an experience is characterized by the interaction between a person and their environment (which may be another person, the material world, the natural world, an idea or whatever may constitute the environment in question). Therefore, the term *experience* is related to two elements: interaction and continuity. There must be *interaction* between subject and environment; and *continuity*, which happens when one confers meaning to each new experience based on their own experiences, on past knowledge or even on knowledge stemming from other people's experiences and ideas. It is based on this understanding that Dewey considers experience as the foundation of learning.

Experience may provide a negative learning, in the sense of restricting it, making the routine dominate one's actions and the subject to be unaware of the effect of their actions over the environment. In this way, individuals close themselves for the impacts that the environment may have over them. On the other hand, experience can be educational, in the widening the field of experiences and knowledge in a conscious and planned way (Rodgers, 2002). However, any kind of experience is not enough to support cognitive thinking; it is imperative to perceive and give meaning to these experiences, and that is the role of reflection.

Reflection is a rigorous manner of thinking, and it must not be mistaken for thoughts that Dewey calls undisciplined, such as the stream of consciousness, invention, and beliefs. For him, we are all involuntarily immersed in a stream of consciousness that consists of uncontrolled ideas that invade our minds. While invention would be the imagination, something that is opposed to the perception of facts. Lastly, beliefs are related to the idea of believing, pre-judging our own mental activities (Rodgers, 2002). Therefore, "the impulse to reflect is generated by an encounter with, and the conscious perception of, the potential significance inherent in an experience" (Rodgers, 2002, p. 850). This movement, in its turn, created the need for the person to develop an additional quality – the quality of being present for the nature of experience, thus allowing an openness to its potential meanings (Rodgers, 2002).

Based on Dewey's considerations, Rodgers (2002) reaffirms that a motivation for the hard work of reflection is curiosity, once, when we are disturbed or perplexed by something, we are motivated to question it.

Thus, reflection must include action, not the definitive action, but an intelligent one, conceived (planned), that which experiments and tests theories and, thus, more questions, more ideas, more problems arise. Based on that, Rodgers (2002) summarizes four phases for the *professional development of reflexive teachers*, as follows: i) spontaneous interpretation of experience – which is the involuntary interpretation of experience, a moment when suggestions

of meanings start to arise, based on previous experiences; ii) describing the experience – which means keeping spontaneous interpretations under control until a more careful analysis is done; iii) analyzing the experience – it is the phase that differs reflexive thinking from other forms of thinking, it implies clarifying or eliminating possible meanings that rose up from the contraposition between current experience and previous ones; and iv) intelligent action/experimentation – it is an educative experience that widens the field of knowledge, being shaped by the objectives of the experience and by the obtained data. It confers meaning to the planned action, which can be experimented and enhanced in future actions.

Rodgers (2002) considers that, even though individuals can create meaning isolated, the interpretation can be completer and more complex when created in community. Dewey understands that, when we express our ideas to other people, we can reveal both strengths and frailties/gaps in our thinking. He also considers that when someone shares something, their field of experience is widened.

In so far as we are partners in common undertakings, the things which others communicate to us as the consequences of their particular share in the enterprise blend at once into the experience resulting from our own special doing (Dewey, 1916/1944 cited by Rodgers, 2002, p. 857).

Once again, Rodgers (2002, p. 857) considers at least three factors arising from collaborative reflection, which highlight the importance of the collective dimension in reflexive processes:

- 1) affirmation of the value of one's experience: In isolation what matters can be too easily dismissed as unimportant;
- 2) seeing things "newly": Others offer alternative meanings, broadening the field of understanding;
- 3) support to engage in the process of inquiry: The self-discipline required for the kind of reflection that Dewey advocates, especially given the overwhelming demands of a teacher's day, is difficult to sustain alone. When one is accountable to a group, one feels a responsibility toward others that is more compelling than the responsibility we feel to only ourselves.

Reflection in community is thus essential and "also serves as a testing ground for an individual's understanding as it moves from the realm of the personal to the public" (Rodgers, 2002, p. 857). Thus, this implies that the individual must develop a set of attitudes that, for

Dewey, are exercised on the act of reflecting and that can equally make room for learning or block it.

When desire, fear, need, or other strong emotions direct the course of inquiry, we tend to acknowledge only the evidence that reinforces that premise, causing learning to become tightly circumscribed. In contrast, reflection that is guided by wholeheartedness, directness, open-mindedness, and responsibility, though more difficult, stands a much better chance of broadening one’s field of knowledge and awareness (Rodgers, 2002, p. 858).

The reflexive process is thus one of the fundamental aspects to be considered by researchers of their own practice who are focused on their learning aimed at improving professional practice. Therefore, we consider “reflection and cooperative work as fundamental pieces in professional development” (Ponte, 2004, p. 19). Cochran-Smith and Lytle (1999) have also showed that a teacher’s engagement with other colleagues contributes to professional development once, when communicating, teachers enhance their investigative and critical attitude to describe ideas and positions in relation to their own practice.

In this sense, based on the mentioned debates, we have designed a reference table (Table 1) that shows the phases of the reflexive process related to descriptors in two reflexive dimensions.

Table 1.

*Phases related to individual and collective dimensions of teachers’ process of reflection when investigating their own practice (designed based on Rodgers, 2002)*

<b>Reflection phases</b>	<b>Individual Dimension</b>	<b>Collective Dimension</b>
<b>Spontaneous interpretation of experience</b>	<ul style="list-style-type: none"> <li>▪ Demands disposition to work on researching and preparing for public exposition;</li> <li>▪ Expresses the individual reflection for the group to enable the understanding of ideas emerging from experience;</li> <li>▪ Possible meanings of the experience are suggested by the one experiencing it;</li> <li>▪ Interpretations are designed to support future actions;</li> </ul>	<ul style="list-style-type: none"> <li>▪ Shows strengths or frailties based on the individual thinking;</li> <li>▪ By communicating, making an experience public, the group contributes, making observations, suggesting, interfering and widening the universe of interpretation, exposing aspects related to the development of the experience (difficulties, desires, fears, insecurities, ways to implement the planning, contraposition between</li> </ul>

	<ul style="list-style-type: none"> <li>▪ Moment that demands discipline and patience, so that feelings and/or emotions do not affect the reflection before the whole experience is considered;</li> <li>▪ Demands time to reflect, especially if the teacher is a beginner in this practice.</li> </ul>	<p>practice and planning, influences related to content knowledge).</p>
<p><b>Experience description</b></p>	<ul style="list-style-type: none"> <li>▪ Moment when a certain distance from the situation must be taken to enable the perception of elements that constitute the experience;</li> <li>▪ Observation of the aspects constituting the experience (formulating questions and questioning oneself);</li> <li>▪ Beginning of meaning construction;</li> <li>▪ Demands discipline so that important data are not neglected and that ideas can evolve.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Allows for the contraposition between spontaneous interpretations, what is being described and what was planned for the development of experience;</li> <li>▪ Formulates relations among the elements of the experience, between this experience and other ones, between this experience and previous knowledge, and between this knowledge and the one produced by other thinkers;</li> <li>▪ Meanings start to make sense, providing a (re)construction and reorganization of the experience that adds meaning to it;</li> <li>▪ Extends the teacher's ability to observe, pay attention, perceive, and be open to the diverse situations involving the classroom and the experience at hand;</li> <li>▪ Helps identifying the quality or need for other data that are important for the situation.</li> </ul>
<p><b>Experience analysis</b></p>	<ul style="list-style-type: none"> <li>▪ Temporary hypotheses arise, based on previous experiences;</li> <li>▪ Refines suggestions gathered during previous phases;</li> </ul>	<ul style="list-style-type: none"> <li>▪ Contributes to give reflection the perspective of a systematic thinking, inferring on the rigor and methodical character of the experience so that it can be reproduced in the future;</li> </ul>

	<ul style="list-style-type: none"> <li>▪ Explanations arise based on the synthesis on meanings of the current experience and previous ones – the meaning begins to take shape;</li> <li>▪ Teachers become equipped to articulate their needs with the students’ ones, taking positions and proposing actions inside and outside of the classroom;</li> <li>▪ It is necessary to look for theoretical resources to deepen and widen the knowledge;</li> <li>▪ Evidence of instability, insecurity, and difficulties inherent to the development of the experience appear.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Implies looking at previous phases, contrasting theory, practice, beliefs, and concepts;</li> <li>▪ Explores the implications of systematic reflection;</li> <li>▪ Deepens and widens the scope of understanding based on theory-based discussions;</li> <li>▪ Intellectual tests arise from systematic reflections on the experience;</li> <li>▪ Enables outlining understandings on what and why certain actions are taken and why certain situations occur.</li> </ul>
<p><b>Intelligent action/ experimentation</b></p>	<ul style="list-style-type: none"> <li>▪ The contrast between theory and practice is done;</li> <li>▪ Insecurities and difficulties that are inherent to teaching are overcome;</li> <li>▪ Demonstrates whether students are able to understand and engage with the class proposal;</li> <li>▪ Brings stability for unbalances that may arise in the moment of spontaneous interpretation of the experience;</li> <li>▪ The meaning given to the experience makes sense and can be trusted for future experiences.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Contributes by questioning, problematizing, and designing new ideas for the implementation of the meaning, signification, and stability of the experience, so to bring a widened and improved view for future practices – implies giving continuity to the experimentation.</li> </ul>

### Context and methodological referrals

This study involves a qualitative study with data interpretation (Creswell, 2010), which constitutes an investigation of personal practices that, according to Cochran-Smith and Lytle

(1999), is characterized as a *systematic* study, as it is organized regarding forms of recording inside and outside classroom; and an *intentional* one, as it is an activity designed and planned by the teacher.

Due to the pandemic caused by the SARS-CoV-2, which prevents schools to provide in-person attendance to all students, from March 2020 to December 2021, the execution of the investigated practice was adapted and implemented for a restricted group of students, according to health guidelines, which made it impossible to organize the lesson in phases and to form small groups for task solving. Therefore, the adaptation considered the experience involving exploratory teaching based on the guiding principles of this perspective, which are: inquiry, collaboration, communication, and reflection as guiding students' activities in the classroom. Namely, the class counted with the presence of three 8<sup>th</sup> graders of Elementary School of a Paraná State school, Brazil. These students were authorized by their guardians to participate in a presential class in the school, which followed all safety protocols suggested by the State and Municipal Health Secretaries. Two students were from the morning class and one from the afternoon one. The TR had not given them classes in previous years, and, in the current one, up to the moment of the intervention, all interactions had been exclusively online, in the terms of Emergency Remote Teaching (ERT).

In this scenario, the material recorded for the analysis was initially the students' written registries and transcriptions of class audio recordings. Being guided by Table 1, these records were initially analyzed by the TR based on individual reflections that supported the intentional selection of some class events to share and discuss with the Group of Studies on Practice and Technology in Mathematics and Statistics Teaching – GEPTeMatE, of which she is a member. In this sense, the collective dimension of reflection considered both the moments for discussing the events in the group and the later revision of audio recordings of the interactions in the research group by the TR.

In possession of these materials, the group looked for evidence of aspects related to the learning and professional development arising from this first experience by the TR based on an interpretative analysis. The TR demonstrated predisposition and acceptance by being committed to investigate her own practice based on her teaching experiences (Rodgers, 2002), aiming to improve it based on the analysis of emerging aspects of this process, involving the teaching of Statistics guided by a teaching perspective that was novel to her, as well as challenging and complex – Exploratory Teaching. The class was supported by a previous and intentional planning designed by the TR and reviewed by the peers involved in this process,

which involved designing a task, an orientation board, and the class plan. A detailed discussion of this process can be found in Brandelero (2021).

### **The task and the Development of the class**

The task *Mean of the means* (Table 2) consists of an exploratory task considered as having high level of cognitive demand, since it arouses to use mathematical procedures connected with their conceptual meanings (Cyrino & Jesus, 2014). It aims specifically to obtain the values of the simple and weighted arithmetic means; to interpret and understand these concepts in the situation at hand; as well as to notice the conceptual difference between simple and weighted arithmetic means.

Table 2.

*The task Mean of the Means that supported the investigated practice (designed by the authors)*

**Task: Mean of the Means**

Observe the grades that the student Lucas, from 8<sup>th</sup> grade A, got on Mathematics in the previous school year. In the 1<sup>st</sup> trimester, in the three evaluation activities done, his grades were: 4.0; 4.0 and 4.0. In the 2<sup>nd</sup> trimester, there were four evaluation activities, and his grades were: 7.5; 8.0; 9.0 and 9.5. In the 3<sup>rd</sup> trimester, there were only two evaluation activities, and his grades were: 4.5 and 3.5. Based on this information, answer the following items:

- a) How can we know whether Lucas was approved or failed based on the analysis of his grades? Write your reasoning down in detail, as well as what does this value mean.
- b) By calculating Lucas's annual mean through each trimester's mean, would he be approved or failed? What does this value mean?
- c) How could we calculate Lucas's annual mean if the grades were not grouped into trimesters? Explain in detail.
- d) Why are mean values different when they are determined based on all grades and based on trimester means? Explain your conclusions in detail.

The planning of this task was a moment of professional learning for the TR, based on reflections and collective discussions on aspects of this trajectory, which was nonlinear,

characterized by many comings and goings. This shows that knowing and reflecting over the importance of a task may enable teachers to perceive how tasks influence their teaching and, consequently, their students' learning (Cyrino & Jesus, 2014).

Equipped with these perceptions, the teacher began the class by delivering the printed task, presenting it for students and explaining how they should proceed for its solution. Right after reading, the teacher inquired students on their comprehension of the task questions and terms, and she emphasized the importance of registering. There were no doubts regarding the task questions and, then, the teacher clarified that, due to the current pandemic, they could not get together in groups, but that they should try to keep communicating and exchanging ideas regarding the resolution of the task items. Right after the reading by a student, they started to suggest possibilities to solve the task. The teacher encouraged them, despite being distant, to share their opinions and discuss possible ideas involved in the resolution of each item.

After that, the students started to work individually in solving each task item, keeping their distance, and the teacher sought to boost their communication by mediating emerging ideas observed in the resolutions of each student. The discussion of ideas and resolutions proposed by students took place as they were solving each item, followed by the systematization of learnings related to each respective item. To keep the anonymity of the participating students, pseudonyms are used to identify them.

Therefore, below are presented the analyses and discussions of some events of the class development, organized according to the task items, besides the contributions that emerged from reflections and discussions with the study group on the TR's teaching experience. The analyses were based on Table 1's design, which seeks to support reflections pertinent to the implementation of this class's planning, focused on the outline of TR actions in articulation with the teaching goals and referral of the class.

## **Results and discussion**

### **Regarding task item a)**

This item refers to the calculation of simple arithmetic mean and its conceptual meaning. In the following episode, the students and teacher discuss the 1<sup>st</sup> trimester simple arithmetic mean. Transcriptions were translated from Portuguese into English, seeking to reflect the reality of the moment.

Gil: *I'd add:  $4.0 + 4.0 + 4.0$  and divide by 3.*

TR: *And what is this calculus that you spoke of?*



Pedro: *This result we have to add to the second trimester, then we have to add to the third trimester, then we have a result. I think we don't need to divide. Because it's asking if he'll be approved; it's to add, it's not asking to divide.*

Gil: *No, but then look,  $4.0 + 4.0 + 4.0$ , it's going to be 12, on the report you wouldn't put 12 in the grade, it's from 0 to 10. So that's why we have to divide. The first is easy, it'll be 4.0 his final grade, but then the others we have to do the maths to know.*

TR: *And this grade that you say it's 4.0, his final grade, what is this final grade?*

The reflections on this episode show aspects related to the teaching perspective when there is communication and collaboration among students, which is a characteristic of Exploratory Teaching (Cyrino & Oliveira, 2016), which is frequently encouraged and mediated by the teacher (Stein et al., 2008). The teacher's inquiring action aims to confirm the student's understanding of her own thinking and to instigate the others to share that understanding of the procedure of mean calculation so to, after that, advance to the conceptual understanding. The context plays a role in conferring meaning to the calculations, for example, when Gil refers to the impossibility of a mean above 10.

Gil: *I got a result, I added and then I divided by the number of grades in the year (She calculated the simple arithmetic mean of the 3 trimesters).*

Pedro: *I think he was approved.*

Gil: *He failed!*

TR: *Why do you think he failed, Gil?*

At this moment, the teacher asked herself if she was emphasizing Gil's ideas the most (*experience description*) because they corresponded to her expectations. She perceives herself focusing her attention to one student who was corresponding to what she wanted to hear.

TR: *The calculus that Gil did: she added and divided by the number of grades. What is this final result that she got?*

Gil: *It's like it's his final grade that would be in the report!*

TR: *And what is the final grade that is in the report?*

Pedro: *It's what decides if he's going to be approved or not?*

Gil: *It is!!*

TR: *And how do we can this value that decides if he's going to be approved or not?*

Pedro: *Now you confused me!*

Gil: *This I don't know.*

At this moment, the teacher reports having felt frustrated by the students' answers, once she expected to hear, at least from Gil, that this would be the mean, so to begin systematization. However, it was foreseeable that this could happen, since the exploratory Mathematics teaching does not advocate that students should discover by themselves the mathematical ideas they should learn, neither that they should invent concepts or procedures or guess their names (Canavarro, 2011, p. 11). The first reflections by the teacher regarding these excerpts demonstrate how much feelings and/or emotions and, in this case, expectations (*spontaneous interpretation of the experience/individual*) can influence the course of the class, converting the experience into positive or not.

Emotions and/or feelings were also present when the teacher presented the class events to the study group. The TR shares that it was a moment that caused a kind of anxiousness and expectation, by presenting/exposing the development of her class to the group. Because of that, before presenting the episodes to the study group, she prejudged her class by thinking that the discussions had been too long and, possibly, even losing sight of the focused subject. She also thought whether she had then suggested possible meanings and interpretations about the experience she lived (*individual/spontaneous interpretation*).

In this sense, under the perspective and the discussions that rose up in the study group, the teacher realized that the class went according to plan in most actions presented. This shows how important the group is for broadening the interpretations made by the researcher of personal practices, since it was from the group analysis that the TR could partially overcome her fears and insecurity, being able to advance her understanding based on the discussions (*group/spontaneous interpretation*), which is connected to Rodgers's ideas (2002).

When the TR questioned whether the class was following her planning, it is possible to see the beginning of the construction of meanings for her teaching experience (*individual/experience description*), the the group's collaboration in this phase broadened her ability to perceive situations that had emerged from the experience at hand. We highlight, for example, the contraposition of her insecurity in face of the class progress, when thinking that she was being unable to implement the planning, thus contributing to broaden her observation ability (*group/experience description*).

After this class, the teacher began systematizing the learning for this item, making the calculations on the board for each trimester based on the discussions. Lastly, she systematized that this was a simple arithmetic mean and conceptualized it as a measure of central tendency – a value that tends to show the center of a set of data. She drew attention to some properties of the means found for each trimester, as the fact that the mean can be one of the values of the

set of data (1<sup>st</sup> trimester); a value between the extremities of the distribution (2<sup>nd</sup> and 3<sup>rd</sup> trimesters); and also be a value that balances the values of a set and that its elements have the same weight in relation to the final mean. Based on that, she presented the algebraic representation for the calculus of simple arithmetic means.

For the teacher, systematizing the learning related to the concept of simple arithmetic mean was one of the moments that struck her as odd, since she was used to conceptualize the mean based on the calculation procedure, and, in that moment, she was following the guidance planned for the class, aiming not only to calculate the mean, but to confer meaning to the found values.

After systematizing the task item *a*, still during the class, the teacher affirmed feeling that the discussions had not led to the objective of this item (*individual/experience analysis*). This was a temporary hypothesis that was refined after the debate in the study group, which made her realize and understand the motives for certain actions, as, for example, the fact that one of the students had done many of the actions foreseen for this item in the class orientation chart (*collective/experience analysis*), as follows:

Gil: *Another thing, teacher, that we could've done from start was to sum all grades together and divide by 9, and it would be the final result.*

TR: *But would it have the same result, Gil? (the mean of the means).*

Gil: *I think so.*

TR: *Let's see if it is so? Check it out (encouraging the student to calculate it).*

Gil: *Look, teacher. My sum, adding the first, second and third, is 5.5. And the other was 6. So the first one can be wrong or... But it makes no sense not having the same result...*

TR: *It makes no sense, right? Because, if it was the same mean, it should have the same result, right?*

Gil: *Then why is the first one wrong?*

TR: *But is it wrong or are you making different calculations? Can we make this sum that you did by calculating the three trimesters and dividing by three? Is it also an arithmetic mean? What do you all think? (brief silence) Let's go on? Let's go to item 'b' so that we can finish this after.*

In this moment, the teacher was mistaken to say that “we are making different calculations”, when, in fact, the calculation procedures are the same, confirming the indications by Estevam, Cyrino and Oliveira (2015), when report mistakes related to the teachers' knowledge construction. This was evinced by the teacher after watching the recorded video of the class, which suggests difficulties that are inherent to the development of the class

(*individual/experience analysis*) and that may be traces of the way she had been working previously or even from her insecurity in face of the context in which the class happened (*individual/spontaneous experience interpretation*). The idea related to the procedure/algorithmic actions is strong in pedagogical practices, showing how important it is for teachers to analyze their teaching experiences, corroborating to what is suggested by Schön (1983), Ponte (2002) and Rodgers (2002).

Still on item *a*, the research group drew attention for the objective, which was for students to determine a possible procedure to know whether Lucas would be approved or failed, and what happened is that the discussions were more focused on his approval or not, and not on the procedure to determine it. Therefore, the group helps to contrapose what was planned to what happened, fomenting the situation that enabled to widen, (re)frame, and reorganize the experience (*collective/experience description*), enabling improvements for its effective execution in the future (*collective/intelligent action/experimentation*).

Another factor that extended the resolution of item *a* was the appearance of classroom situations that are difficult to anticipate, such as a student having difficulty to understand the ideas expressed by Gil, since he came from another municipality where the trimestral mean was determined by another way (sum), besides not being able to perform basic mathematical calculations, such as adding and dividing decimal numbers. In this situation, it is possible to observe that the teacher's experience was relevant so that she did not disregard that context and unforeseen situations that appeared in the classroom, which is very common in the practice of Basic Education teachers, especially in the exploratory perspective. This happens because the process of reflection demands teachers to face the complexity of student learning, of them and of their teaching, of their study object and of the contexts in which they all happen (Rodgers, 2002).

### **Regarding item b)**

Gil had already done the mean of the means when she solved item *a*. Pedro showed to be confused and reported not knowing with calculus to do. Encouraged by the teacher, Gil explains to Pedro that he has to add the means of each trimester and then divide them by the number of means. The ability to discuss, communicate and argue about their understandings corroborate to the components of statistical literacy, accepted by Gal (2002). Pedro compares the procedure with the algebraic representation systematized in item *a*, showing that he had understood the systematized representation. The teacher encourages them to communicate among themselves, asking Gil to explain what she had done.

Gil: *In the sum:  $4 + 8.5 + 4$ ? You first add, then you get the result, and you're gonna divide it by 3, which is the "x" there (comparing to the algebraic representation systematized in item a).*

The other students were able to perform the calculation, and the teacher questioned them regarding the meaning of the result found, asking whether if it was also a simple arithmetic mean. She asks them to compare it with what was conceptualized in the previous systematization.

TR: *Do these values (referring to each trimester means) have all the same weight in relation to the final mean?*

Pedro: *I don't understand it.*

Gil: *Me neither.*

The teacher asks how they discovered the means of each trimester, intending for them to realize that there were different numbers of grades.

Pedro: *Ah, no, then they don't have the same weight because each trimester was different.*

TR: *What was different in each trimester?*

Pedro: *The result of his grade, the whole trimester.*

TR: *Yes, the means were different, but that was all that was different in each trimester?*

Gil: *No, one was divided by 3, the other by 4 and the other by 2.*

TR: *So, can each of these means have the same weight for his final grade?*

Gil: *No.*

TR: *Why not?*

Pedro: *They don't have the same weight because they were different in each trimester.*

TR: *But what was different in each trimester?*

Gil: *The division.*

TR: *Yes, but what does it (the division) represent?*

Pedro: *The 3 evaluations (referring to the 1<sup>st</sup> trimester).*

By instigating students, questioning them regarding their answers, the teacher sought to encourage them to reflect on the meaning of the involved concepts beyond the calculation procedures. She indicates her concern with the importance of developing the students' statistical literacy but also regarding herself, since that was a teaching experience developed in an atypical context based on a challenging teaching perspective, especially for beginner teachers. Despite Gil demonstrating a certain comprehension, the questions developed by the teacher may have led to a confusion, since the means have the same weight for the final mean,

while the difference is that each of one of the grades have different weights of the final grade in both procedures performed.

After identifying this confusion, the teacher decides to systematize item *b* based on the geometrical explanation/representation (Figure 1), as planned. She compares each bar (horizontal), referring that the first represents the school year (a whole); the second, its division into trimesters; the third, each trimester divided according to the number of evaluations; and the fourth showing how much each evaluation corresponds in relation to the final mean, in the sense of representing what the students referred as different in the means of each trimester.

ANO LETIVO (1 inteiro)								
1º TRIMESTRE			2º TRIMESTRE				3º TRIMESTRE	
$\frac{1}{3}$			$\frac{1}{3}$				$\frac{1}{3}$	
$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{2}$
$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{6}$	$\frac{1}{6}$

Figure 1.

*Geometrical representation used in the systematization of item b (planning of the class around the task Mean of the means)*

The teacher realized that, when they added the fractions and reached the result of 1 whole, the students demonstrated having understood that the grades had different weights. So she proceeded by determining the whole weights for each grade, showing that the grades in the first trimester weight 4, the second ones weight 3, and the third ones weight 6. Based on that, she demonstrated the calculus of the weighted arithmetic mean, using the discovered weights and also making the algebraic representation.

Students demonstrated having understood that, and the teacher affirms she felt more relieved, since item *b* was her greatest challenge, considering the difficulties that appeared while developing the planning for this item (see Brandelero, 2021). The insecurity that appeared during the planning is related to the concern regarding how the students would react to that situation, since it had been challenging for the TR, as well as for the research group, to think on ways of systematizing the learning related to this task item. This shows that teachers can unconsciously project their own insecurities and difficulties on students during the class

(Estevam & Cyrino, 2016). Likewise, it is observed that this can be minimized by planning the class, thinking on which strategies may emerge, on different types of representation, confirming that students are able to engage, reason, and understand the proposed situation through the teaching strategy used (*collective/experience analysis*).

The analysis of the TR's teaching experience moments shows evidence of an *intelligent action/experimentation*, in the sense that the TR starts to gain awareness of that which was a frailty and now is effective, since the experience feedback has strengthened her and encouraged her to continue. The research group mentioned that they saw, in the TR, evidence that the way she analyzes the class events indicates that, in a future action, she will look at the experience in a different way, in the sense of implementing changes to elements that demand adjustments (*collective/intelligent action/experimentation*). The experience starts to be signified and interpretations are drawn thinking on future actions (Rodgers, 2002).

### **Regarding item c)**

On item *c*, the teacher questioned Gil regarding the calculus she had done before, adding all grades and dividing them by 9:

Gil: *The result was 6.*

TR: *So it can't be the same thing.*

Gil: *Oh, I get it.*

TR: *It's not the same calculus, the result isn't the same. Why?*

Gil: *Because it has different weight?*

Once again, the teacher mentions not being the same calculus, but the procedure used is in fact the same, showing misconceptions related to the construction of professional knowledge (Estevam, Cyrino & Oliveira, 2015).

Gil: *But then, how come that adding the trimesters has one result and adding the year has another one?*

TR: *Look, when a get this 6.0 mean (simple), was it calculated in the same way than the other one? (weighted[5.5]).*

Students: *No!*

During the discussion with the research group, one of the members questioned whether the teacher had shown the division of the bar in 9 parts in the geometric representation (Figure 1), which could have contributed for the students' understanding, showing the collaboration of knowledges other than those one has when looking at something alone (*collective/experience description*). It is also possible to notice that the group acts, in this moment, in the sense of deepening and broadening the elaboration of understandings regarding the actions taken,

seeking to improve the experience and thus advance in the future to the phase of *intelligent action/experimentation*.

The teacher kept on comparing and questioning the means, and the students demonstrated having understood the enounced concepts. Lastly, the students answered to the task's item *d* without difficulty.

In general, the post-class reflections revealed another aspect that deserves to be considered. Despite the limited number of students, each one had very different characteristics: one of the students stood out with her reasoning ability, fast and very well constructed, she made connections and communicated very well; another had a certain attachment to mathematical calculations and expected a numerical answer, not being convinced with the answers given, in addition to demonstrating considerable difficulty involving basic operations; and finally, one student did not engage in the discussions, even though she was motivated and questioned by the teacher. Discussions in the study group suggest that, perhaps, the fact that the development and the discussions took place at the same time may have inhibited this student from expressing her difficulties or even her ideas, as she did not have such quick reasoning, dexterity or courage to communicate.

This leads to the reflection that investigating a teaching practice under these conditions imposed certain limitations, but it also made it possible to think that, if we extended this experience to a situation in which the classroom had the total number of students and we could compose groups, the experience professional would approach the conditions experienced. The interventions and questions made by the teacher demonstrate her preponderance in relation to the students, a fact that also happens in the classroom when we place more emphasis on ideas that converge more with our expectations than others.

Overall, the development of this teaching experience provided the TR with learnings related to content and pedagogical knowledge, showing the complexity involved in dealing with the diversity of behaviors and knowledges that appear in a class. It also showed how much more efficient can a class implemented based on the principles of Exploratory Mathematics Teaching be when well-planned and discussed in collaboration. Implementing a class according to this teaching perspective encouraged the teacher to deepen and (re)frame the knowledge of the involved statistical content, as well as of the particularities permeating its teaching oriented toward statistical thinking and literacy.

Besides that, learnings emerge related to the relevance of registries, of idea exchange among students, of the teacher staying alert to the students' thinking so nor to overvalue one to the detriment of the others, the complexity of dealing with the diverse student knowledges,



strategies, and experiences, and the importance of the reflexive process, both individual and collective. These aspects emerge and gain potential through communication, be it between teacher and students or even between the TR and her peers in the study group.

Therefore, it is possible to infer that the teacher-researcher experience, based on her own and the collective (study group) reflections, indicated an *intelligent action/experimentation*, since there is evidence that the teaching experience shared with the research group provided meaning, stability, signification, and evolution based on emerging questions for new ideas and, consequently, improvement for the development of a future action. Given that, the experience must not be considered definite, but a possibility to new investigations that will certainly provide new learnings in the principle of continuity (Rodgers, 2002).

### **Final remarks**

During this investigation of personal practices, episodes of a teaching experience were analyzed based on the conduction and analysis of a previously planned exploratory Statistics teaching practice, in a shared manner with a study group. With that, the complexity and relevance of the action of reflecting and sharing ideas in a group focused on professional learning was evinced.

The analyzed data and the reflections of the teacher-researcher made it possible to observe that an ambitious teaching perspective promotes indeed student reasoning in complex situations, as the one problematized in the class. Teachers, to deal with such complexity in the context of investigating their own practices, need courage to deal with exposure, to be honest with themselves and with others, and to be responsible toward their profession. Given that, the professional learning that arises in this kind of practice is enriched and broad by involving collective contexts with diverse perspectives, permeated by the respect and intentionality of the involved people. Namely, the experience allowed the teacher to think on and signify the difference between the conceptual Statistics approach and the one based on calculus procedures (reframing her own knowledge in order to teach); the role of planning in practice; the importance of identifying and dealing with students' difficulties; the complexity of fomenting and dealing with the students' strategies and reasoning; the implications of her own actions for class management and student learning; and the importance of individual and collective reflection for gaining awareness over events that emerge in practice, their implications, and possible needs for change.

Collective reflection collaborates to broaden the perceptions and for the teacher-researcher's professional strengthening, enabling the contraposition between theory and practice, to overcome fears and/or difficulties, to review situations that, in continuity or during a future teaching experience, may be improved or even changed, widening the emerging possibilities in similar teaching contexts. These aspects show thus the teacher-researcher's learning and professional development. Besides that, although Rodgers (2002) does not explain if reflection phases are linear or not, the teaching experience of the teacher showed they were nonlinear, once this process unveiled many comings and goings, retakes and revisions. However, the actions foreseen in the planning that guided the investigation are promising for such studies.

The teacher's reflections also show moments in which she is concerned with the development of statistic literacy through intentional actions that were previously planned for the class, a contribution of the teaching perspective used and of collective discussions, as well as moments when she emphasizes mathematical procedures based on a traditional teaching process, due to her experiences and knowledge, sometimes impregnated with technical and mechanized dimensions arising from a traditional teaching model.

It must be considered that the study had certain challenges and limitations due to the context in which it took place, being conducted with a small number of students, which made it impossible to create groups. This scenario has, however, provided a certain depth in terms of work and student discussion and of the relationship between students and teacher, which may not happen in a classroom with all the students, especially considering the nature of the work of investigating the personal practice, in a first teaching experience with the investigated characteristics.

Therefore, the reflections that emerged from the development of the class contributed for the teacher to be able to view the possibility of implementing a complex and challenging teaching perspective, such as the Exploratory Mathematics Teaching, which is thus possible and promising in Basic Education teaching, especially considering the essential phase of class anticipation/planning with regards to the proposed objectives. In addition, it highlights the potential of this type of practice in putting into effect a perspective of teacher professional development oriented towards advances and expansions based on the problematization of knowledge, beliefs, understandings and feelings that the teacher has, over models and actions derived from the presentation of (new) knowledge that the teacher does not have, that he/she lacks. In this sense, the study also points to the pertinence of considering professional identity

(De Paula & Cyrino, 2021) and the emotional dimension of teaching (Freire et al., 2014) in investigations and teacher education actions similar to the one presented.

Other complementary studies and those that conduct the phase of *intelligent action/experimentation* in different contexts may complement and advance the ideas and discussions presented here on the implementation and appropriation of exploratory Statistics teaching practices by Basic Education teachers.

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## References

- Batanero, C. (2019). Treinta años de investigación en educación estocástica: reflexiones y desafíos. In: Contreras, J. M. et al. (ed.). *Actas del tercer congreso internacional virtual de educación estadística* (p. 1-15). <https://www.ugr.es/~fqm126/civeest.html>
- Brandão, R. J. B. (2012). *Formação do professor de matemática no centro de estudos superiores de Bacabal/UEMA para o ensino de estatística* [Tese de doutorado em Educação Matemática, Pontifícia Universidade Católica de São Paulo]. <https://repositorio.pgsskroton.com/handle/123456789/3496>
- Brandelero, D. S. (2021). *Aprendizagem profissional de uma professora na realização de práticas de Ensino Exploratório de Estatística* [Dissertação de mestrado em Educação Matemática, Universidade Estadual do Paraná]. <http://biblioteca.unespar.edu.br:8080/pergamumweb/vinculos/00008a/00008adb.pdf>
- Canavarro, A. P. (2011.) Ensino Exploratório de Matemática: Práticas e desafios. *Revista Educação e Matemática*, 115, 11-17. <https://em.apm.pt/index.php/em/article/view/1982>
- Chapman, O., & Heater, B. (2010). Understanding change through a high school mathematics teacher's journey to inquiry-based teaching. *Journal of Mathematics Teacher Education*, 13(6), 445-458. <https://doi.org/10.1007/s10857-010-9164-6>
- Cochran-Smith, M., & Lytle, S. L. (1999). Relationships of knowledge and practice: teacher learning in communities. *Review of Research in Education*, 24, 249–305. <https://doi.org/10.3102/0091732X02400124>
- Costa Júnior, J. R. (2019). *Compreensões de letramento estatístico entre licenciandos de matemática: explorando dimensões críticas em situação de formação* [Tese de doutorado em Educação Matemática e Tecnológica, Universidade Federal de Pernambuco]. <https://repositorio.ufpe.br/handle/123456789/37704>
- Creswell, J. W. (2010). *Projeto de pesquisa: método qualitativo, quantitativo e misto*. 3ª. Ed. Porto Alegre: Artmed.

- Cyrino, M. C. C. T., & Jesus, C. C. (2014). Análise de tarefas matemáticas em uma proposta de formação continuada de professoras que ensinam matemática. *Ciência & Educação*, 20(3), 751-764. <https://doi.org/10.1590/1516-73132014000300015>
- Cyrino, M. C. C. T., & Oliveira, H. M. (2016). Ensino exploratório e casos multimídia na formação de professores que ensinam matemática. In: Cyrino, M. C. C. T. (Ed.). *Recurso multimídia para a formação de professores que ensinam matemática: elaboração e perspectivas*. Londrina: EDUEL, 19-32.
- Cyrino, M. C. C. T., & Teixeira, B. R. (2016). O ensino exploratório e a elaboração de um framework para os casos multimídia. In: Cyrino, M. C. C. T. (Org.). *Recurso multimídia, para formação de professores que ensinam matemática: elaboração e perspectivas*. 1ª ed. Londrina: Eduel (pp. 83-99).
- De Paula, E. F., & Cyrino, M. C. C. T. (2021). Identidade profissional de professores que ensinam matemática: elementos e ações para a construção de uma proposta para futuras investigações. *Pro-Posições*, 32, e20180109. <https://doi.org/10.1590/1980-6248-2018-0109>
- Estevam, E. J. G., & Cyrino, M. C. C. T. (2016). Desenvolvimento Profissional de Professores em Educação Estatística. *Jornal Internacional de Estudos em Educação Matemática*, 9(1), 115-150. <https://doi.org/10.17921/2176-5634.2016v9n1p115-150>
- Estevam, E. J. G., Cyrino, M. C. de C. T., & Oliveira, H. (2018). Desenvolvimento do Conhecimento Estatístico para ensinar a partir da análise de tarefas em uma comunidade de professores de Matemática. *Revista de Ensino de Ciências e Matemática*, 9(2), 32–51. <https://doi.org/10.26843/rencima.v9i2.1643>
- Estevam, E. J. G., Cyrino, M. C.C. T., & Oliveira, H. M. (2015). Medidas de Tendência Central e o Ensino Exploratório de Estatística. *Perspectivas Da Educação Matemática*, 8(17). <https://periodicos.ufms.br/index.php/pedmat/article/view/835>
- Estevam, E. J. G., Cyrino, M. C.C. T., & Oliveira, H. M. (2021). Aprendizagens profissionais de professores sobre o ensino de estatística suscitadas por reflexões na análise de um caso multimedia. *Revista Portuguesa De Educação*, 34(1). <https://doi.org/10.21814/rpe.20709>
- Freire, I., Bahia, S., Estrela, M. T., Amaral, A. (2014). A Dimensão Emocional da Docência: Contributo para a Formação de Professores. *Revista Portuguesa de Pedagogia*, 46-2, 151-171. [https://doi.org/10.14195/1647-8614\\_46-2\\_8](https://doi.org/10.14195/1647-8614_46-2_8)
- Gal, I. (2002). Statistical literacy: meanings, components, responsibilities. *International Statistical Review*, 70(1), 1-25. <https://doi.org/10.1111/j.1751-5823.2002.tb00336.x>
- Lima, C. N. M. F., & Nacarato, A. M. (2009). A investigação da própria prática: mobilização e apropriação de saberes profissionais em matemática. *Educação em Revista*, 25(2), 241-265. <https://doi.org/10.1590/S0102-46982009000200011>
- Oliveira, H., & Cyrino, M. (2013). Developing Knowledge of Inquiry-Based Teaching by Analysing a Multimedia Case: One Study with Prospective Mathematics Teachers. *Sisyphus. Journal of Education*, 1(3), 214-245. <http://dx.doi.org/10.25749/sis.3712>
- Oliveira, H., & Serrazina, L. (2002). A reflexão e o professor como investigador. In: GTI (Org.), *Refletir e investigar sobre a prática profissional* (pp. 29-42). APM.
- Ponte, J. P. (2002). Investigar a nossa própria prática. In: GTI (Org.). *Refletir e investigar sobre a prática profissional* (pp.5-28). APM.

- Ponte, J. P. (2004). Investigar a nossa própria prática: uma estratégia de formação e de construção do conhecimento profissional. In: Castro, E. & Torre, E. (Eds.), *Investigación en educación matemática* (pp. 61-84). Coruña: Universidad da Coruña. Republicado em 2008, *PNA - Revista de Investigación em Didáctica de la Matemática*, 2(4), 153-180. <http://dx.doi.org/10.30827/pna.v2i4.6196>
- Rodgers, C. (2002). Defining Reflection: Another Look at John Dewey and Reflective Thinking. *Teachers College Record*, 104(4), 842–866. <https://doi.org/10.1111/1467-9620.00181>.
- Schön, D. A. (1983). *The Reflective Practitioner: how professionals think in action*. Basic Books.
- Stein, M. K.; Engle, R. A.; Smith, M. S.; Hughes, E. K. (2008). Orchestrating Productive Mathematical Discussions: five practices for helping teachers move beyond show and tell. *Mathematical Thinking and Learning*, 10(4), 313-340. <https://doi.org/10.1080/10986060802229675>