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Collaborative training of teachers who teaches mathematics: an experience in the context of remote activities[1]

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ABSTRACT

Research involving collaboration or analysis of collaborative groups has been gaining more space in the field of Education. This paper aims to analyze collaborative practices developed in an online training process, with 28 teachers who teach mathematics in Basic Education and who participate in a network project. The training was developed using the Spiral RePARe methodology (Reflection-Planning-Action-Reflection). Based on a qualitative approach, data were collected from the narratives of participants in the training process, in synchronous meetings on a digital platform, through direct observations and audio and video recordings of the meetings. The results point to the constitution of a collaborative group with practices based on the construction of discussion environments, autonomy, and mutual respect, which permeate debates on theory and practice in the teaching of mathematics, based on a teacher training model.

KEYWORDS: Teacher training. Professional development. Sharing experiences.

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A formação colaborativa de professores que ensinam matemática: uma experiência no contexto de atividades remotas

RESUMO

Pesquisas que envolvem colaboração ou análise de grupos colaborativos têm ganhado cada vez mais espaço na área da Educação. Este artigo tem por objetivo analisar práticas colaborativas desenvolvidas num processo formativo online, com 28 professores que ensinam matemática na Educação Básica e que participam de um projeto em rede. A formação foi desenvolvida a partir da metodologia da Espiral RePARe (Reflexão-Planejamento-Ação-Reflexão). Tendo como base uma abordagem qualitativa, os dados foram coletados a partir das narrativas dos participantes do processo formativo, em encontros síncronos, em uma plataforma digital, por meio de observações diretas e das gravações de áudio e vídeo dos encontros. Os resultados apontam para a constituição de um grupo colaborativo com práticas pautadas na construção de ambientes de discussão, autonomia e respeito mútuo, que permeiam debates sobre a teoria e a prática no ensino de matemática, a partir de um modelo de formação de professores.

PALAVRAS-CHAVE: Formação de professores. Desenvolvimento profissional. Compartilhamento de experiências.

La formación colaborativa de los profesores que enseñan matemáticas: una experiencia en el contexto de las actividades a distancia

RESUMEN

La investigación que implica la colaboración o el análisis de grupos colaborativos ha ido ganando más espacio en el ámbito de la Educación. Este artículo tiene como objetivo analizar las prácticas colaborativas desarrolladas en un proceso de formación online, con 28 profesores que imparten matemáticas en Educación Básica y que participan en un proyecto de red. La formación se desarrolló utilizando la metodología Spiral RePARe (Reflexión-Planificación-Acción-Reflexión). Con base en un enfoque cualitativo, se recolectaron datos de las narrativas de los participantes en el proceso de capacitación, en reuniones sincrónicas en una plataforma digital, a través de observaciones directas y grabaciones de audio y video de las reuniones. Los resultados apuntan a la

constitución de un grupo colaborativo con prácticas basadas en la construcción de ambientes de discusión, autonomía y respeto mutuo, que permean debates teóricos y prácticos en la enseñanza de las matemáticas, basados en un modelo de formación docente.

PALABRAS CLAVE: Formación de profesores. Desarrollo profesional. Compartiendo experiencias.

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Introduction

Research involving collaboration or analysis of collaborative groups has gained more and more space in the field of Education. This is due to changes in perspectives regarding the production of knowledge in academia and educational practices, as authors have pointed out that the gap between educational theories and pedagogical experiences has contributed little to necessary changes in school institutions. (CRECCI; FIORENTINI, 2018).

To overcome the theory and practice/university and school dichotomy, investigative methodologies have been explored to favor the development of significant knowledge for Education, as well as the training of teachers who reflect the transformation of educational practices. It is within this new investigative and training panorama that the development of collaborative research is sought.

Thus, this article brings a discussion on the concept of collaborative research, based on the perspective of Ibiapina (2008), describing some research guided by the perspective of this type of investigation, and highlights characteristics and contributions of a collaborative group for the professional development of teachers who teach math.

This group is called Rede Educação Matemática Nordeste (REM-NE); it was constituted from the E-Mult Network[5] in 2012, through Education Observatory Program (Programa Observatório da Educação) promoted by the Coordination for the Improvement of Higher Education Personnel (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - CAPES), and currently comprises 32 researchers from nine Brazilian universities located in Bahia, Ceará, Pernambuco, Rio Grande do Norte and São Paulo; 28 Basic Education teachers working in the states of Bahia, Ceará, Rio Grande do Norte and São Paulo and 21 students, including: 11 undergraduate, 7 master's and 3 doctorate, all linked to partner universities. The Basic Education teachers, who are the subjects of this investigation, teach in the initial and final years of Elementary School in public schools that are partners of REM-NE; they are pedagogues or graduates in mathematics and work collaboratively with REM-NE, building and participating in the training process.

The project currently being developed by this group, from which this article derives, is funded by the Lemann Foundation and monitored by Teachers College – Columbia University, aiming to establish a teacher training process, which aims to plan teaching sequences that can be developed, in the approach of statistical concepts in Mathematics classes, with partner teachers of the REM-NE network and that aim to discuss local and global elements linked to Covid-19 pandemic.

In view of the presented scenario, this article aims to analyze collaborative practices developed, in a formative process, with teachers who teach mathematics, based on the methodology Reflection-Planning-Action-Reflection.

[5] The general objective of the project was to investigate and intervene in the practice of Elementary School teachers regarding Multiplication Structures, based on the dialectical process training model RePARe - Reflection-Planning-Action-Reflection (MAGINA, 2008, 2013), with a view to forming a group with collaborative characteristics.

Collaborative research

In search of changes in methodological approaches to teaching, in recent decades, we have observed an increase in research that discusses teacher education. This is because "there is no quality teaching, no educational reform, no pedagogical innovation, without adequate teacher training" (NÓVOA, 1997, p. 9). From this perspective, about the process of teacher education, based on collaboration, Ponte (2012) states that it is configured as an activity of co-production of knowledge, reflection on practices and professional development. In this way, it is based on the construction of scenarios where trainers, researchers, interlocutors, and teachers act interactively, to understand and transform a given educational reality.

That said, investigations that involve collaborative research, collaborative work or the study of groups and collaborative practices have been gaining ground in the educational scenario, as they foresee, in addition to the production of knowledge that value the relationship between theory and practice, the construction of a training model of teachers that overcomes the traditionalist perspective.

Thinking about collaborative research is first to understand what action-research is. Action research aims to transform the school into a critical space, where teachers reflect and reformulate their practices, as proposed by Ibiapina (2008). For this researcher, research-action starts from three basic conditions:

> [...] the study is triggered from a certain social practice susceptible to improvement; it is conducted considering the spiral of planning, action, observation, reflection, new action; is developed, preferably, in a collaborative way (IBIAPINA, 2008, p. 9).

It is perceived that its process consists of enabling the emancipation of the teacher from reflections and actions, with a view to improving their practice, seeking to transform both the classroom and the school.

Inspired by Carr and Kemmis (1988), Ibiapina (2008) presents three models of action research, namely: Technical Research-Action, Practical Research-Action and Emancipatory Research-Action. In the first, the presence of the researcher as an external agent is strong, with a distancing from the practice to seek to understand it. In the second, the teacher can become a researcher of their practice, but there is no systematic development that seeks reflection. In the third, decisions are taken together, having as one of its principles the investigation of the educational action itself.

This last model is the basis for our study, as "action research can only be considered emancipatory when it is collaborative" (IBIAPINA, 2008, p. 17). In it, the researcher is no longer the actor, who talks about Education, and starts to investigate for Education, and the teacher is no longer just an object and starts to share with researchers the act of transforming their practice, the school, and the society. That is, research is no longer about teachers and starts to be with the teachers. According to the above-mentioned author, when developing research in this perspective, the researcher becomes the one who helps the teacher to analyze and theorize about their practice. It is a movement of collective construction, in which the researcher no longer presents unquestionable theories, but that together, from practice, it is constituted.

There are three necessary conditions for, in fact, to constitute an emancipatory action research: collaboration, reflective circles and the co-production of knowledge between researchers and teachers (IBIAPINA, 2008). Initially, it is worth discussing the meaning of collaboration, emphasizing its distinction from cooperation, as they are sometimes treated as synonyms. For Ibiapina (2008), cooperation consists of collective work, from which those involved do not have

autonomy, and power relations are hierarchical. In collaboration, decision-making is democratic, and everyone involved has the same opportunities to present their insights and principles. Within this same perspective, Fiorentini (2013, p. 56) highlights that

> [...] in cooperation, they help each other ("co-operate"), performing tasks whose purposes do not result from joint negotiation by the group, and there may be subservience to each other and/or unequal and hierarchical relationships. In collaboration, everyone works together ("co-work") and mutually support each other, aiming to achieve common goals negotiated by the group's collective.

As discussed by the authors, collaboration is marked by shared leadership and joint responsibility for the group's actions. In cooperation, on the other hand, there are power relations between members, which generate dominance over each other. In other words, as pointed out by Ibiapina, inspired by Kemmis (1987) and Desgagné (1997), collaboration implies the negotiation of conflicts existing in the teaching and learning process, seeking common action and communication between researchers and teachers, in a way to favor decision-making.

Regarding reflective circles, it is necessary to have systematized actions of reflections that enable teachers to think about the ideas built so far about teaching work, seeking to build practices that prioritize the creativity of the profession. Therefore, "reflecting on practice involves both the need to review theory and to unveil the ups and downs of teaching action" (IBIAPINA, 2008, p. 18).

In the assumptions discussed so far, reflexivity is a fundamental activity in collaborative research and, for the development of this reflection, mediating devices are needed, such as: interviews, video training, autobiography, collaborative observation, and reflective sessions, highlighting that all these tools, in addition to generating research data, aim at professional development and teacher emancipation.

Co-production concerns the involvement of the teacher in research activities, as he/she is not just a user of knowledge developed by third parties (IBIAPINA, 2008). The author points out that this type of research.

> [...] it is produced through the interactions established between the multiple competences of each of the participants, the teachers, with the potential to analyze pedagogical practices; and the researcher, with the potential of trainer and organizer of the formal stages of research (IBIAPINA, 2008, p. 20).

Thus, it is understood that the attributions of the participants are not the same, but the competences of each one is valued. On the one hand, the teacher with his/her practice, and on the other, the researcher, as a trainer, who, together with the teacher, seeks to understand this practice through reflections, seeking to theorize it. This interactive movement between the parties enhances the quality of collaboration. Based on Desgagné (2001), Ibiapina emphasizes that

> Faculty members are not necessarily called upon to participate in formal research tasks, such as, for example, in the stages of defining the conceptual framework necessary to problematize the research objectives, in the methodology of data construction and analysis, and in the production and dissemination of results (IBIAPINA, 2008, p. 21).

These steps concern the researcher more than the teachers. The reflection and the search for understanding the practice are related to the teachers, who, with the mediation of the researcher, will understand them from theories, seeking to reframe them, as well as being presented to new situations, to contribute to the professional development and the production of theories closer to social concerns.

In collaborative research, researchers must collaborate with teachers in their professional development, promoting reflections on the complexity that involves the teaching activity, and teachers collaborate by reflecting on the teaching activity, transforming it, if necessary. About the roles of the researcher and the teacher, we must

> [...] when it comes to collaborative research, it is assumed, initially, that teachers participate in all stages related to formal investigation and, also, that they are responsible for delimiting and defining, together with the researcher, the research object, the construction processes of data analysis, the presentation and publication of the results obtained from the study. In fact, collaborating does not mean that everyone should participate in the same tasks and with the same intensity, but that, based on a common project, each participant makes their specific contribution, that is, contributes to benefit the project (IBIAPINA, 2008, p. 31).

It is clear, therefore, that this type of investigation involves a complex development, which takes time to understand, as it requires multiple learning, involving formative actions that enable the teacher to value the place of the other, construction of discussion environments, autonomy, and mutual respect.

What studies with collaborative characteristics point out

Although we understand that authors have presented different perspectives on collaborative research, this section proposes to discuss three works that involve this type of investigation or, at least, have elements of it, to highlight collaborative characteristics.

Curi (2018) discusses contributions from a collaborative group in the professional development of teachers. This group consisted of researchers, undergraduate students, professors, and scholarship holders, with their studies focused on the teaching and learning of Mathematics. From the discussions held by the author, some characteristics of collaboration in the group's activities are identified that are worth discussing. The first refers to the establishment of common goals, because, despite involving professionals with different experiences and academic trajectories, the subjects select a common goal: improving the teaching of Mathematics.

Another feature involves the training of teachers and the production of academic knowledge by the group - defense of theses and dissertations. According to the author, the studies carried out in the group favor "expansion of mathematical concepts and procedures and deeper knowledge of the proposed curriculum" (CURI, 2018, p. 47). As expected from this type of training process, based on collaboration, the role of the teacher is modified, as this professional is assumed as a researcher and producer of knowledge. The author emphasizes this perspective by pointing out that

> In this group, the position was assumed that the teacher is a competent and active subject and not a mere applicator of curricula, that is, that the teacher linked to the public school is also a researcher in education, protagonist of their own practice and develops knowledge in action (CURI, 2018, p. 44).

Another characteristic identified is the establishment of the practice as a starting point. This conception is based on the need to overcome the theory and practice dichotomy, by valuing knowledge arising from educational practice, so that this approximation occurs through reflection. The author reveals such an approach when she explains that

> [...] in group meetings, discussions started with reflections on classroom practices and the performance in Mathematics of students on the Prova Brasil. From these discussions, theoretical studies were incorporated This allowed us to relate theoretical references and situations of practice, enabling reflections on the practice of teachers, promoting professional development (CURI, 2018, p. 47).

Another collaborative group that is worth discussing was developed from a project entitled “Challenges for inclusive education: thinking about teacher education on the processes of mastery of mathematics in the early grades of basic education.” The contributions of this group were discussed by Manrique (2018), who reports the influence of collaborative practices on the professional development of

the participants. In the discussion conducted by the author, we also listed some characteristics of collaboration in the mentioned group.

From the observed characteristics, we list the teacher training and production of academic knowledge. These elements aim to overcome a type of teacher training addressed by Grecci and Fiorentini (2018): professional development for practice. In this type of formative conception, the teacher is seen as a mere recipient of knowledge and methodologies produced by academia, seeking, in their teaching activity, to reproduce them. This type of approach is refuted, as the classroom context is dynamic and unpredictable, and the teacher may face conflicts for which they were not prepared. For that, it is necessary, review the teacher's role, ceasing to be a mere reproducer of knowledge, but a subject capable of reflecting, making decisions, researching, and transforming their teaching practice. In view of this conception, the group involves

> In addition to reflections on the working conditions of the teachers participating in the collaborative group, in the training meetings, there were seminars on types of disabilities and on mathematical content, development of activities, sharing of classroom experiences, preparation of workshops to be developed in schools linked to the project, use of educational software for teaching mathematics, among other training actions (MANRIQUE, 2018, p. 58).

This type of training favors the critical professional development of teachers and makes direct contributions to educational practices, as pointed out by the author when stating that the changes in the conception of teachers about the teaching of Mathematics led to changes in teaching practice.

A similar study was conducted by Gama and Fiorentini (2009) when they investigated the contributions of collaborative groups in the formation of Mathematics teachers at the beginning of their careers. This initial period of the profession matches the first three years of teaching activity, considered as a stage marked by feelings of "survival" and "discovery". The investigation was conducted with three Mathematics

teachers from the interior of São Paulo, participants from three distinct groups[6], with collaborative characteristics.

According to Gama and Fiorentini (2009), the researched groups were formed by school coordinators, graduate students, undergraduates, university teachers and schoolchildren from the early years of elementary and high school, highlighting the different experiences among the group's participants. The formative character of teachers is evidenced by the authors when they point out that

> [...] teachers develop, within the groups, a process of continuous training in a paradigm that places the professional development of participating teachers and the transformation of their teaching and learning mathematics practices in schools as a center of concern (GAMA; FIORENTINI, 2009, p. 447).

The authors identified that the reflections provided by the groups, the exchange of experiences, theoretical studies on the learning of Mathematics and collaboration between the participants were fundamental in the training of the investigated teachers. The authors showed that this initial period of teaching is marked by insecurities, and the feeling of belonging in a group of professionals dedicated to improving teaching was fundamental to overcoming difficulties and transforming the practice. This can be identified in the following excerpt:

> We were able to show that collaborative groups contributed to the professional practice of beginning teachers by promoting a reflective and systematic process (individual and collective) on teaching practice; for providing support to face the challenges and difficulties that the beginning teacher encounters before the complexity of school practice, mainly because they are generally attributed to the most problematic classes in the school; for promoting changes in pedagogical practice in schools, valuing exploration, problematization and

[6] Saturday Group (Grupo de Sábado (GdS)) at the College of Education of the Universidade Estadual de Campinas; Mathematical Education Group (Grupo de Educação Matemática (GEM)) at the Department of Teaching Methodology at the Universidade Federal de São Carlos; Collaborative Group for Studies in Mathematics Education (Grupo Colaborativo de Estudos em Educação Matemática (GCEEM)) at the Diretoria Regional de Americana.

> interaction among students, especially group work and inter-group socialization, and for leading teachers to listen carefully to students, considering their responses and meanings, making questioning interventions, promoting the negotiation of meanings and the construction of mathematical concepts with their students (GAMA; FIORENTINI, 2009, p. 459).

It is noticed, therefore, that such groups favor the professional development of teachers, promote reflections on Education and encourage changes in the classroom, so that Education is no longer an individual process and constitutes a collective concern.

Methodology

The present study fits into a qualitative approach, in line with Triviños (1987), considering that this type of research is characterized by descriptive studies which require the researcher to delimit techniques, make use of methods, support use theories to be able to carry out data collection and interpretation, indicating a separation between the subject who makes the observations and the object being observed, without personal interference, as pointed out by Bicudo (2012).

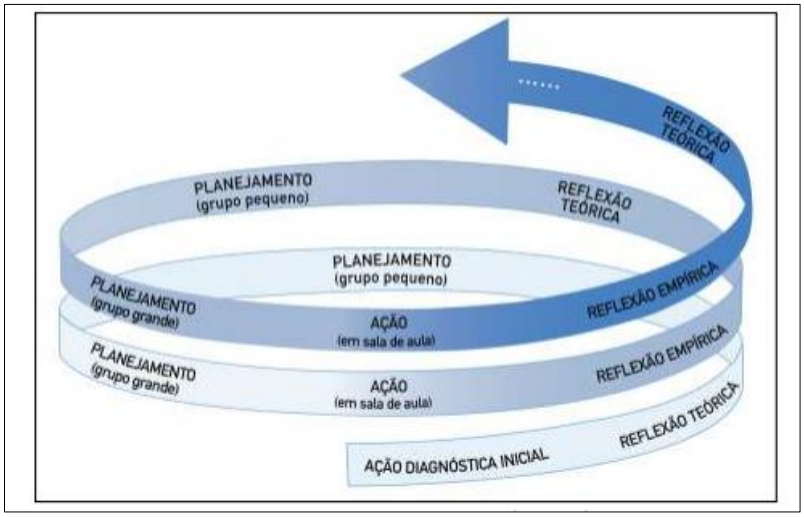
In the light of what has been said, this study discusses a small excerpt from research in progress, which analyzes the training process with 28 Basic Education teachers working in partner schools of our project, in a collaborative construction on Statistical Education activity, which can have repercussions for the professional development of these teachers through collaborative research. These teachers work in public schools in the initial and final years of elementary school and are pedagogues or graduates in Mathematics.

All teachers signed the Free and Informed Consent Form (FICF), and to preserve their identities, we assigned them fictitious names. The project is registered with the Research Ethics Committee (REC), with protocol number 26229119.1.1001.5526 and embodied opinion number 3.813.638/2020.

The training process developed by the Northeast Mathematics Education Network (Rede de Educação Matemática do Nordeste REM-NE) is based on the theoretical assumptions proposed by Day (2001) and Ponte (2012), including the continuing education of teachers from the perspective of professional development, as according to Day (2001, p. 233), " continuing education is a necessary and potentially rich area of continuing professional development for teachers". In this sense, training involves the teacher in different activities, such as planning, reflection and action, in collective and individual activities, whose focus is the activity in the classroom and the learning of the students involved. The constitution of the training process from this perspective "is generated in an internal movement and involves the teacher in their cognitive, affective and functional aspects, has internal motivations and can provide the teacher's autonomy in the classroom" (SANTANA et al., 2018, p. 3).

Given what has been said, the conduct of the training process under investigation is supported by the Reflection-Planning-Action-Reflection model (RePARe spiral), proposed by Magina (2008) and readapted by Magina et al. (2018), as shown in Figure 1, which aims to promote the development of teaching strategies for the appropriation and expansion of the conceptual field at work (in the case of this study, the statistical conceptual field), by the participating Basic Education teachers, similarly to the studies developed by Magina (2008) and Santana et. al. (2018).

FIGURE 1: Current model of the RePARe spiral



Source: MAGINA, SANTANA, SANTOS and MERLINI, 2018, p. 247.

The methodological proposal of this training model, as indicated by Magina et al. (2018), is based on a dialectical process of Reflection-Planning-Action-Reflection, forming a growing and continuous spiral movement, which is expanding, in terms of knowledge, at each lap covered.

In summary, based on the spiral and the studies by Magina (2008) and Magina et al. (2018), we have that the initial diagnostic action seeks to work between researchers and teachers, so that they can understand the knowledge of students about the content mathematics that will be explored during the formative process. It will form the basis for the debate on student learning. Theoretical reflection is built from the results of the initial diagnostic action, based on didactic knowledge. Planning takes place in a movement like reflection and results from the results of reflections (empirical and theoretical).

Continuing, the action is the moment when the activities and tasks that will be developed in the actions of teachers in the classroom are elaborated. The empirical reflection, conducted in Small (Pequenos) groups, preferably formed by teachers who work in the same school year, is made on the results of the action in the classroom that was developed

by the teachers, results of how students' learning and difficulties occurred. All of this fostered theoretical reflection, in the Large (Grande) group, which is made up of all the participants in the collaborative group. And in this process, training is developed from the notes made by the Large group, in empirical reflection, which should provide the basis for the new plans to be built by the teachers and the group.

The training process discussed in this research, based on the RePARe spiral model, took place between September 8 and December 15, 2020, on previously scheduled dates and according to the availability of all group members, being organized and taught by the researchers, with the active participation of teachers in discussions and decision-making.

Due to the COVID-19 pandemic, the activities took place remotely, synchronously, and asynchronously, using the *Google Meet, Google Classroom, Google Drive, Google Forms and Telegram*. These activities consisted of studying texts, conducting activities, participating in chat with questions, presentations of activities developed synchronously. The studies were performed asynchronously, before each synchronous encounter.

During this period, meetings took place in Large groups, that is, in a joint meeting in which all members of the collaborative group, and in Small groups, which were subgroups by school year, for the study and planning of teaching sequences. These actions were organized into 4 modules, which had as its strands the study of mathematical content, more specifically statistical concepts, equity and research in mathematics classes and the development of teaching sequences.

To produce data collection in this article, in which we analyzed Small excerpts from the training process at synchronous moments in the Large groups, the procedures used were based on: teachers' narratives, direct observations of discussions in virtual classrooms and audio and video recordings in training meetings via *Google Meet*. In this perspective, all

material from the meetings was transcribed according to the dates of the meetings and the groups constituted.

Through the use of interactional and video graphic analysis (JORDAM; HENDERSON, 1995), a type of research methodology that tries to bring our view closer to that of the subjects at the time of interaction, we sought to describe and understand the ways in which collaboration of the group is constituted in the formative process, via the Reflection-Planning-Action-Reflection methodology, in a certain context that is emergent and contingent. The proposal of interactional analysis has as its source of study the minutiae of social interactions situated in time and space in the interactions that emerge in a natural way.

Analysis and discussions

We will analyze some of the reflections conducted in the formative meetings, based on excerpts from the narratives of teachers and researchers, based on the theoretical assumptions of the constitution of a collaborative group and how the movement of the RePARe spiral permeates this process. In training meetings, all researchers, and students in the group (undergraduate, masters and doctoral) are called trainers and all professors are called participants.

In the first synchronous meeting, in a Large group, via *Google Classroom*, in which all trainers and group participants are present online, after the initial presentations and all the discussion about the training process, conducted by the project coordinator researcher and others participating researchers, one of the trainers responsible for mediating this meeting asks the participants to fill in the "diagnosis of the statistical knowledge of teachers", one of the necessary activities and that is part of the initial diagnostic action (first stage of the RePARe spiral). The collection was done via a link to a *Google Form*, made available via chat in the *Google Classroom* room, and group

trainers followed the posting of the material outside the synchronous meeting environment. The trainers who mediated the meeting gave instructions about the posts, and the other trainers involved followed the group's actions, interacting with everyone, when necessary. An initial dialogue is established.

> Participant Maria (via chat): I cannot send.
> Participant Joaquina (via chat): I am not getting it either.
> Participant José (via chat): I have already tried to send it several times and it will not, it shows an error.
> Participant Severina (via chat): Mine too. Why don't we deliver them after class?
> Trainer Josefa: Because this is a research instrument that will guide our actions.
> Participant Isabel: I cannot do it, I also agree to deliver it after class, it is nervous (laughs).
> Participant Conceição: I am not able to send the photo in question 1.
> Trainer Josefa: Joaquim's suggestion, do it in excel, save, and add the recorded file.
> Trainer Carminha: Conceição send to email xxxxx@yyyyy.br and place a blank document in place.
> Trainer Josefa: Photos can be sent to the email address of xxxxx@yyyyy.br. And you do not need to attach a blank file, because the requirement has been removed.
> (Trainers Carminha, Antônia and Josefa gave some suggestions, and the form was answered by each participant. In possession of the completed forms, the floor was given to the trainer Josefa).
> Trainer Josefa: So, because of the late hour, we will not be able to have the interaction that would be what we expected to have at this moment. So, we need to start this investigative cycle experience so that you can conduct next week's activities...

In an action-research movement, we see collaboration and reflective circles being formed between participants and trainers on the necessary data collection for the development of the following steps: reflection, planning and training action based on the base questionnaire and element of the initial diagnosis, with the active participation of all group members. Decisions seek dialogue with a democratic bias, in which all involved have the same opportunities to present their perceptions, as proposed by Ibiapina (2008). In this sense, we also see

that collaboration is marked by shared leadership through the joint mediation of the trainers who lead the process and joint responsibility for the group's actions, from the perspective of negotiation, corroborating the vision of Fiorentini (2013).

Continuing the meeting of the Large group, based on elements of the initial diagnosis, the four trainers responsible for the activities of the first module build and mediate theoretical reflection, the second stage of the methodological spiral, based on the analysis of statistical concepts present in the presentation elaborated by them, considering the context of experience of the project to which the training is linked: the Covid-19 Pandemic. Let us see an excerpt from the discussions in this process.

> Trainer Josefa: …from tomorrow until next week, the theme that we chose to conduct the activities is a theme that is very present in all our lives, which is the issue of the pandemic. So, I did a little contextualization.
> (A slide with the theme "The Pandemic" was presented. Then, a graph was shown that informed the number of deaths by Covid-19 in Brazil).
> Trainer Josefa: If we make a statement and I present to you only one source: World Health Organization. We hope that what will be presented is some information that has to do with health. I present this graphical representation. Quickly, in the chat, someone could say what this graphic is about.
> Participant Joaquim (via chat): Number of deaths by Covid.
> Participant Pedro (via chat): Number of deaths by Covid in Brazil.
> Trainer Ana: Joaquim placed numbers of deaths by Covid. Peter, same thing.
> Trainer Josefa: How did you find out about, Joaquim?
> Participant Bia (via chat): a larger rise and then a stabilization in the number of deaths.
> Trainer Ana: Bia placed a larger crescent and then a stabilization in the number of deaths.
> Trainer Josefa: That's right. So, why can we identify that you are talking about the number of deaths and the number of deaths in Brazil?
> Participant Joaquim: We identify it by the title.
> Trainer Josefa: Because it has a title. So, what, other colleagues have gone beyond that? Besides identifying what this chart is about, have you started to do trend analysis? Look, there was a growth until July, now we see a decrease in the

> number of deaths. So, we have information that, in Brazil, deaths began to be counted in March 17, and until August 31, there were 121,385 people who died because of Covid-19.
> (The trainer Josefa continued the contextualization of the situation presented and showed a study conducted by the Imperial College (London), which compares conditions of health systems in first and third world countries; the mortality rate in places without access to hygiene resources, without conditions to conduct social isolation and without access to hospitals).

From the above dialogue, it is evident that reflexivity is a fundamental activity in collaborative research (IBIAPINA, 2008), promoting reflections on the complexity involved in teaching work in addressing the concepts involved in school activities. It is also evident that the initial diagnosis, when the completion of the form "diagnosis of statistical knowledge of teachers" was requested, is the starting point of the training process, conducted collaboratively, so that the diagnostic data support theoretical reflections throughout the entire training process, as indicated by Magina and collaborators (2018). This is what Curi (2018) indicates as a practice as a starting point for collaborative training.

In the direction of established dialogues, the exchange of experiences in theoretical studies on the learning of Mathematics concepts, collaboration and mutual support between participants and trainers are fundamental for the mathematical training and professional development of teachers. This corroborates the research by Gama and Fiorentini (2019), as well as the collaborative research perspective, in the view of Fiorentini (2013).

In another Large group meeting, continuing the activities of the training module, two trainers reflect with the participants on the plans developed in the Small groups (accompanied by specific trainers in each of these groups, with activities conducted at intervals between trainings in the Large groups). This stage of the training process always takes place after theoretical reflection, when teachers are divided into Small groups according to criteria, such as the school year in which they work,

as pointed out by Magina et al. (2018). Below, we bring an excerpt from the discussions of that moment.

> Trainer Fátima: …we are going to have a brief discussion now at the beginning, just to make an outline of how we are going to conduct the work here today. And today we will work on the planning of the first phase of PPDAC in which we propose an activity divided into two parts. In part 1, individually, each teacher would think about the topic and write a problem. And that was done, and we discussed it in our groups. Then it generated from everyone, and 21 problems were referred to us.
> Trainer Cristina: As Fátima said, now the teachers will present their activities. Each group has 3-5 minutes to present their activity 3, part 2. What was discussed in the groups, how consensus was reached, in relation to the theme, the problem, according to the investigative cycle, in the first phase.
> Participant Vilma: (introduces the group and thanks the trainer for the role in the Small group. Her presentation slide is shared on the screen for the entire Large group) ... at first, there was a discussion, we met through *Telegram*, but also through *Google Meet* with the coordination of professor Fátima. We met twice and there we presented our theme, our research problem and from there we talked and decided which of the themes we were going to work on. The object of knowledge, the statistical concepts that we will work with, we take from National Common Curriculum Base (Base Nacional Comum Curricular BNCC), and then the object of knowledge will be the collection, classification, representation of data referring to categorical variables through tables and graphs. The skill we have here is a skill that is at BNCC, performing research involving categorical variables in a universe of up to 50 elements, organizing the collected data using lists, simple or double-entry tables and representing them in simple column charts, with and without the use of digital technologies.

It is observed that, after the Small groups have conducted their plans regarding the activities to be developed in the investigative cycle, the participants are invited by the trainers to present their productions and visions, for each of the groups and for the other participants, promoting reflections on the complexity that involves the teaching activity, as suggested by Ibiapina (2008). In this direction, new

reflective circles are instituted, seeking to build practices that prioritize the creativity of the profession.

At this point, the collective discussion addresses the point of view of the content that teachers bring and its logical structure, as pointed out by Magina (2013) and Magina et al. (2018), in which teachers point to collaborative co-production, conducted in Small groups, pointed out by Ibiapina (2018) and Fiorentini (2018) as part of the teacher's involvement in the research activity. In this sense, this type of activity in a training process favors the critical professional development of teachers, corroborating the findings of Gama and Fiorentini (2009).

From this perspective, the sharing of experiences for the classroom and the teachers' conceptions about the teaching of Mathematics can lead to changes in teaching practice and constitute practices of a collaborative work in the perspective pointed out by Manrique (2018).

In the direction of the actions and activities of the training modules, in the Large and Small groups, the training of Basic Education teachers continued, experiencing each of the stages of the RePARe spiral. The narratives of the participants and trainers were around the constitution of collaborative work by all members of the modules. This permeated the need to continue the approach to statistical concepts dealt with in the teaching of school mathematics, as the contents needed to be consolidated in greater depth.

Final considerations

The training process consisted in the construction of environments for discussion, autonomy, and mutual respect (basic elements of a collaborative practice), in addition to learning about the production of knowledge that value the relationship between theory and practice. This implies a collaborative continuing education process that contributed to the professional development of teachers who work in this network

research. In this sense, we identified that the reflections provided by the group, the exchange of experiences and the collaboration between the participants are fundamental in the training of the investigated teachers.

The training process involves the teacher in different activities, such as reflection, planning and action, in collective activities (in Large and Small groups) and individual, whose essence is the expansion of the conceptual field under discussion (in this case, statistical concepts) and construction of math activities in a collaborative way. Thus, it is understood that the attributions of the participants are not the same, being the skills of each one valued.

Reflection takes place at various times: between teachers, between trainers and between teachers and trainers, who encourage changes in the way they look at the classroom, so that the teaching of Mathematics ceases to be an individual process and becomes a collective concern. This provides a theoretical and empirical reflection, which consisted of learning actions about teaching practice and professional development.

Regarding training activities, we understand that the actions that were developed from the RePARe spiral provide an expanded reflexive, enabling participants to build and reconstruct meanings when they think about the concepts and their teaching practices. Therefore, the stages and development of the spiral can be understood as a possibility for continuing teacher education and as a practice of groups with collaborative characteristics.

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