Continuing professional development of a Mathematics teacher

Desenvolvimento profissional contínuo de uma professora de Matemática

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Abstract

This paper discusses the Continuing Professional Development (CPD) of a mathematics teacher involved in a FAPESP research project that studies the potential of implementing teaching through interdisciplinary projects that have statistical education as an integrating axis. It seeks to answer these questions: what teacher learning was evidenced by the teacher in her narratives, and which perspective of Continuing Professional Development generated such learning? To answer those two questions, a narrative investigation is taken not only as a methodology but also as a way to construct reality since it is anchored as an ontology. The narrative favors evidence about the experience perceived and seen as an
account, capturing the details and richness of human affairs’ meanings, based on evidence from the world and life. Experience is reconstructed by reflecting on what was lived and giving sense to what happened. Holistic analysis of the form will help find the best expression for the plots expressed in the accounts. The results reveal the practice of a teacher-researcher who autonomously exercises her teaching to include actions of creativity, self-criticism, collaboration, self-ethics, and reflexivity brought about by continuing professional development based on reimagination.

**Keywords:** Continuing Professional Development of Teachers. Narratives. Interdisciplinary Projects. Mathematics Education. Statistics Education.

**Resumo**

O objetivo deste artigo é discutir o Desenvolvimento Profissional Contínuo (DPC) de uma professora de matemática envolvida em um projeto de pesquisa financiado pela FAPESP\(^1\) que estuda a potencialidade da implementação de um ensino por meio de projetos interdisciplinares que tiveram como eixo integrador a educação estatística. Busca-se responder às questões: quais aprendizagens docentes foram evidenciadas pela professora em suas narrativas e qual perspectiva de desenvolvimento profissional contínuo gerou tais aprendizagens? Para tanto, toma-se a investigação narrativa não somente como metodologia, mas como forma de construir a realidade, uma vez que a metodologia está ancorada em uma ontologia. A narrativa favorece evidências sobre a experiência percebida e vista como um relato, captando a riqueza e os detalhes dos significados nos assuntos humanos, com base nas evidências do mundo e da vida. Reconstrói a experiência, refletindo sobre o vivido e atribuindo significado ao sucedido. A análise holística da forma será utilizada para encontrar a melhor expressão para as tramas expressas nos relatos. Os resultados revelam a prática de uma professora pesquisadora que exerce com autonomia sua docência constituída por ações de criatividade, autocrítica, colaboração, autoética e reflexividade provocados por um desenvolvimento profissional contínuo baseado na reimaginação.


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Introduction

In the present article, we discuss the Continuing Professional Development (CPD) of a mathematics teacher who participated in a research project sponsored by FAPESP that aimed to generate pedagogical experiences that would support the elaboration, development, and evaluation of interdisciplinary projects whose integrating axis was statistical education. This paper assumes statistics as a data-analysis science rooted in interdisciplinarity (LOPES, 2008).

The research was a collaboration between researchers and professionals linked to schools to analyze students’ learning through oral and written narratives of vice-principals; pedagogical coaches; and science, geography, Portuguese, and mathematics teachers. Thus, data production occurred under two perspectives: (1) students’ learning and (2) principals’, vice-principals’, pedagogical coaches’, and teachers’ learning.

With a team of educators from three schools involved in the project, we conducted the CPD through monthly meetings. We discussed scientific articles during these meetings, enabling principals, vice-principals, pedagogical coaches, and teachers to expand their theoretical and methodological knowledge. These sessions allowed groups to develop school projects according to problems emerging in each context. The educators were responsible for defining, creating, developing, and evaluating each stage of the interdisciplinary project developed.

Besides the monthly meetings related to the interdisciplinary projects, there were weekly meetings at each school to discuss courses of action and pedagogical directions. Sometimes with the presence of the researcher responsible for the project, the first author of this article, to give a voice and listening to teachers, we recorded their oral narratives and debated possibilities for practice that would help our interdisciplinary proposal succeed. Thus, we based the CPD on the perspective of teaching autonomy and professional agency, through which teachers were protagonists and unveiled their potential as knowledge producers. We consider that teachers constitute their autonomy through personal aspects such as moral and ethical commitments as well as social aspects such as relationships and values. Therefore, teaching autonomy is a social and not a technical issue. It exists when teachers are aware of their incompleteness (Freire, 2015) and bias; they are supportive and sensitive towards other actors in the process, particularly students. Such attitudes indicate that teachers consciously deliberate about their judgments, retrospectively reflect on their practice, distance themselves critically from the profession’s bureaucratic structure, and expand their view about teaching towards issues beyond the classroom. As such, their teaching practice becomes not only reflective but also intellectually critical (CONTRERAS, 2002).

We consider that this teaching autonomy permeates the reframing of teachers’ professional identity, which leads us to the idea of agency, that implies “self-knowledge, self-esteem and the ability for self-regulation in determining their actions” (PASSEGGI; CUNHA, 2013, p. 46). “Thus, for the teacher, exercising agency can mean ‘taking charge of’ the construction of their professional identity, without waiting for public policies or institutional
determinations to involve them in processes that, often, may seek to ‘shape’ them.” (LOPES, 2019, p. 601).

Considering these assumptions and the formative context of this study, based on Nathalia’s narratives, we will discuss her learning while teaching by developing innovative pedagogical experiences with the elaboration, organization, and evaluation of an interdisciplinary project in a school on the outskirts of the city of Valinhos, Sao Paulo State.

We view narrative investigation not only as a methodology but as a way of constructing reality, as an ontology anchors the methodology. We believe that humans socially construct reality as indicated by Berger and Luckmann (2008) and Bicudo (2000), for whom reality is the world, a world of relationships in which we live and are situated.

Therefore, we believe that narratives favor evidence about perceived experience. They are accounts that capture the richness and details of meanings within human issues, based on evidence of life and the world. Narratives reconstruct experience, reflecting on what is experienced and making sense of what happened. Thus, we will use a holistic analysis of format to answer the questions: what teacher learning was evidenced by the teacher in her narratives, and which perspective of CPD generated such learning and, find the best expression for the scenarios expressed in Nathalia’s accounts.

**Theoretical Considerations**

The research project’s professional development process focused on theoretical discussions about the mobilization of interdisciplinary ideas, work with projects, and using narratives to promote the reflectivity of both the teacher’s and students’ teaching and learning processes.

We believe that “interdisciplinarity shows its utopian face when it enables the recognition of man as an integral man,” a product of his history and capable of producing knowledge (HAAS, 1995, p. 12). We believe that with this attitude towards knowledge, we can "replace a fragmented conception of human beings for a unitary one.” (FAZENDA,1979, p. 8).

The research project from which this article originates aims to link content, procedures, and practices of mathematics, sciences, geography, and Portuguese, through an approach that explores interdisciplinarity not as a mere combination of disciplines but as a courageous and driven attitude towards knowledge.

We rely on Fazenda’s (1991, p. 32) ideas when considering interdisciplinarity from a point of view that enables a deep and critical reflection about the inner workings of teaching. For the author, we can use interdisciplinarity as follows:

- as a means of achieving a better education in general, since only an interdisciplinary approach can enable some identification between what is lived and what is studied, provided what is lived results from the interrelation of multiple and varied experiences;
- as a means of achieving professional training, since it enables the opening to new fields of knowledge and new discoveries;
- as an incentive to the formation of researchers and conduction of research, since the aim of interdisciplinary investigations is to reconstruct the unity of
objects that were separated by the fragmentation of methods and, thus, foster the analysis of global situations, the limits of their own conceptual system and the dialogue between disciplines;
- as a condition for permanent education, since through intersubjectivity - an essential characteristic of interdisciplinarity - it is possible to continuously exchange experiences;
- as a way of understanding and modifying the world, as man is both agent and patient of the reality of the world, having an effective knowledge of this reality in its multiple aspects is fundamental;
- to overcome the teaching-research dichotomy, as, considering this new pedagogical focus, research is the only possible form of learning.

Implementing a proposal for work based on interdisciplinarity involves several obstacles. The first is delineating the problem to be investigated because, as Fazenda (2008) reminds us, interdisciplinary investigative activity only becomes possible when several disciplines come together emanating from the same object. The author considers it necessary to create a problem situation under a Freirean perspective. The idea arises from common conscience, from belief in recognition of the complexity and the willingness to redefine the project as a response to each question or answer found. Therefore, research through work projects favors interdisciplinarity, given its nature linked to problematizations.

The organization of work projects is based on a concept of globalization, understood as “a more internal than external process, in which the relations between content and areas of knowledge are developed according to the needs which entail solving a series of problems underlying learning” (HERNÁNDEZ; VENTURA, 1998, p. 63). In this type of work, concerns regarding students’ resistance to new didactic approaches, constraints of time, space, material resources, and support from school management, among others, naturally emerge. There is also an ever-present challenge: an effective dialogue between mathematics and other subjects within elementary school students’ learning.

Haas (1995, p. 11) argues that the construction of interdisciplinary projects requires a commitment to the community, and there must be an identification among those involved with the proposal outlined. “The (self)recognition of individuals in the project is a guarantee of conscious and responsible action.”

Therefore, interdisciplinarity, through working with projects, has foundations in the dialogue, responsible for authentic communication that is not the “exclusive transfer or transmission of knowledge from one individual to another, but their co-participation in the action of understanding the significance of meaning (FREIRE, 2018, p. 90).

Under this perspective, that approach enables the construction of new cognitive skills and the attribution of new meanings. It is possible to extract from interdisciplinarity content constituted by the intersection of knowledge that translates the dialogues, divergences, confluences, and boundaries of the different disciplines.

To highlight the potential of interdisciplinary pedagogical practice, we stimulated the analysis of the narratives produced by the group of educators participating in the research. The idea was that they would realize that through oral and written narratives, we could list emerging aspects of students’, teachers and management learning in a process of self-
discovery, which contributes to the understanding of the learning processes when related to their training, at the same time, conscious, intentional and self-reflective.

The production of narratives allows us to understand the complexity of individuals' stories about conflicts and dilemmas in their lives. Bolívar (2002) understands it as the structured quality of the experience perceived and seen as an account, capturing the richness and details of the meaning of social issues. It enables the reconstruction of experience, reflecting on what is lived and giving meaning to what happened.

The construction of a narrative is a (self)educational process, as it allows a person to interpret and reframe their formative path through reminiscence. By socializing a narrative about our experience, either orally or in writing, we reflect on our actions and recognize ourselves. Reflexivity regards our pedagogical actions as educators, and we obtain it through self-awareness of our possibilities for intervention and dimensioning within our classrooms.

Self-learning makes it possible for us to reflect dynamically on ourselves and expand autonomy, initiative, and creativity (DOMINICÉ, 2006). This reflectivity leads us to consider that self-learning in the educational process enables the construction of self-ethics. Morin (2005) considers that as self-ethics develops, it links to a constant movement of self-knowledge, self-clarification, and self-criticism. For that author, individual autonomy fosters autonomy and the personalization of ethics. Thus, self-ethics derives from an individualization process, from personal understanding and values introjected into the self.

In teaching and learning processes, self-learning provokes sensitivity, awareness, and commitment to others. This means that there is a road for you and others (FURLANETTO, 2011). Thus, when we carry out experiments with others and within the world, we elaborate and recreate our inner world, and, in this cycle, we build our biography, our identity (JOSSO, 2010). Therefore, personal, social, professional, and ethical training, from the perspective of self-training, requires that each of us be a researcher of ourselves in relation to others.

Given these assumptions regarding interdisciplinarity and project work, aiming at the self-learning of all those involved in the teaching and learning processes, the study investigated Nathalia's continuing professional development process based on Sachs (2011) when she developed and explained four metaphors for CPD: CPD as retrofitting; CPD as remodeling; CPD as revitalization and CPD as reimagination.

That author explains that the first metaphor, which consists of CPD as retrofitting, is firmly based on a practical view of teaching. Content relevance and immediate application in the classroom is a primary objective. Thus, we view teachers as managers of students' learning instead of reflective and inquisitive practitioners who gauge the appropriate pedagogy for the students they teach.

CPD, like remodeling, refers to a model that is concerned with transmission. However, it is more related to modifying existing practices to ensure that teachers comply with governmental agendas for change. It is extremely focused on valuing content and the pedagogical knowledge of teachers. This CPD model reinforces the idea of teachers as uncritical consumers of specialized knowledge.
CPD indicated by Sachs (2011) as revitalization connects teachers with other teachers' and students' needs. The difference between this type of CPD and those presented before is that it focuses mainly on teacher learning, particularly on professional development through opportunities to rethink and review practices and become reflective professionals. Another form of revitalizing CPD represents professional development networks that create opportunities for teacher-learning and transformation.

CPD, as reimagination, refers to authentic professional learning, which provides teachers with the latitude and time to ask questions and investigate identity issues that are important to them and their students. A dialogue goes beyond teachers' meetings in the professional development process when teachers plan strategies in their schools and exchange ideas they can implement in their classrooms. It is a transformative vision of the teaching profession, which seeks to develop teachers as creative curriculum developers and innovative teachers. Such teachers value their own divergent and bold thinking, that of their colleagues and students, and, in doing so, assist their students in developing their own critical and transformative skills. Transformative teachers also collaborate with colleagues, students, and other stakeholders on a deeper level, and, for this to happen, they must be open to change and transformation within themselves. “The focus on learning is significant as it recognizes teacher agency and personal responsibility. Each of these approaches serves different purposes and has different outcomes.” (SACHS, 2011, p. 162-163). The author argues that CPD must incorporate all four elements: retrofitting, remodeling, revitalization, and reimagination.

We believe that the professional development process should emphasize teachers' learning by reflecting on their practice of producing narratives as in the CPD developed during the research reported in this text.

**Methodological Treatment**

Regarding the present study's methodological design, we believe that ambiguity is at the heart of the investigation, considering multiple perspectives for interrogation. Science can explain certain aspects of human experience, but it cannot grasp the entirety of its complexity. The threat to science, research, and, ultimately, education favors one and only one way to perceive the world (HENDRY, 2010). That author considers the narrative as an epistemology of doubt, as, through this research method, questions related to three main domains can be answered: physical (science), human (symbolic), and metaphysical experience (sacred). This understanding of narrative as three modes of investigation leads to the engagement of such methods in elaborating questions since the narrative affords a unique approach to the doubt caused by them. These modes of narrative investigation are not distinct and immeasurable - they are interconnected and interdependent.

The narrative investigation is based on constructivist and interpretative epistemology and assumes that language mediates action; that the narrative is the central structure of the way humans construct meaning, that is, the course of life and personal identity is experienced as a narration; that the storyline shapes the narrative; that temporality and
narration form a whole (time constitutes meaning); that cultural and individual narratives are intertwined (BOLÍVAR; DOMINGO; FERNÁNDEZ, 2011).

Under this perspective, the narrative helps to rethink research more ethically and democratically, expanding the dialogue about multiple research traditions. The possibility of unveiling human experience aspects allows the researcher to experience respect and admiration derived from some phenomenon's mystery.

In this study, the participants produced narrative materials. We assume the perspective of Clandinin and Connelly (2011) that there are three sets of aspects related to the method in narrative research: theoretical considerations; practical considerations and geared toward the account in the field; and analytical-interpretative considerations, as we make the transition from field accounts to research texts.

To analyze the narratives, we have relied on Schütze (1997), cited by Jovchelovitch and Bauer (2010, p. 106), who proposed the following six steps:

- high-quality detailed transcription of oral material;
- separation of the text into indexed material (which express concrete reference to 'who did what, when, where and why') and non-indexed (of investigative nature - can be descriptive or argumentative. When descriptive refers to how events are felt and experienced, to the values and opinions linked to them, while argumentative material refers to the legitimation of what is not peacefully accepted in the story and reflections in terms of theories and general concepts about the events);
- use of all indexed components to analyze the sequence of events, called 'trajectory,' of individuals;
- the non-indexed dimensions of the text are investigated as 'knowledge analysis';
- grouping and comparing individual trajectories;
- comparison of cases which allow the identification of collective trajectories.

These steps allowed us to analyze Nathalia's narratives, following different phases to understand the phenomenon investigated.

Nathalia's narrative: interdisciplinary practice in math classes

In 2002, Nathalia earned a bachelor’s degree in mathematics from Universidade Estadual de Campinas – UNICAMP (State University of Campinas). In 2007, she completed her master’s thesis at Unicamp’s Faculty of Education on algebraic learning.

Nowadays, Nathalia is a tenured teacher at the Department of Education of Valinhos. She works as a math teacher at a municipal school on the outskirts of town, teaching teenagers aged 11 to 14; she also coordinates a group of mathematics teachers, who students in the final years of elementary school, who are also 11 to 14 years old. She is responsible for promoting the continuing education of her colleagues. At the same time, she is conducting doctoral research at Cruzeiro do Sul University, investigating three mathematics teachers' professional trajectory as they face challenges of teaching statistics.
Nathalia has always invested a lot in her professional development. Since 2012, she has participated in a collaborative group called Grupo de Investigações e Formação em Educação Matemática – GIFEM (Group for Research and Training in Mathematical Education). From 2019 to 2020, she participated in the FAPESP Project described in this article and produced three written narratives that constitute this study's data source.

The project, “Environment of Parque Portugal,” was developed at the school where Nathalia works. Parque Portugal is also the name of the school's neighborhood. The project was defined by a team of three mathematics teachers, a geography teacher, a Portuguese teacher, and a science teacher. The team outlined the project's steps in their weekly meetings.

The general coordination of the project was delegated to the first author of this paper. However, there was no local coordination; therefore, teachers had the autonomy to define the project with their students. Also, they exercised their creativity when designing pedagogical strategies for the steps of the project. It should be noted that the theoretical studies carried out and discussed in general meetings about interdisciplinarity, working with projects. The use of narratives, coordinated by the professor responsible for the FAPESP project, was essential for teachers to explore new practices and function without the curriculum's encumbrances and previous determinations of higher instances.

In her first written narrative, the teacher describes how she presented the project, and we observed that the problem situation she presented was essential to stimulate students' involvement.

I spoke about the theme: “Environment of Parque Portugal” and they received it with great enthusiasm. They thought it was an important theme because it is the environment where they live, which is quite problematic due to its geography.

We had a brainstorm, and everyone was able to list their opinions on the board, and, based on what colleagues said, everyone kept adding information. I asked: “what comes to mind when we talk about the environment?” The first thing they said was “fires,” so I asked, “What do fires have to do with the environment?” and they replied, "It has to do with the pollution of the air we breathe." They talked about water pollution, and garbage floating in rivers.

All students commented on was the issue of garbage accumulated in the surrounding area of the school and their homes. They reported that in the neighborhood, there were several empty lots where garbage and construction waste accumulated. They were extremely uncomfortable with the garbage on sidewalks and in the streets, ending up clogging drains and causing floods. They talked about air pollution and noise pollution. They added that the smoke coming out of cars also pollutes.

While they were talking, I wrote everything down on the blackboard and prompted them to comment on each item. They remembered that garbage releases leachate that can contaminate people, causing diseases. They also
said that there is a lot of deforestation in the neighborhood where they live and justified, “they cut the tree, and it releases oxygen.” I went on to talk about photosynthesis.

Another type of pollution mentioned was visual pollution. I asked what the relationship would be with the environment. The students replied that they did not know, so I suggested we research it to see a link.

I found the conversation took a curious direction... They associated the topic only with bad events and continued talking about the potholes on the neighborhood streets that cause accidents. I asked about their relationship with the environment, and they said that when it rains heavily, it flows down the neighborhood's slopes, taking the pavement with it.

Another problem reported was the fact that there were a lot of overgrowths on sidewalks. A student made the following pun: “It will be known as “Parque Matagal”. She added that finding snakes was a real possibility.

In addition to the snake problem, they reported that sidewalks are all broken and overgrown, which does not allow students to travel to school safely. The same student noted: “when the deputy mayor of Valinhos came here, and we asked her to have the weeds on the sidewalk cut, she simply ordered those very close to the sidewalk cut, but what was behind it continued growing.” Students began to comment on their situation about this: “The weeds in front of my house have no end... I will set it on fire”, “The sidewalks on my street are just bush.” "The most common insect in this neighborhood, which I hate, is wasps." Another said: “It's mosquitoes; there is a lot of stale water that can cause dengue fever.”

I asked if they saw stagnant water in the neighborhood. And the students answered in unison: YES!! A lot!

One student reported that there was a sewer in front of his house (he meant drainage gutter), and when it rained, the water remained trapped.

I asked students if all that had anything to do with the time of year or if all the problems occurred throughout the year. They did not know how to answer that, and I asked them to think about it.

I concluded by saying that the first part of our project would deal with the influence of the environment on our health. One of the stages of that study would be the survey of students' medical certificates. From that moment on, I asked them to turn in all medical certificates to me. We will conduct a statistical analysis of students' health problems over time if the diseases they had at the beginning of the year when it was summer are the same in winter.

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2 A pun on the words Portugal, the name of the subdivision, and Matagal, which means “overgrowth or bush” in Portuguese.
At that moment, the students started to report some symptoms that they observed, such as headaches being more frequent in summer, runny nose more frequent in winter. I stated that, in addition to medical certificates, together, we (the teachers) had prepared a socioeconomic questionnaire and would print the questionnaire, and everyone would take it home to answer. Some students were concerned: “Do you want to know what my father does (for a living)?” I explained that it was merely to outline the socioeconomic profile of families.

They wanted to know if they were going to be able to interview other people, I explained that at that moment, they would not, but later we could think of something like that.

I explained that we would start the second part of the project as soon as the thermometers and rain gauges arrived. While on vacation, some students (we would draw names) would take the thermometer home and record the temperature three times every day: at 8 am, 12 pm, and 6 pm. I explained the different types of thermometers and clarified some questions from students.

I commented that the third stage had to do with what they had listed at the beginning of the class: map risk areas. At the end of the class, I asked them what they thought. They replied that they liked the idea and that everyone wanted to participate. I was quite happy with the receptiveness.

In the following class, I handed out the socioeconomic questionnaires and explained in detail how they were supposed to be filled out and what precisely each question meant. We agreed that they would deliver the answered questionnaires upon returning from vacation. As soon as the thermometers arrived, we (teachers) placed labels on them to identify them as project materials and ensure that each student would be responsible for the material they took home. They signed a statement of responsibility. I explained the importance of taking care of the material and that after we finished the project, all of that would be turned over to the school.

In the first stage, the survey of temperatures was carried out successfully. The students who were responsible for doing it, did it correctly.

I prepared a script with some questions related to the environment to survey what the students knew, their conceptions about the environment, and seasons were; what links there would be to our health. The questionnaire was applied by the geography teacher. In the end, we asked students to develop a drawing that would best represent all the answers they put to paper. (Nathalia’s written narrative, August 11, 2019).

Nathalia’s first narrative shows that to know and study the environmental problems of the neighborhood in which one lives, with a significant portion of the teaching team, addressing the theme under different theoretical and methodological approaches, according
to the specificities of each discipline, generated greater involvement of students when they were able to analyze the problems of their community, employing scientific knowledge from different fields, enabling students to achieve mutual enrichment and produce knowledge collectively.

Nathalia’s observation that the students associated the theme solely with adverse events demonstrate how much students’ daily reality (Berger; Luckmann, 2008) is present even in unexpected situations. Interdisciplinarity is present in the discussion through the activity proposed. By removing the boundaries of mathematics, interdisciplinarity is a pedagogical practice that contributes to students acquiring real knowledge of the world in which they live, providing global knowledge.

We can also see the teacher’s clarity about the goals she wanted to achieve in mathematics with the recording, organization, and data analysis. Her practice based on problematization, eliciting students’ voices, and listening to them was fundamental. (D’AMBROSIO, 2013). Thus, we can infer that Nathalia took advantage of opportunities and students’ questions to discuss conceptual notions such as photosynthesis and diseases, highlighting interdisciplinary connections within the theme - the neighborhood and the school. Moreover, given that her students expressed concern about identifying their parents’ professional activity, which generated their family’s income, she was ethical and respectful to avoiding embarrassing her students.

Nathalia created opportunities for discussion and questioning. These opportunities revealed that the interdisciplinary practice she adopted contributed to developing research to elaborate and implement pedagogical actions that constituted significant opportunities to establish relationships between students’ everyday life (Berger; Luckmann, 2008) and the specific knowledge of the involved disciplines. This practice allowed students to voice their concerns about this reality, which, though constructed through various personal experiences, manifests a shared vision, a common sense that everyone shares.

In a second written narrative, Nathalia addresses another stage of the project in which we observe the work done with graphic representations derived from the answers to the socioeconomic questionnaire. This shows the result with statistical surveys recommended for understanding the reality experienced and a pedagogical proposal that aims to develop students’ critical thinking based on consistent and plausible arguments (LOPES, 2008).

We started developing these ideas as we worked on what we had already begun: the tabulation of data from the socioeconomic questionnaire. When I asked 6th graders what could be done with the data collected from the socioeconomic questionnaire and how we would present it to the school community, they suggested graphs and tables. I surveyed the types of charts they knew - column and sector charts. While talking, I realized that it would be necessary to revisit those graphs and their characteristics and deepen the understanding of existing types of graphs and their purposes and tables. The students were delighted with the variety and the graphics I presented to them when we studied column, bar, sector, line, stem and leaf diagrams, pictograms, simple and double-entry tables. Together, we interpreted several of the charts.
I had suggested. All this was possible because I had created a series of slides that I showed to students on the TV set acquired with the project budget. The students were divided into 5 groups, and each group was responsible for tabulating, in their way, the answers given to 4 questions of the questionnaire. During the tabulation, we needed to revise the questionnaires to ensure that we tabulated all the data. After that, we started creating graphs. Most students chose column and sector charts, primarily because of their familiarity with this type of chart and the type of data analyzed. They thought that they would enable better visualization.

It was remarkably interesting to observe the students’ learning and discussion processes regarding the construction of graphs, their concern for the people who would read them, and their understanding. We discussed the importance of the title, caption, and proportionality. My role was crucial in verifying that everything was following our studies. Some instances in which my interventions were necessary were:
- checking if all groups had tabulated all questionnaires;
- guiding the elaboration of column graphs: all columns should have the same width and maintain the same distance among them;
- in the pie chart, as expected, students were only aware of what half would be (50%), so I assisted in the calculation of sector angles using the calculator;
- while working on the conclusions, the students felt the need to have the percentages so that they would be able to explain the results; together, we discovered that with the help of calculators, which the project acquired, we could easily calculate percentages.

It is impressive how students engage in differentiated activities, which require autonomy. Gradually, I’m trying to make my classes more meaningful for them. I still cannot work with all the content in this manner, but my participation in this FAPESP project has helped me a lot, especially regarding interdisciplinary and collaborative work. (Nathalia’s written narrative, October 21, 2019).

Nathalia narrates the connections between mathematical concepts and graphical representations, impressing relations with the calculator’s aid. Concerning teacher education, she also recognizes that not all content is approached in an interdisciplinary way in her practice. However, she points out that research projects of this nature enable her to grow professionally.

This narrative shows Nathalia’s mediating posture and attitude. She states that during the activity, she provided access to the data obtained through the socioeconomic questionnaire. Still, it can be observed that her disposition consisted of questioning more than answering, giving students more autonomy, thereby contributing to their greater involvement in the activity. The adoption of such a posture reveals a concern with students’ learning.

The discussion about using the data collected made it possible for students to enjoy a learning moment when they realized their responsibility in the learning process and built
strategies that would contribute to the analysis and possible decision-making, which was not imposed but based on the information available.

The theme of the project, as well as the data collected, resulting from students’ everyday reality provides a learning environment (Skovsmose, 2000), based on inquiry and investigation, which seeks to foster the construction of knowledge through observation of the application of mathematical content in situations arising from that reality.

Nathalia, while narrating her role and describing some points in which she needed to intervene, reveals the importance of her understanding that the autonomy given to students should not be taken as abandonment and that supervision is fundamental to gauge whether the proposal for construction of knowledge is adequate, at the same time that the teacher exercises their role of systematizing it and guiding students towards the best paths to take.

In her third written narrative, Nathalia highlights the importance of producing written narratives for the reflective process of her teaching practice. Also, she points out that immersion reading of scientific texts helped her rescale her actions in class, particularly in developing the interdisciplinary project.

For me, the process of elaborating the narratives throughout the development of the project was especially important because it made me reflect on what we were doing at school. The first narrative made me realize that we were not doing interdisciplinary work, and I did not know how to lead students into becoming protagonists of the process. Incidentally, right after writing the first narrative, I participated in the second edition of ICOCIME (International Conference on Creative Insubordination in Mathematics Education). The lectures, work discussed, and the short course I taught helped me analyze my practice further, and I realized that I needed to go back to reading Paulo Freire. It was then that I read “Pedagogy of Autonomy” again with fresh eyes. I felt like I had never touched the pages of that book, but I clearly remembered reading it when I did my master's degree 13 years before. The new reading consolidated my ideas of how we should work with students at school, what we needed to offer them to analyze the world they live in, and act critically and consciously. The field study carried out during the project was consistent with the text and, I could visualize what Paulo Freire said within my practice through the students' narratives. In addition to that book, I read other texts about the seasons, types of graphs, among others. Some worth mentioning are the following:

Students also collected information about temperature and rainfall on a rotation basis; each week, a student was responsible for recording the temperature using a digital thermometer. Another student kept the analog thermometer, and the pluviometer assisted in the collection of rainfall data. They will also tabulate these data to analyze and draw conclusions regarding the seasons. (Nathalia’s written narrative, December 18, 2019).

In her third narrative, Nathalia’s reflection reveals the importance of considering the temporality of spaces and events and their influence on pedagogical practice. For Clandinin and Huber (2010, p. 63), “situating things in time is the way to think about them,” and Nathalia’s decision to reread Paulo Freire’s work and her narrative about that moment highlights the impact of that understanding for her pedagogical practice.

Nathalia highlights the importance of elaborating narratives in her practice, demonstrating that they can provoke pedagogical practice changes through the critical analysis of oneself. Thus, she also attributes to narrative production the status of learning alternative, contributing to teachers’ continuing professional development. She also describes the search for collaborative work to implement interdisciplinary practice. As a teacher-researcher, she seeks, on her own, theoretical references that underpin her teaching and further declares her commitment to the socialization of knowledge produced within her professional practice by participating and presenting work in scientific events.

Final Considerations

While trying to answer the questions: what teacher learning was evidenced by the teacher in her narratives? And which perspective of continuing professional development generated such learning? Indications related to the pedagogical perspective of interdisciplinarity were mobilized due to work with projects and the CPD made possible by the research developed.

The teacher learning revealed in Nathalia’s narratives shows the work with narratives with students; the pursuit of dialogue with colleagues to implement interdisciplinary practice; the creativity brought about by breaking away from teaching materials, and the need to explore the underlying reality of students’ social and economic contexts; as well as teaching autonomy expressed in the actions of a teacher-researcher.

From such emerging learning, we can highlight the proximity of CPD work, carried out through the FAPESP research project, with the perspective of reimagination. The development of an interdisciplinary project was possible when the teachers involved worked collaboratively and reimagined themselves as producers of knowledge emerging from the school routine’s complexity.
It must be pointed out that this collaboration also took place between teachers and students and was essential for their self-education. It is also noteworthy that the assumptions operated in the construction of self-learning narratives reveal an understanding of the self concerning the processes of learning, knowledge, and self-education.

According to the teacher's narrative, it was possible to identify and realize the potential which emerges from the development of an interdisciplinary project linked to the investigation of students' reality. Moreover, we emphasize that the analysis of narratives of teachers involved in interdisciplinary projects can contribute to the theoretical assumptions of CPD and the transformation of school reality, including all professionals working in the educational community. Research and monitoring policies regarding professionals who deal with the complexity of school in the integration of interdisciplinary projects are suggested and emerge as research topics in mathematics education.

References


