



Article

Study groups and the teacher education of teachers who teach mathematics in the early years

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Abstract

The participation of teachers in study groups is a possibility for education and reflection on teaching practice that can contribute to the professional development of teachers who teach mathematics in the early years. The objective of this article was to identify the contributions of participation in study groups for the education of this professional. For this, a search of works on the subject published in three important events in the area of Mathematical Education was carried out: National Meeting of ANPED, National Meeting of Mathematical Education (*ENEM*) and International Seminar on Research in Mathematics Education (*SIPEM*), in the period comprised between 2010 and 2019. There were 19 works on the subject, which were categorized into: mathematical content, initial education, task analysis, university-school partnership, change in teaching practice in the school context and education of educators. The analyzes showed that these groups addressed mathematical concepts and content that are often left in the background, such as geometry and magnitudes and measurements. In addition, the participation of teachers allowed them to jointly plan and analyze activities to be developed in the classroom. It also enabled the sharing of experiences, mutual help, collaboration, the formation of a space in which they were heard and could discuss challenges in practice, which helped in the professional development of teachers.

Keywords: Teacher education, Study Group, Mathematics, Elementary School Teachers.

1. Introduction

A lot of research in the field of Mathematics Education has addressed not only the training of teachers who teach mathematics in the first years of schooling, but also ways of contributing to this training

We consider study groups to be formative groups in which undergraduate students, postgraduate students, teachers from basic education and higher education participate simultaneously, who have different experiences with the

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teaching and learning of mathematics and who can share and exchange ideas, express their opinions, listen to and support others, etc.

The aim of this study is therefore to identify the contributions of participation in study groups to the training of teachers who teach mathematics in the early years. To this end, we conducted a survey of papers on the subject published in three important events in the field: the National Meeting of the National Association of Graduate Studies and Research in Education (ANPED), the National Meeting of Mathematics Education (ENEM) and the International Seminar on Research in Mathematics Education (SIPEM), between 2010 and 2019.

This article is structured as follows: initially, we will present the theoretical framework that underpins our discussions; then, the paths taken to develop this research; then, we will present and analyze the data; and, finally, we will make some considerations.

2. Study groups in the training of teachers who teach mathematics

Study groups can be an opportunity for early years teachers, during their teacher training, to discuss and reflect on their classroom practice and on the teaching and learning of mathematics.

Mesquita, Formosinho and Machado (2012) mention the tendency for teaching work to often take place in isolation and emphasize the importance of "(re)creating" a culture of collaboration to the detriment of a culture of isolation, as a way of contributing to the professional development of teachers and school institutions. Collaborative work strengthens, nourishes and enriches teaching practice, but according to the authors (2009), adhering to a collaborative practice must come from the teacher themselves, and this takes time. It's a long road to travel in order to overcome individualism.

Collaborative practices, according to Mesquita, Formosinho and Machado (2012, p. 11),

They imply moments of sharing experiences and mutual help between people, allowing us to reflect on each other's experience and everyone's experience, on conventional models, on what others think and do, on opinions and interpretations of concepts.

Fiorentini (2006) makes great contributions regarding the meanings given to the terms: cooperative work, collaborative work, and collaborative research. Often these terms are confused or interpreted in different ways, which can make it difficult to organize, develop, and study a collaborative group.

According to Fiorentini (2006), not all collective work can be characterized as collaborative. He presents some general forms of teacher culture - examples of collective work that are not consistent with true collaboration: artificial collegiality, which is neither spontaneous nor voluntary; and balkanization, in which teachers are divided into subgroups. Cooperation is also different from collaboration. "In cooperation, some help others (co-operate), carrying out tasks whose goals are generally not the result of joint negotiation by the group, and there may be subordination of some to others and/or unequal and hierarchical relationships. In collaboration, on the other hand, participants work:

jointly ("collaborate") and mutually support each other, with the aim of achieving common objectives negotiated by the group's collective. In collaboration, relationships therefore tend to be non-hierarchical, with shared leadership and co-responsibility for carrying out actions (FIORENTINI, 2006, p. 52).

With regard to communities of practice, Fiorentini (2006) states that they are not necessarily collaborative groups, since there can be a distinction between those who learn and those who "teach". This practice, in which each member plays a leading role in the production of knowledge, is not characteristic of a collaborative group.

It is important to keep these distinctions in mind because they help us understand the nature of a group. According to Fiorentini (2006, p. 55), groups that begin as cooperative can become collaborative as they "jointly acquire and produce knowledge, participants gain autonomy and begin to self-regulate and assert their own interests. Being in a collaborative group is a voluntary action in which everyone has responsibility for the group, everyone makes decisions as a group, tries to solve problems together, and the course of activities does not result from orders from others. Relationships in the group tend to be spontaneous, as Fiorentini says. But they can also be supported and mediated by someone in the group.

Teachers' desire to participate in a group is understood from the perspective of needs arising from their profession. Many teachers are looking for support, solutions to their professional problems, ways to deal with a new challenge, and even enrichment of their training. Thus, they tend to choose groups according to their affinity with the subject and their needs, creating a real network of support and mutual help to contribute to their professional development. With regard to collaborative research in education, Ibiapina (2008, p. 31) states that it can be understood as "an activity of co-production of knowledge, training, reflection and professional development, carried out interactively by researchers and teachers with the aim of transforming a given educational reality". Thus, bringing researchers and teachers together in collaborative research has many advantages in terms of producing knowledge about teaching practice. However, "collaborative research does not require teachers to be co-researchers in the strict sense of the term, i.e. to participate in all formal research tasks with the same competence as the researcher", but rather aims for collaborative work to be "the opportunity for teachers to participate as co-producers of research, without necessarily becoming researchers" (IBIAPINA, 2008, p. 32).

Fiorentini (2006) talks about the characteristics that distinguish collaborative research from cooperative research: the former must be fully developed by the members of the group, including written texts that cannot be written individually, as they must be authored by the group, which guarantees the collaborative nature. As a result, the type of research that considers collaborative or cooperative practices and groups as an object of study is, in most cases, not configured as collaborative, as the author exemplifies with academic work (dissertations and theses). We found that there is a divergence between Ibiapina (2008) and Fiorentini (2006) in terms of the participation of group members so that the research is collaborative. For Ibiapina (2008), it is not necessary that the participants carry out all the formal tasks of the group research together, unlike

Fiorentini's (2006) suggestion that even the writing should be done together. We emphasize that we agree with the latter author that collective participation is an important feature of collaborative groups. However, in this article we analyze study groups in general without focusing on this type of group work.

The transformative and emancipatory nature of collaborative research, according to Ibiapina (2008), concerns the production of knowledge that denounces relations of power, authoritarianism, and domination in order to offer solutions to address these issues. In this type of research, it is possible to perceive a proximity between theory and practice, a complementary relationship that can promote change, because sometimes teachers often complain about the emptying out of theory, and sometimes academics miss the practical experience. This distance between the two is reduced by developing a collaborative activity.

This joint work, aimed at training and professional development, provides a kind of mutual help in which the researcher contributes to the teachers and vice versa. The researcher helps the teachers by encouraging reflection and experiences that enable them to learn from the situations they experience in their practice. Teachers, in turn, contribute to the researcher "when they reflect on their practices and understand the conflicting situations inherent in teaching" (IBIAPINA, 2008, p. 34). This is a real interaction between the members involved. According to Mesquita, Formosinho and Machado (2012), a real change in the practices inherent in the school environment is necessary to provide a favorable environment for the development of collaborative teaching activities, because individual practices make it difficult to change situations and build new professional skills in the school environment. To this end, a change in school spaces is essential, with the aim of promoting the development of collaborative groups, exchanges, dialogues and studies, because "teachers cannot be held exclusively responsible for the lack of a collaborative culture in schools" (MESQUITA; FORMOSINHO; MACHADO, 2012, p. 5).

Study groups in teacher training are a way to bring together those interested in discussing issues related to a particular topic, and to contribute to the training of all participants. Several studies focus on this topic.

One of them, Gama's research (2007, p. 188), aimed to understand the process of teacher induction and professional development based on participation in collaborative groups. She found that teachers:

In this context, they constructed trustworthy critical friends who supported them during difficult times and helped them to develop their strangeness and learnings about the process of teaching and learning mathematics at school and about their own process of learning and discovering the profession, configuring a space that was not allocated to the school, but which also enabled professional development.

In contrast, Azevedo's (2013a) research sought to investigate the mathematical and methodological knowledge produced, recognized and re-signified by early childhood education teachers when they meet in a study group on early childhood mathematics education. The results of this study showed that mathematical knowledge and methodological strategies are produced and re-signified in a training process in a collaborative study group. In addition, participation in this group, in which there was no predetermined hierarchy among

members, mutual help, trust, negotiation, respect, joint decision making, and the search for knowledge based on the teachers' needs, led to the strengthening of the group and enabled it to become collaborative.

Grando and Toricelli (2012) also studied study groups and aimed to investigate how the collaborative practices adopted as training strategies in a study group with pedagogy students contributed to giving these students a new meaning in mathematics and its teaching, as the training strategies promoted moments of reflection and learning about mathematics and its teaching. In addition, the creation of collaborative groups, the readings carried out and also the questioning attitude of the trainer generated indications for the training of teachers who teach mathematics in the early years.

These reports show that changing teaching practices is not an easy process. It is a challenge that requires personal and professional effort. This can be achieved, among other things, through a closer relationship between university and school, researchers and teachers, through the development of mutual support work in study groups, with a view to helping teachers with the problems that affect education and their classroom practice.

3. Research paths...

In order to achieve the objective of the research - to identify the contributions of participation in study groups to the training of teachers who teach mathematics in the early years - we carried out a documentary analysis that searched for papers related to the subject in the three main Brazilian events in the field of mathematics education.

The first step in the development of this research was to search for papers on the subject in the websites of the National Meeting of ANPED, the National Meeting of Mathematics Education and the International Seminar on Mathematics Education of the Brazilian Society of Mathematics Education between 2010 and 2019.

On the websites of the events, we read the titles of all the papers published in the above-mentioned period, looking for texts that mentioned the study groups, excluding those that did not deal with the subject or with the first years of elementary school.

The search was carried out on the ANPEd website, considering Working Group 19 - Mathematics Education, from the 33rd to the 39th edition of the National Scientific Meeting, thus respecting the predetermined chronology. As a way of selecting the papers, we tried to select those whose subject dealt with study groups formed by teachers who teach mathematics in the early years, then we looked at the titles and abstracts of the papers. The first analysis yielded a total of seven papers: one from the 33rd meeting, two from the 35th meeting, one from the 36th meeting, one from the 37th meeting, and finally two papers from the 38th meeting. One paper from the 35th meeting was excluded because it did not focus on the early years.

Regarding the website of the Brazilian Society of Mathematics Education (SBEM), the search considered the papers in the SIPEM Annals, from the V SIPEM onwards, using as search parameter the Working Group 7, which aims at the training of teachers who teach mathematics. Of the WG7 papers, two initially fit the search topic. However, one of them had a focus on mathematics teachers

and not on study groups, so it was also removed. As a result, seven papers were found on the ANPED and SIPEM websites that related to the topic.

After this initial analysis, due to the small number of papers found, it was necessary to broaden the search. To do this, we also searched the ENEM annals, looking for papers related to teacher training in the scientific communications of the XI, XII and XIII ENEM. However, since the papers of the XII ENEM were not divided by axis, the research took more time, since it was necessary to analyze all the papers of the meeting.

As a result of this new survey, there was an increase in the number of papers selected. Thus, 18 new papers were found according to the theme: 9 belonging to the XI ENEM, 4 to the XII and 5 to the XIII. In a new analysis, 6 papers were also removed from the ENEMs because they did not deal with the topic under study.

We then obtained the following number of papers from each of the events in which the search was carried out, as shown in Table 1.

Chart 1 - Number of papers per event

| Event | Works |
|---------------|-------|
| ANPED meeting | 6 |
| SIPEM | 1 |
| ENEM | 12 |
| Total | 19 |

Source: prepared by the authors.

After this survey, all the texts were read and filed and Table 2 was drawn up with the works analyzed in this article.

Chart 2 - Event, authors and papers

| Event | Authors | Title |
|--------------------|---|---|
| 33rd ANPED Meeting | Mônica Cerbella Freire Mandarino | <i>The analysis of student solutions in the training of teachers who teach mathematics</i> |
| 35th ANPED Meeting | Maria Auxiliadora Bueno Andrade Megid | <i>Mathematical learning in the pedagogy course and its impact on the practices of early years teachers</i> |
| 36th ANPED Meeting | Priscila Domingues de Azevedo | <i>Mathematical knowledge in early childhood education: the process of continuing education for a group of teachers</i> |
| 37th ANPED Meeting | Cristina Cirino de Jesus e Márcia Cristina de Costa Trindade Cyrino | <i>Training teachers who teach mathematics: rethinking pedagogical practice by analyzing mathematical tasks</i> |
| 38th ANPED Meeting | Carlos André Bogéa Pereira e Adair Mendes Nacarato | <i>The training of teacher educators who teach mathematics: the case of São Luis/MA</i> |

| | | |
|--------------------|---|---|
| 38th ANPED Meeting | Maria Auxiliadora Bueno Andrade Megid e Alessandra Rodrigues de Almeida | <i>Teacher learning in collaborative groups teaching mathematics in early childhood: a look at magnitudes and measures</i> |
| V SIPEM | Cirléia Pereira Barbosa e Ana Cristina Ferreira | <i>Geometric thinking in motion: the case of Marta</i> |
| XI ENEM | Kelly Cristina Betereli | <i>The university-school partnership contributing to the professional development of a primary school teacher in ways of teaching mathematics</i> |
| XI ENEM | Maria Cândida Müller e Dione Lucchesi de Carvalho | <i>Teachers learning mathematics in investigative communities: GDS AND GETEMAT</i> |
| XI ENEM | Cristina Cirino de Jesus e Márcia Cristina Nagy | <i>Contributions of the critical analysis of tasks to the continuing education of teachers who teach mathematics</i> |
| XI ENEM | Edite Resende Vieira e Nielce Meneguelo Lobo da Costa | <i>Teaching geometry and appropriating technology: the trajectory of a study group</i> |
| XI ENEM | Julia de Cassia Pereira do Nascimento | <i>Collaborative groups in teacher training to teach mathematics in the early years of elementary school: an experience with students on the pedagogy course as part of the education observatory program</i> |
| XI ENEM | Marjorie Samira Ferreira Bolognani | <i>How much does talking about oneself enable teachers who teach mathematics in the early years of elementary school to train themselves?</i> |
| XI ENEM | Vanessa Moreira Crecci e Dario Fiorentini | <i>Professional development practices in communities of teachers who teach mathematics</i> |
| XII ENEM | Karina Daniela Mazzaro de Brito e Elaine Sampaio Araujo | <i>The constitution of the collective and the process of teacher signification</i> |
| XII ENEM | Ana Maria Porto Nascimento | <i>Some reflections on the training of mathematics literacy teachers: the school as a space for research and training</i> |
| XII ENEM | Maria Auxiliadora Vilela Paiva e Karla de Almeida Brandão | <i>Building knowledge: a study group with teachers trained in pedagogy and with a degree in mathematics</i> |
| XIII ENEM | Rosimeire Aparecida Rodrigues | <i>The pedagogue's mathematical training with the literacy and numeracy study group - GELEN</i> |
| XIII ENEM | Ana Paula Krein Müller e Marli Teresinha Quartieri | <i>Continuing education for early years teachers in a collaborative context</i> |

Source: prepared by the authors.

From the perspective of Laville and Dionne (1999, p. 167), documents are all the sources of information that already exist and that help the researcher, because "they provide information directly: the data is there, all that remains is to sort it, criticize it, that is, judge its quality according to the needs of the research, code it or categorize it".

For Lüdke and André (2014, p. 45), based on Caulley (1983), document analysis aims to identify factual information in documents based on questions and hypotheses of interest.

According to Calado and Ferreira (2004, p. 2), documents in a research study can be of central importance - that is, "documents are targets of study in their own right" - or complement the information obtained by other instruments, such as questionnaires or interviews. In this study, documents played a central role.

According to the authors (2004), documentary research basically involves two stages - document collection and analysis - the first of which can be described as the nature of the data, the location and selection of the documents. The location of the documents is determined by the research itself, which directs the researcher towards certain sources. The documents used in this study are referred to as primary sources, as this category includes laws, manuscripts, minutes of meetings, memos, films, among others. The selection of documents is determined by a number of factors, such as the time needed to carry out the research.

The second stage was the actual analysis of the data obtained from the documents which, according to Flores (1994 apud Calado and Ferreira, 2004, p. 3), "implies a set of transformations, operations and verifications carried out on them [documents] with the aim of attributing a relevant meaning to them in relation to a research problem".

Thus, the works related to the participation of teachers from the early years who teach mathematics were selected and analyzed in order to achieve the proposed objective.

4. Work on study groups and early years teachers

Once the papers had been selected, it was possible to see some similarities between them and they will be analyzed based on these categories that they have in common: mathematical content, initial training, task analysis, university-school partnership, changing teaching practice in the school context and training of trainers. Thus, all the categories that emerged from the papers are presented here. The category "mathematical content" refers to the papers that refer to collaborative groups whose purpose is to help early childhood teachers with specific mathematical content. There are five papers in this category.

The paper by Megid and Almeida (2017) discusses how early years teachers' participation in a collaborative study group helps them to learn and change their teaching practice about magnitudes and measures. The study group allowed for discussion and the development of proposals based on a kindergarten teacher's narrative of her teaching practice on magnitudes and measures. Barbosa and Ferreira (2012) sought to analyze the knowledge acquired by teachers in a study group on geometric thinking in the early years of primary school. Their work deals with the account of a teacher, fictitiously named Marta, about the gaps in her training in the teaching of geometry. The knowledge gained from participating in the group enabled the teacher to rethink her practice and, in particular, the vocabulary for teaching geometry.

Vieira and Costa's (2013) work analyzes the learning that took place in the study group on technology and the teaching of geometry. The authors denounce that teacher training, in most cases, does not address the use of digital technologies that can help in the teaching of geometry, for example, in terms of visualization, experimentation, and manipulation of geometric figures. The role of the group in this situation was to understand and discuss the challenges and ways in which teachers teach geometry, thus helping them to appropriate geometric concepts and to use software to help them understand these concepts and, above all, to teach geometry. Paiva and Brandão (2016) aimed to reflect on the knowledge built by the teachers from the discussions in the study group on

the topic of magnitudes and measures, and also from solving situations proposed by the group. The resolution drew the attention of the teachers to the importance of the statements, as they are fundamental in solving problems. The idea of the group was to bring together teachers from the early and final years of primary school to share their experiences.

The analysis of teaching practices based on the collaborative group was also the focus of the research by Müller and Quartiere (2019). The group meetings, which took place in the school context, proved to be conducive to collaborative activity, where teachers shared their experiences and lesson plans and helped each other. This dynamic allowed the teachers to better understand mathematical concepts through games, mainly related to multiplication and division.

This work highlights the approach to mathematical content that often takes a back seat in classroom practice, which emphasizes working with numbers and operations (NACARATO; MENGALI; PASSOS, 2009). Thus, it is interesting to note that out of the five papers, two dealt with the teaching of geometry, another two with quantities and measures, and only one with numbers, studying multiplication and division. This aspect highlights the importance of study groups in discussing other topics that should appear in teachers' practice.

In addition, this training space can promote a diverse dynamic, as opposed to "ready-made" training in which teachers have no voice. In two cases, one teacher's narrative and another's account were the catalysts for the discussions and reflections that took place in the group. The group meetings took place at the school.

In these works, the teachers' uncertainty about teaching the reported content was also evident. However, their involvement and participation in the study groups enabled them to broaden their knowledge and develop a more consolidated basis for proposing activities in the classroom.

In addition, we observed in the work that the use of different resources, such as games and technologies, is an ally for teachers in the classroom, as it allows them to approach mathematical concepts in a different way from what they are used to, and also arouses students' interest and involvement.

The "initial training" category concerns the role of study groups in complementing the training of teachers who teach mathematics. Three papers discuss this issue.

Megid (2012) investigates the initial practice of two newly qualified teachers, seeking to understand the differences and similarities between the knowledge acquired during their undergraduate studies in pedagogy and the knowledge needed to teach. Both of the teachers surveyed recognized the important role and contribution of the degree to their classroom practice. However, in her narrative, one of them exposes a certain abandonment of what she learned at university, developing a more traditional practice due to the demands of external agents and pressure in the work environment. Participation in the study and research group allowed the teachers to plan activities together, reinvigorating their teaching work.

Nascimento (2013), on the other hand, aimed to discuss the mathematics experienced during the undergraduate course in the education of five pedagogy students and to assess the contribution that the study groups made by promoting other knowledge for this education. The mathematics taught on the course left

something to be desired, as it was very theoretical and distanced itself from reality and situations experienced in the classroom.

When the undergraduates joined the group, they felt insecure at first, because they didn't know and weren't used to certain mathematical terms. However, they reported that, as a result of the meetings, they felt more involved and confident in teaching mathematics and also problematized the myths they had about the subject. The group gave rise to discussions that sought to break with conceptions about the use of calculators in the classroom, the mathematical learning of non-literate children and mathematics seen as a seven-headed beast. According to the undergraduates, the group's contribution was greater than their initial training and internships.

Rodrigues (2019) proposes a similar objective to Nascimento's, by investigating how the group helps the trainee pedagogue in math teaching, contributes to the expansion of concepts and provides an improvement in teaching practice, given that there are gaps in this initial training, present since basic education. The research also shows that, even though undergraduates are aware of the importance and role of study and research groups for math teaching, there is little demand for them.

The first paper (MEGID, 2012) in this category presents several interesting aspects and discusses the importance of the group for teachers at the start of their careers, when they face many difficulties, including not knowing how to teach the content, not knowing how to deal with indiscipline, parents and the school board, among others. But they also experience a lot of learning and the joy of having their own classes. These moments, which are antagonistic, are called by Huberman (1995) survival and discovery.

The other two works in this group (NASCIMENTO, 2013; RODRIGUES, 2019) highlight the gaps left by initial training in relation to mathematics, as the subjects are often theoretical and have a reduced workload, which makes it impossible for future teachers to have contact with methodological aspects of teaching mathematics and to experience the foundations of mathematics and the practice of research in mathematics education (NACARATO; MENGALI; PASSOS, 2009).

It is also clear that future teachers are insecure when they enter the school context, even though they consider their initial training to be a source of knowledge that contributes to the students' future practice. Many arrive at schools full of ideas and novelties, but are suffocated by the pressures and higher demands that dictate the work of teachers, as expressed in their studies. That's why it's important to highlight the role of these groups that revitalize ways of teaching and help teachers to (re)mean their actions.

It is important to emphasize that, from the point of view of some researchers and also research participants, initial training in mathematics is not enough: it is necessary to look for something more, especially a complementary experience that addresses teaching action in practice. Collaborative groups are therefore an opportunity to continue studying and tackling educational problems.

The three papers in the "task analysis" category present the analysis of school tasks as a means of rethinking teaching practice and developing investigative action.

Jesus and Nagy (2013) investigated how a study group dealt with the critical analysis of tasks in early childhood mathematics. For this purpose, the

participants of the group prepared tasks that were used in the classroom by the teachers in the group and characterized them according to the level of cognitive demand. The teachers themselves reflected that some of the tasks were of little benefit to the students and began to opt for high-level tasks that contributed to the understanding of mathematical concepts. The similarity between the work of Jesus and Cyrino (2015) and the previous work is striking. Based on the discussions and problematizations of the tasks presented by the teachers in the study group, they were able to see that the analysis culminated in a change in the teachers' attitude in the classroom: they began to give their students the opportunity to demonstrate their mathematical reasoning when solving problems. In this paper, the researchers present, through tables, the teachers' conceptions when choosing the tasks and the changes that occurred as a result of the group discussions.

Mandarino (2010), on the other hand, seeks to identify the skills necessary for teachers to pursue an investigative practice by analyzing students' work. To do this, she develops her research based on a research group of teachers and trainers who are studying a professional development course, Pro-Literacy in mathematics.

The choice of mathematical tasks directly affects the students' learning and also determines the thinking and reasoning that the student develops to solve them. Therefore, it is necessary for teachers to make choices that allow students to think, to express their hypotheses, without the desire for a "right and wrong" result, because the analysis of such issues can be a possibility for them to reflect on "conceptions of didactics, visions of evaluation, the bases that support the teacher's mathematical knowledge and the process of transforming their knowledge of the content into knowledge aimed at teaching" (MANDARINO, 2010, p. 3).

In this context, studies show the great contribution of study groups, which give teachers the opportunity to analyze, together with other teachers and researchers, the mathematical tasks used in the classroom, with the aim of reflecting on their choices in order to achieve the desired goals with the chosen task. In this way, students become more involved in solving problems and develop "forms of reasoning and strategies that allow them to go beyond the mere memorization of facts or procedures" (JESUS; NAGY, 2013, p. 4). In addition, teachers may change their instructional practices because they realize that certain tasks may not be contributing to their students' learning. In the category of "university-school partnership," there are two articles that address the potential of university researchers working with practicing teachers.

Betereli (2013) examines the importance of the university-school partnership based on a study group that supports the professional development of an early childhood teacher who had a negative relationship with mathematics during her schooling. Through the discussions, the teacher realizes how the difficulties of the past have reverberated in her classroom and recalls the mistakes she has made in her practice.

Nascimento (2016) also reports on a possible partnership between university and school, after examining the production of knowledge about mathematical literacy in the context of an action research project by a group of teachers from one school.

The difficulties encountered in teaching mathematics are often related to the lack of initial training that breaks with the negative experiences teachers have had in this subject during their school career. This can lead them to reproduce the practices of teachers who were considered good, which can be based solely on the blackboard, chalk and textbook. Thus, the university-school partnership seems promising for the professional development of teachers who teach mathematics in the early years. Through this partnership, teachers are equipped with theoretical knowledge that forms the basis for rethinking teaching practices. What's more, the theory-practice relationship fills in the gaps found during initial training and in their own work in the classroom.

The category of "changing teaching practice in the school context" includes studies that attempt to analyze the role of collaborative groups in changing practice in schools. Azevedo (2013b) sought to examine the mathematical learning that resulted from a study group, (Other Views of Mathematics), composed of 39 kindergarten teachers, which gave new meaning to teaching practice. Working together in the group enabled the teachers to build bridges between mathematics and play, and to approach mathematical content in early childhood education in a playful way.

Müller and Carvalho (2013) analyze the types of knowledge produced in the collaborative groups Grupo de Sábado (GdS) and Mathematics Teaching Study and Pedagogical Work Group (GETEMAT) from the perspective of Cochran-Smith and Lytle, who address three conceptions of teacher learning knowledge: knowledge for practice, knowledge in practice, and knowledge of practice.

According to the authors' analysis, the GoS presents a perspective consistent with the characteristics of producing knowledge of practice, as teachers learn collaboratively in communities of inquiry. The initial goal of GETEMAT was to produce knowledge for practice, as teachers looked to the group for theoretical underpinnings to support their practice. However, by the end of a period analyzed by the authors, teachers began to see the group as strengthening their practice rather than providing a "manual" for teaching. As a result, the authors noted the development of research as an attitude in both groups that changed their practice in teaching mathematics. Bolognani (2013), in her research, observed moments in a discussion group that valued, in the narratives of early years teachers, school memories of mathematics classes and their practices in teaching this subject. From the author's point of view, professional development in the form of courses silences teachers' voices. In this sense, the space given to the teachers' voices in the observed group allowed access to the teachers' trajectories and remarkable experiences in the process of learning and also teaching mathematics. These reflections on the challenges they faced and the negative experiences they witnessed during the training led the teachers in the group to rethink and transform their practices in the school context.

Crecci and Fiorentini (2013) studied the process of professional development and professional identity formation of teachers who participated in inquiry communities. From the teachers' testimonies, it could be observed that participation in investigative communities contributes to professional development as well as to the transformation of classroom practices by choosing mathematical investigation activities.

Brito and Araújo (2016), in turn, sought to understand the extent to which the collective group Study and Research Group on the Teaching and Learning of Mathematics in Childhood (Gepeami) can trigger the development of participating teachers and teaching-learning situations. With this research, the authors concluded that the actions of the group promoted experiences that questioned the alienation of the teaching work and provided reflections that gave new meaning to the act of teaching.

The first three papers present some of the characteristics of collaborative groups found in the literature (FIORENTINI, 2006). Two of them indicate that collaboration was important for the group participants and led them to learn mathematical content together. The other paper highlighted that the group was a space where the teacher had a voice and could be heard. The papers also highlighted the formation of the teacher's professional identity and the development of the participants' teaching.

In the research that falls into this category, the study groups helped teachers transform their practices around early childhood mathematics content. The study groups created an environment conducive to the acquisition of knowledge and the sharing of experiences, in which teachers exposed and reflected on their classroom practices and helped to overcome learning conflicts. Finally, there is a study that discusses the "training of trainers". In their study, Pereira and Nacarato (2017) sought to understand the professional constitution of teacher educators based on their narratives in a discussion and reflection group. The study found that teacher educators' identities are influenced by the experiences of their entire personal and professional trajectories.

The spaces that allow teacher educators to talk about themselves, their professional and personal experiences, and their professional learning allow them to build their professional identity. However, the teachers' narratives emphasize that the training of trainers does not take place in a course, for example, but in the process, in the act of training, in the exchange of knowledge, in study and research, in building, with other teachers, ways of rethinking classroom practices.

5. Final considerations

When we analyzed the papers on the participation of primary school teachers who teach mathematics in study groups, we found research that addressed different mathematical contents related to quantities and measures, geometry and addition and subtraction operations. With regard to geometry, the texts discussed the development of geometric thinking and the visualization, experimentation and manipulation of geometric figures.

The groups allowed teachers to rethink their practice by jointly drawing up and analyzing proposals for use in the classroom. They also promoted exchange, the sharing of experiences, mutual help between teachers, the possibility of discussing the challenges of practice and collaboration.

In some of the papers, participants pointed out that initial training is often theoretical in nature and far removed from the reality experienced in the classroom. For this reason, participation in the groups made future teachers feel

more confident when teaching mathematical content and reflecting on their conceptions of mathematics.

The groups also helped in the professional development of those participants who had negative relationships with mathematics in their school career and who, as a result of the discussions, realized that these experiences influenced their teaching practices.

The work also indicated that the study groups contributed to the professional development of teachers who teach mathematics in the early years and to building their knowledge of mathematical concepts and content, which made them more confident in approaching them in the classroom.

References

AZEVEDO, Priscila Domingues. **O conhecimento matemático na educação infantil: o movimento de um grupo de professoras em processo de formação continuada.** 2012. 241f. Tese (Doutorado em Educação) – Centro de Educação e Ciências Humanas, Universidade Federal de São Carlos, São Carlos, 2013a.

AZEVEDO, Priscila Domingues. O conhecimento matemático na educação infantil: o processo de formação continuada de um grupo de professoras. *In: ENCONTRO NACIONAL DA ANPEd*, 36., 2013, Goiânia. **Anais [...]**. Goiânia, 2013b. p.1-18.

BARBOSA, Cirléia Pereira; FERREIRA, Ana Cristina. O pensamento geométrico em movimento: o caso de Marta. *In: SEMINÁRIO INTERNACIONAL DE PESQUISA EM EDUCAÇÃO MATEMÁTICA*, 5., 2012, Petrópolis. **Anais [...]**. Petrópolis, 2012. p.1-23.

BETERELI, Kelly Cristina. A parceria universidade-escola contribuindo com o desenvolvimento profissional de uma professora das séries iniciais: nos modos de ensinar matemática. *In: ENCONTRO NACIONAL DE EDUCAÇÃO MATEMÁTICA*, 11., 2013, Curitiba. **Anais [...]**. Curitiba, 2013. p.1-16.

BOLOGNANI, Marjorie Samira Ferreira. O quanto falar de si possibilita às professoras que ensinam matemática, nos anos iniciais do ensino fundamental, se formarem? *In: ENCONTRO NACIONAL DE EDUCAÇÃO MATEMÁTICA*, 11., 2013, Curitiba. **Anais [...]**. Curitiba, 2013. p.1-16.

BRITO, Karian Daniela Mazzaro, ARAÚJO, Elaine Sampaio. A constituição do coletivo e o processo de significação docente. *In: ENCONTRO NACIONAL DE EDUCAÇÃO MATEMÁTICA*, 12., 2016, São Paulo. **Anais [...]**. São Paulo, 2016. p.1-12.

CALADO, Silvia Santos; FERREIRA, Silvia Cristina Reis. **Análise de documentos: método de recolha e análise de dados.** 2004. 13p. Disponível em: <https://docplayer.com.br/12123665-Analise-de-documentos-metodo-de-recolha-e-analise-de-dados.html>. Acesso em: 23 set. 2022.

CAULLEY, Darrel. Document analysis in program evaluation. **Evaluation and Program Planning**, v. 6, p. 19-29, 1983.

CRECCI, Vanessa Moreira; FIORENTINI, Dario. Práticas de desenvolvimento profissional em comunidades de professores que ensinam matemática. *In: ENCONTRO NACIONAL DE EDUCAÇÃO MATEMÁTICA*, 11., 2013, Curitiba. **Anais [...]**. Curitiba, 2013. p.1-15.

FIORENTINI, Dario. Pesquisar práticas colaborativas ou pesquisar colaborativamente. *In: BORBA, Marcelo Carvalho; ARAÚJO, Jussara Loiola. (org.). **Pesquisa Qualitativa em Educação Matemática***. Belo Horizonte: Autêntica, 2006.

FLORES, Javier. **Análisis de datos cualitativos**: aplicaciones a la investigación educativa. Barcelona: PPU, 1994.

GAMA, Renata Prenstteter. **Desenvolvimento profissional com apoio de grupos colaborativos**: o caso de professores de matemática em início de carreira. 2007. 209f. Tese (Doutorado em Educação: Educação Matemática) – Faculdade de Educação, Universidade Estadual de Campinas, Campinas, 2007.

GRANDO, Regina Celia; TORICELLI, Luana. A colaboração em um grupo de alunas da Pedagogia que ensinarão matemática. **Revista Eletrônica de Educação**, São Carlos, v. 6, n. 1, p. 67-90, maio 2012. Disponível em: <https://www.reveduc.ufscar.br/index.php/reveduc/article/view/395/173>. Acesso em: 10 out. 2022.

HUBERMAN, Michael. O ciclo de vida profissional dos professores. *In: NOVOA, Antonio (org.). **Vidas de professores***. Porto: Porto Editora, 1995. p.31-61.

IBIAPINA, Ivana Maria Lopes Melo. **Pesquisa colaborativa**: investigação, formação e produção de conhecimentos. Brasília: Liber Livro, 2008.

JESUS, Cristina Cirino; CYRINO, Márcia Cristina Costa Trindade. Formação de professores que ensinam matemática: um repensar da prática pedagógica por meio da análise de tarefas matemáticas. *In: ENCONTRO NACIONAL DA ANPEd*, 37., 2015, Florianópolis. **Anais [...]**. Florianópolis, 2015. p.1-14.

JESUS, Cristina Cirino; NAGY, Márcia Cristina. Contribuições da análise crítica de tarefas para a formação continuada de professores que ensinam matemática. *In: ENCONTRO NACIONAL DE EDUCAÇÃO MATEMÁTICA*, 11., 2013, Curitiba. **Anais [...]**. Curitiba, 2013. p.1-14.

LAVILLE, Christian; DIONNE, Jean. **A construção do saber**: manual de metodologia da pesquisa em ciências humanas. Porto Alegre: Artmed, 1999.

LÜDKE, Mega; ANDRÉ, Marli Eliza Dalmazo Afonso. **A pesquisa em educação**: abordagens qualitativas. Rio de Janeiro: E.P.U, 2014.

MANDARINO, Mônica Cerbella Freire. A análise de soluções dos alunos na formação de professores que ensinam matemática. *In: ENCONTRO NACIONAL DA ANPEd*, 33., 2010, Caxambú. **Anais [...]**. Caxambú, 2010. p.1-13.

MEGID, Maria Auxiliadora Bueno Andrade. Aprendizagens em matemática construídas no curso de pedagogia e seus impactos nas práticas de professoras dos anos iniciais. *In: ENCONTRO NACIONAL DA ANPEd*, 35., 2012, Porto de Galinhas. **Anais [...]**. Porto de Galinhas, 2012. p.1-14.

MEGID, Maria Auxiliadora Bueno Andrade; ALMEIDA, Alessandra Rodrigues. Aprendizagem do professor em grupos colaborativos que ensina matemática na infância: um olhar para grandezas e medidas. *In: ENCONTRO NACIONAL DA ANPEd*, 38., 2017, São Luís. **Anais [...]**. São Luís, 2017. p.1-16.

MESQUITA, Elza; FORMOSINHO, João; MACHADO, Joaquim. Individualismo e colaboração dos professores em situação de formação. *In: SIMPÓSIO DE ORGANIZAÇÃO E GESTÃO ESCOLAR, VII.*, Aveiro, Portugal, 2009. **Atas [...]**. Aveiro, Portugal, 2012.

MÜLLER, Ana Paula Krein; QUARTIERI, Marli Teresinha. Formação continuada de professores dos anos iniciais em contexto colaborativo. *In: ENCONTRO NACIONAL DE EDUCAÇÃO MATEMÁTICA, 13.*, 2019, Cuiabá-MT. **Anais [...]**. Cuiabá-MT, 2019. p.1-9.

MÜLLER, Maria Cândida; CARVALHO, Dione Lucchesi. Aprendizagem do professor que ensina e aprende matemática em comunidades investigativas: GdS e GETEMAT. *In: ENCONTRO NACIONAL DE EDUCAÇÃO MATEMÁTICA, 11.*, 2013, Curitiba. **Anais [...]**. Curitiba, 2013. p.1-14.

NACARATO, Adair Mendes; MENGALI, Brenda Lima Silva; PASSOS, Cármem Lúcia Brancaglioni. **A matemática nos anos iniciais do Ensino Fundamental: tecendo fios do ensinar e do aprender.** Belo Horizonte: Autêntica Ed., 2009.

NASCIMENTO, Ana Maria Porto. Algumas reflexões sobre a formação de professoras alfabetizadoras em matemática: a escola como espaço de pesquisa e formação. *In: ENCONTRO NACIONAL DE EDUCAÇÃO MATEMÁTICA, 12.*, 2016, São Paulo. **Anais [...]**. São Paulo, 2016. p.1-9.

NASCIMENTO, Julia de Cassia Pereira. Grupos colaborativos na formação do professor para ensinar matemática nos anos iniciais do ensino fundamental: uma vivência com alunos do curso de pedagogia no âmbito do programa Observatório da Educação. *In: ENCONTRO NACIONAL DE EDUCAÇÃO MATEMÁTICA, 11.*, 2013, Curitiba. **Anais [...]** Curitiba, 2013. p.1-15.

PAIVA, Maria Auxiliado Vilela; BRANDÃO, Karla Almeida. Construindo saberes: grupo de estudos com professores formados em pedagogia e licenciados em matemática. *In: ENCONTRO NACIONAL DE EDUCAÇÃO MATEMÁTICA, 12.*, 2016, São Paulo. **Anais [...]**. São Paulo, 2016. p.1-12.

PEREIRA, Carlos André Bogéa; NACARATO, Adair Mendes. A formação de formadores de professores que ensinam matemática: o caso de São Luís/MA. *In: ENCONTRO NACIONAL DA ANPEd, 38.*, 2017, São Luís. **Anais [...]**. São Luís, 2017. p.1-17.

RODRIGUES, Rosimeire Aparecida. Formação matemática do pedagogo com o grupo de estudos de letramento e numeramento - GELEN. *In: ENCONTRO NACIONAL DE EDUCAÇÃO MATEMÁTICA, 13.*, 2019, Cuiabá. **Anais [...]**. Cuiabá, 2019. p.1-10.

VIEIRA, Edite Resende; COSTA, Nielce Meneguelo Lobo. Ensino de geometria e apropriação de tecnologia: trajetória de um grupo de estudos. *In: ENCONTRO NACIONAL DE EDUCAÇÃO MATEMÁTICA, 11.*, 2013, Curitiba-PR. **Anais [...]**. Curitiba, 2013. p.1-15.

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