http://doi.org/10.14393/ER-v29a2022-19

Considerations on the interaction between teachers and researchers in the development of the PREMa-EB project[1]

Sonia Barbosa Camargo Igliori [2]
Celina Aparecida Almeida Pereira Abar [3]
Chrystian Bastos de Almeida [4]

ABSTRACT

This paper aims to present the contribution of Documentational Genesis, especially the idea of scheme, to the collaborative work of teachers belonging to the research project Considering Resources for Teaching Mathematics in Basic Education (PREMa-EB) and its impacts. The project is based on the research-action-training methodology, in accordance with a research pathway that favors articulation between researchers from universities and groups of basic education teachers. The theoretical framework of the research is Documentational Genesis by Gueudet and Trouche (2009), which is based on the notion of a document (combined resources + schemes of utilization). The impacts of the notion of scheme can be observed in the collaborative work, indicating transformation of resources in accordance with the elements presented by teachers, all derived from their conceptions and their classroom practices.

KEYWORDS: Documentational Genesis. Scheme. Collaborative work. Research-action-training.

[1] English version by Aline Bortolassi. E-mail: comercial@luminatraducoes.com.br.

[2] Professor of the Postgraduate Studies Program in Mathematics Education: Pontifical Catholic University of São Paulo (PUC-SP). Coordinator of the PREMa-EB project. Orcid: https://orcid.org/0000-0002-6354-3032. Email: sigliori@pucsp.br.

[3] Professor of the Postgraduate Studies Program in Mathematics Education: Pontifical Catholic University of São Paulo (PUC-SP). Orcid: https://orcid.org/0000-0002-6685-9956 . Email: abarcaap@gmail.com.

[4] Doctoral student in Mathematics Education: Pontifical Catholic University of São Paulo (PUC-SP). Orcid: https://orcid.org/0000-0002-5062-0836. *Email*: chrystian.bastos.irara@gmail.com.

http://doi.org/10.14393/ER-v29a2022-19

Considerações sobre a interação entre professores e pesquisadores no desenvolvimento do Projeto PREMa – EB

RESUMO

Este artigo visa a apresentar a contribuição da Gênese Documental, em especial da noção de esquema, no trabalho colaborativo de professores do projeto de pesquisa Pensar os Recursos para o Ensino de Matemática no Ensino Básico – PREMa – EB e seus impactos. O projeto foi desenvolvido tendo como alicerce a metodologia da pesquisa-ação-formação, enquadrando-se na proposta de um caminho de pesquisa que favorece a articulação entre pesquisadores de universidades e grupos de professores da educação básica. O referencial teórico da pesquisa é a Gênese Documental, elaborada por Gueudet e Trouche (2009), a qual tem como pilar a noção de documento (recursos combinados a seus esquemas de utilização). Pode-se perceber no desenvolvimento do trabalho colaborativo os impactos da noção de esquema indicando a transformação dos recursos em acordo com os elementos trazidos pelos professores, os quais são advindos de suas concepções e suas práticas de sala de aula.

PALAVRAS-CHAVE: Gênese Documental. Esquema. Trabalho colaborativo. Pesquisa-ação-formação.

Consideraciones sobre la interacción entre profesores e investigadores en el desarrollo del proyecto PREMa – EB

RESUMEN

Este artículo tiene como objetivo presentar la contribución de la Génesis Documental, especialmente la noción de esquema, en el trabajo colaborativo de los profesores del proyecto de investigación Pensar os Recursos para o Ensino de Matemática no Ensino Básico – PREMa – EB y sus impactos. El proyecto se desarrolló sobre la base de la –etodología de investigación-acción-formación, ajustando la propuesta de una ruta de investigación que favorece la articulación entre investigadores de universidades y grupos de profesores de educación básica. El marco teórico de la investigación es el Génesis Documental, elaborado por Gueudet y Trouche (2009), que tiene como

pilar la noción de documento (recursos combinados con sus esquemas de uso). Se puede percibir en el desarrollo del trabajo colaborativo los impactos de la noción de esquema que indica la transformación de los recursos de acuerdo con los elementos aportados por los profesores, que se derivan de sus concepciones y sus prácticas en el aula.
PALABRAS CLAVE: Génesis Documental. Esquema. Trabajo colaborativo. Investigación-acción-formación.

Introduction

In this paper, we seek to present the contribution of Documentational Genesis, in particular the impacts of the notion of scheme, on the collaborative work of teachers carried out under the Considering Resources for Teaching Mathematics in Basic Education collaborative research project (PREMa-EB). The actions described here involved teachers from a private school and a number of public schools in the city of São Paulo, Brazil; Mathematics Education researchers; graduate students; and a French pedagogical engineer invited[5] to guide the methodological organization of incubations, which took place once a week during action-research-training. One of the authors participated in the project as a doctoral student from the Postgraduate Studies Program in Mathematics Education at the Pontifical Catholic University of São Paulo (PUC-SP); the others participated as program researchers.

In this context, we are guided by the following question in carrying out this research: "How has Documentational Genesis, in particular the notion of scheme, contributed to the collaborative work of teachers of the PREMa-EB project and to its impacts?"

PREMa-EB, which was coordinated by one of the authors, is based on research-action-training, as discussed by Vandercleyen et al. (2019), and complies with a research pathway that favors articulation between

[5] Pierre Bénech - IFE at l'Ecole Normale de Lyon

university researchers and groups of basic education teachers; the entire investigation is carried out with the teacher and not for the teacher, thus promoting the collective formulation of knowledge and interference on the analyzed context. The considerations in this work about interactions between teachers and researchers of PREMa-EB are based on the theoretical framework of Documentational Genesis, as discussed by Gueudet and Trouche (2009), which has as its pillar the notion of a document (combined resources + schemes of utilization).

This paper has been organized in four parts: in the first part, we discuss the importance of the connection between research and practice based on the theoretical framework of this paper, i.e. Documentational Genesis. In the second part, we present the details of the PREMa-EB project, emphasizing activities carried out in one of the participating schools. In the third part, we discuss analysis of the project based on Documentational Genesis; and, finally, in the fourth part, we present final reflections on the research.

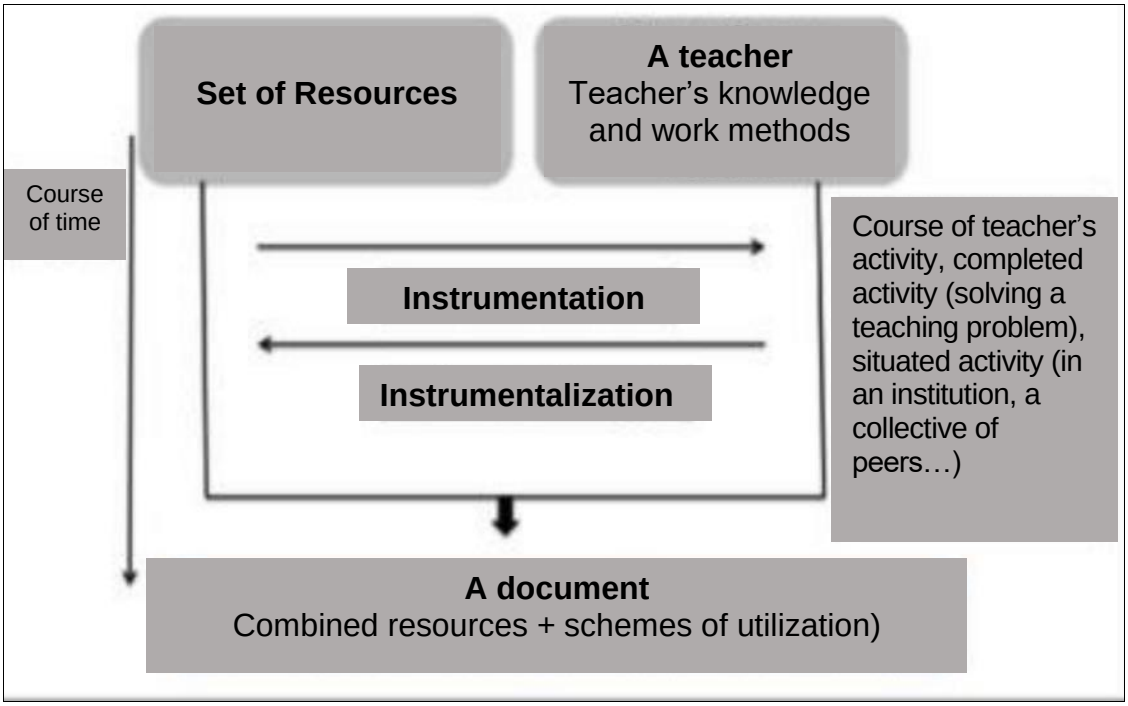
Connection between research and practice

According to Cai et al. (2019), there is a combination of interrelated reasons for the disconnect between research and practice: inattention to teachers' real instructional problems; ignorance of the amount of information teachers need to improve their practice; insufficient understanding of the influence of contexts on the implementation and effectiveness of particular teaching methods; absence of a mechanism to build a shareable knowledge base for teaching; institutional restrictions that discourage researchers and teachers from building productive and sustainable partnerships; and a culture that defines the professional roles of teachers and researchers, pressing them to adopt the traditional research pathway and discouraging them from exploring others.

For these reasons, we consider it important to adopt research pathways that increase the connections between school and university, thus resulting in beneficial consequences that are directly linked to the teacher's work, favoring the formulation of new understanding about the activities carried out at the school, creating a responsibility of the university to also get involved in the search for answers to the questions raised there. In this way, there is articulation between an external researcher and a teacher or a group of teachers, and the entire investigation is carried out *with* the teacher and not *for the teacher*, promoting collective formulation of knowledge and interference on the analyzed context. The PREMa-EB project, which is detailed in the next section, complies with this proposal.

The reflections highlighted in this work about interactions between teachers and researchers of PREMa-EB are based on the theoretical framework of Documentational Genesis, as discussed by Gueudet and Trouche (2009). According to Gueudet and Trouche (2009), the teacher's resources are periodically updated, incorporating other meanings and other modes of application. New resources become part of the teacher's collection, and articulations with students in the classroom environment change and influence the choice and formulation of activities, in addition to modifying planning following interactions with other teachers. This set of actions in which teachers significantly modify their resources for the classroom, which are usually prepared periodically, coupled with schemes for using them, obtaining a document as a product, is called a teacher's documentational work.

FIGURE 1 – Documentational Genesis Scheme



Source: Gueudet & Trouche (2015, p. 8)

In Figure 1, through processing of Documentational Genesis, the resources guide the teacher's action (instrumentation), and on the other hand the teacher starts to master them, adjusting and modifying them in the course of their use (instrumentalization).

Concerning this process, Abar (2019) comments that:

> Documentational genesis is a continuous process and occurs when the resources become a document in view of the schemes of utilization adopted and the teacher's experience, which involves prior knowledge from the mathematical and didactic perspective of the classroom. (ABAR, 2019, p. 222).

The expression resource, in this context, is understood in the broad sense, designating everything that nourishes the teacher's action and its pedagogical improvement, such as a text, the legal bases of education, a notebook, a software, as well as the production of students or an activity performed by another teacher. As the analysis carried out in this work applies

to a project that involves a group of teachers working collaboratively, we will consider the Documentational Genesis of the Community process. About this process, Teixeira comments that (2014):

> [...] Gueudet and Trouche (2012) propose the expression: documentational genesis of the community to describe the process of selecting, creating, and sharing resources to achieve the community's teaching goals. The result of this process, community documentation, is composed of the repertoire of shared resources and the sharing associated with knowledge (what teachers learn from the design, implementation, and discussion of resources). Furthermore, these capabilities and this knowledge evolve together over time. The authors thus characterize the duality between participation and documentation: on the one hand, documentation is a result of participation and, on the other, the shared repertoire is the associated knowledge that supports the participation of each member in the shared objective. The interpretation of these processes in terms of genesis points to the duality between two genesis: the genesis of the community (the emergence of the mutual contract and joint venture), and the documentational genesis of the community (the creation of a shared repertoire and the construction of shared knowledge). (TEIXEIRA, 2014, p. 52).

There are deep interactions between a member of a community and documentational genesis. A community resource is an essential element in a resource system. Furthermore, there is an intense relationship between the knowledge of each community member and the shared knowledge that is integrated into the community's documentation: each individual acquires knowledge from their community, and the shared knowledge is created by the community's documentational genesis. Community documentation cannot be misconstrued as an addition of the documentation of its members.

The Considering Resources for Teaching Mathematics in Basic Education (PREMa-EB) project is described as:

> [...] a research project that aims to investigate, with teachers, the resources for teaching elementary school

> mathematics. It is, therefore, a collaborative research project involving public school teachers, researchers in mathematics education, graduate students and a French pedagogical engineer guest. The objective of the project is to conceive and develop resources for teaching mathematics or other topics in elementary school, as required, preferably, by teachers. The project is developed through collective, collaborative and participatory work, organized in weekly meetings in which incubations (Spérano et al., 2019; Alturkmani et al., 2019) of resources and other tasks are carried out, under co-supervision of the pedagogical engineer. The project's theoretical reference is Gueudet and Trouche's (2010) documentational and instrumental approach of didactics; its methodological reference is Educational Research Design (Altutkmani et al., 2019). The project is to be carried out in November 2019; scientific publications are scheduled for the first half of 2020. This project is similar to PREMaTT (http://ife.ens-lyon.fr/ife/recherche/groupes-de-travail/prematt) that was carried out at the IFE of the École Normale de Lyon in France – an institution in which Sonia Igliori, PREMa-EB proponent, carried out a postdoctoral degree over seven months under the supervision of Luc Trouche, in 2018. Pierre Bénech, our guest, was the methodological coordinator of PREMaTT. His knowledge and experience are essential to PREMa-EB. Also, Professor Cibelle Assis, from the Federal University of Paraiba (UFPB), is willing to participate in this project, collaborating with her expertise in the field of teacher training and her teaching resources, due to her participation in IFE studies. This project is supported by PUC-SP under PEPG-Ex 2019. (IGLIORI, 2019)

It should be noted that, in projects such as PREMa-EB, the dialogue between the researcher and the teacher is considered to reduce inconsistencies between the intended objective and the pedagogical work that is actually performed. This occurs through successes that lead to the re-elaboration of teaching, with a view to greater compliance between objective and execution, considering a teaching-learning model that values shared formulation of knowledge.

The PREMa – EB pathway

PREMa-EB was carried out based on research-action-training foundations, through which, according to Vandercleyen et al. (2019), it is possible to allow articulations between specialized researchers with theoretical knowledge of a given area and professionals who build knowledge from their practice in a given professional field. Research-action-training is part of a set of research practices that express specificities of those who consider the participation of teachers in investigations as a factor that is crucial to the evolution of knowledge connected to practice and, also, to the evolution of the practice itself.

Regarding the methodology used in PREMa-EB, Assis and Bénech (2019) point out that:

> In the execution of PREMa-EB, we held weekly planning meetings (coordinator, pedagogical engineer, researchers and graduate students) and, in addition to these meetings, there were also weekly meetings with school teachers. Each meeting with teachers lasted four hours. Between one incubation and another, the planning team prepared resources for the next meeting, and recorded facts and observations of the work carried out with the teachers in a logbook. The meetings were all recorded in video, audio and photographs. We also organized a folder shared among the planning team in which all this material was made available and archived. (ASSIS and BÉNECH, 2019, p. 6).

The work carried out in the groups within each school was guided by problematization made by the teachers themselves, at the very first meeting, and encouraged by the researchers. For example, in the case of the group of teachers from the private school participating in the project (Colégio São Domingos), one of the problems was the following: “How to

monitor student learning through the use of the portfolio during a school project (Around the World in Eighty Days)?"

Four workshops were organized during the meetings. We present workshop 1 in Table 1, below:

TABLE 1 – Workshop 1: Concept, analogy and experiments

Objective	Proposed activity
To promote teachers' reflection on their conceptual problems, the use of analogies and the value of experience.	The proposed activity was that each teacher presents a text in which they explained what a good analogy would be; address the use of analogies in teaching, highlighting positive and negative aspects; present possibilities for its use in teaching; present examples and discuss the analogy made by the group, its relationship with the referred to concept, and the value of the experience, when possible.

Source: Created by PREMa-EB researchers

In this workshop, the relationship of each teacher with what would be considered as an object of observation was emphasized. The researchers re-issued questions with the aim of improving the teacher's practice, without making judgments, thus leading the teacher to think in a different way.

According to Coll et al. (1998), the more distant the question is from the social context or the perception of participants, the more regularly analogical reasoning should be used, in order to associate it with knowledge they already have. In the case of the group of teachers from Colégio São Domingos, for example, an analogy between the object "population density" (used by some teachers in the "Around the World in Eighty Days" school project) and physical concepts such as "density of solutions," "dilution," "molar concentration" etc., was discussed. An experiment with juice was presented, in which the solution dilution process was demonstrated: initially, the powder (solute) was dissolved

in water (solvent), resulting in a highly concentrated solution; then more water was added to the solution, resulting in a less concentrated solution.

Another interesting example that was discussed at the same school was a physical experiment applied in the classroom by a teacher, in the context of the "Around the World in Eighty Days" school project. Holes were drilled into a plastic bottle filled with water, at three spots and at different levels. When the bottle was closed, there was no water flow through any of the holes, but, when it was open, water leaked through them. This is because, when the bottle is closed, atmospheric pressure does not allow water to pass, as it is greater than internal pressure; when the bottle is open, atmospheric pressure does not affect the flow of liquid, which is conditioned only to the pressure of the water column. The lower the level of the hole, the greater the pressure applied by the water column and, logically, the further away the water will be ejected.

Based on this experiment, analogies were discussed, for example, between the concepts of pressure in the experiment and the concept of blood pressure. In this sense, the consequence of the heartbeat was considered as the movement of a certain volume of blood through the aorta artery. The moment this volume of blood crosses the arteries, they contract, so that the blood is compressed and pushed forward. With this pressure, the blood reaches regions that are further away, such as the toes.

In workshop 2, the researchers led the teachers to reflect on aspects of the project amongst themselves: how the idea of population density will be discovered by students (through pictures of groups of people, simulation in the room distributing students per m^2, records in simulation tables, using the internet etc.); it is not necessary to use formulas at this time; students can, during their research, find the demographic maps or even density values (inhabitants/km^2) of certain countries; the important thing is to give the number meaning; students will work in pairs.

We present workshop 2 in Table 2, below:

TABLE 2 – Workshop 2: Teaching objectives, didactic choices, skills and abilities

Objective	Proposed activity
To promote teachers' reflection on the scenario established by them, comparing it with another in which we present other didactic choices.	In the case of Colégio São Domingos, the proposed activity was that the teachers (organized in teams) present a map of the experience to be analyzed, proposing a situation (action) based on the general problem: In which country, among those visited in the project "Around the World in Eighty Days", would you live if you knew its population density? Would you live in Brazil?

Source: Created by PREMa-EB researchers

Next, in the formulation situation, the proposal was to encourage students to raise conceptual hypotheses about density, asking them to take notes on the information. In the validation situation, the search for demographic densities of countries, Brazil or even São Paulo (demographic values or maps) was proposed. In a situation of institutionalization of the concept, searching for the formula (through experience and student/m^2 recording) and its comparison was proposed. A discussion (with all students and the teacher) about the effects of a high or low population density in a country – such as urbanization, land for plantations, work – was also proposed.

It was agreed that the teacher, at the end of the activity with the students, would return to the question that had been initially proposed, asking the students to make a presentation about the answer (critical reflective record), justifying it based on the information obtained. The record would be made in the Logbook that had been delivered by the teacher before the assignment and would be monitored through it. This scenario in the classroom was performed by one of the group's teachers and recorded in audiovisual resources, so that, later, the group could make its reflections based on these records.

At the end of this workshop, a comparative reflection of the scenario presented by the group and the scenario presented by the researchers was recorded, through audiovisual resources, regarding the following elements: learning objectives; teacher roles; and student roles in both scenarios.

We present workshop 3 in Table 3, below:

TABLE 3 – Workshop 3: Portfolio and reflective writing

Objective	Proposed activity
To promote teachers' reflection on the use of the Logbook/Portfolio with regard to analysis of the learning monitoring process.	The proposed activity was the following: based on all the resources produced by the teacher (experience maps, concept map, questionnaires, and records from workshops 1 and 2), to create questions that allow for reflection about the Portfolio/Log Diary concerning: Portfolio design; difficulties in utilization; new ideas and new perspectives for utilization; old ideas that it keeps.

Source: Created by PREMa-EB researchers

In workshop 3, reflection was carried out by pairs of teachers, with intermediation by a researcher. To present the purpose of this workshop, below are excerpts from a recorded discussion between a researcher and two teachers from Colégio São Domingos.

> Teacher A: The logbook was not used as an instrument for analyzing learning, but as a notebook for recording the experience of a certain country. It's a free log; he'll know at least one aspect of each country.
> Teacher B: This can't be assessed. In Belgium, he made a note about chocolate; in France, about perfume; in another country, about terrain. It's not possible to know if he learned or not through these notes.
> Teacher A: He is evaluated, but not as to whether he learned fractions or division from the Logbook.
> Researcher: If you take a tour of the country, you want to learn something.

> Teacher A: The differences between them.
> Researcher: Isn't this evaluated? How must one measure whether he learned the differences between them?
> Teacher B: I can't take all the logbooks and compare: this child learned, this one didn't. But I see all their notes.
> Teacher A: There is an evaluative perspective, but it's not the main one.

In workshop 4, the objective and proposed activity were the same as in workshop 3. However, reflection was carried out individually with mediation by a researcher. To illustrate the proposal of this workshop, the following are excerpts of a conversation between a researcher and a teacher at Colégio São Domingos, referring to the item "new ideas and new perspectives concerning the use of the Portfolio/Logbook". According to the teacher, the students will fill in the Logbook when working on the concept of the mathematical object Complex Numbers, following the steps described in the recorded conversation:

> Teacher: Between knowledge and teacher, there is a nebulous place. I start by discussing origins and history, but first I present a problem by Girolano Cardano (dividing a 10 cm long line into two segments, resulting in a product equal to 40 cm). By calculating, one arrives at an equation of the 2nd degree in which the value of delta is negative. Why write that there is no solution in $\Re$?
> Researcher: For my students, I say that there is only a solution in the set of complex numbers, which they will study further on.
> Teacher: This is nebulous. I tell the students to try to go further on in their calculations, but they question the usefulness of it, the reason to continue. Based on this, I present the history, the conception, the nomenclature, the idea of the imaginary. I explain the meaning of the letter i, using an analogy. I suggest that they think like mathematicians, do the calculations only in their imagination. To not think like someone who is solving a practical problem.
> Researcher: I emphasize that the square of a number is not always positive in the case of i2.
> Teacher: If the student says it won't work, I tell him to use the distributive property, factorization, simplification.

> Then there is mediation, discussion, multiple ideas, questioning utility. I explain that it's an entity called complex numbers (not defining the set), there is one (real) number that you measure and one that you don't measure. I problematize the meaning of the joining of the two.

In the next section, we present aspects of the analysis carried out according to what was discussed above.

Analysis of PREMa–EB based on Documentational Genesis

The question that guided our work was: How does Documentational Genesis, especially the notion of scheme, contribute to the collaborative work of teachers in the PREMa-EB project and to its impacts? In Documentational Genesis, the notion of scheme is crucial to this understanding, so that we can highlight individual and collective documents resulting from this project.

As discussed earlier, there is a difference between a resource and a document in Documentational Genesis. In this process, we consider that a certain subject, involved in a goal-oriented activity, builds a document from a collection of resources, associating recombined resources and a scheme for their utilization. Since we highlight the articulations between teachers and resources within a collective – or some of them being collective –, we may consider them as genesis.

Documentational Genesis is based on the instrumental approach of Rabardel (2002), which defines a scheme of utilization as a structure that organizes the activity of a subject with an artifact for a given purpose – schemes having an individual aspect, such as the schemes of a particular subject or topic area, but also an essential social dimension. In this sense, we can say that the occurrence of schemes is, basically, a collective process, encompassing the artifact's users and developers; and its repercussions are a social process.

According to Pepin and Gueudet (2020), in the context of resource use, the utilization scheme includes procedural schemes (for example: how to use specific resources) and mental/cognitive schemes (for example: global use strategy; knowledge about the means that the resource offers; conceptions of a way to use the resource for a given class of tasks). In this regard, this conception of schemes allows us to better understand the articulations between teachers and the resources and the impacts of these articulations.

According to Vergnaud (1998), a scheme has the following components: The objective of the activity, sub-goals, and expectations; action rules, generating behavior according to the characteristics of the situation; operational invariants (concepts in action and theorems in action) and inference possibilities. Concepts in action are concepts that are considered relevant (teaching differentiation, for example), and theorems in action are propositions that are considered true (that is, if students are underperforming, then they need more help from the teacher). As an example of inference possibilities, there is: "in this class, I need to adapt my scheme for differentiation, because there are students that have a very good performance."

According to Pepin and Gueudet (2020), different teachers can develop different schemes for the same type of task. In this sense, teachers can develop certain schemes in the collaborative work environment and develop others in the classroom context.

Regarding the work developed in PREMa-EB workshops 1 and 2, there was a scenario (created by the group from Colégio São Domingos in a collaborative way) referring to the teaching of population density, carried out in the classroom by one of the teachers in the group and recorded by audiovisual resources. In this case, due to common operational invariants, teachers were able to develop a shared (or partially shared) document. The occurrence of shared operational invariants likely established common work.

This document involved several resources, in particular the Logbook, and shared schemes of utilization for these resources. Together, the group's teachers developed theorems in action, such as the following: it is necessary to encourage students to raise conceptual hypotheses about density, asking them to take notes on the information. Then, common documents were developed referring to the teaching of population density. Certainly, their uses of resources in the classroom would be different because of their pre-existing schemes. However, in the activity of creating a scenario, they developed new and common documents, in particular common schemes.

Concerning PREMa-EB workshops 3 and 4, we highlight the reflections of the teacher from Colégio São Domingos (mediated by a researcher) on the following issue: new ideas and new perspectives for use of the Portfolio/Logbook. According to the teacher, the students fill in the Logbook when constructing the concept of the mathematical object "Complex Numbers", following the steps described in the presented conversation. It can be seen that the teacher's intention was to develop students' learning skills, based on problematizations and questions, using as a general rule of action "listening carefully to students," and developing their activities based on the students' reasoning.

Within the scope of PREMa-EB, the teacher revealed that he had developed questioning skills and improved his understanding of the student's reasoning. The actions implemented in the project presented the teacher and the group with relevant procedures to expand their questioning skills, such as the use of analogies.

By adapting the project's actions to his classes, the teacher developed flexible ways of questioning, in order to guide the students' reasoning and help them understand the tasks. The teacher also emphasized that, regarding the possibilities of inferences, he had considered different activities for different categories of students and

with other resources. This element was already present in the teacher's schemes that were enhanced by his participation in the project.

Final considerations

We found that Documentational Genesis, especially the notion of scheme, contributed to the collaborative work of teachers in the PREMa-EB project, showing us that shared operational invariants impact involvement in collaborative work and favor this work; and that collaborative work can lead to the development of individual schemes (or to parts of these schemes). After checking common documents generated by collaborative work, we found that the participation of teachers in this work can enhance their individual schemes.

We also verified, from the PREMa-EB project, that collaborative work expresses the way a community reasons, its collective scheme. In this sense, there is some impact of individual schemes on the development of the collective scheme – and, conversely, new individual schemes suffer some impact and adaptation based on this collective scheme.

In conclusion, we highlight the importance of the PREMa-EB project regarding the continuing education process of a collective of teachers who wanted to develop resources for new teaching practices, making collaborative decisions to achieve certain goals. Exchanges took place during the work, indicating the successes and inadequacies of the incubations to the researchers, and thus contributing to other investigations. Accordingly, the project researchers contributed to the groups of basic education teachers, carefully assisting them in their reflections and reinforcing the connection between school and universities.

Researchers also benefited from the work carried out with teachers, since it presented an opportunity for private research problems to be more adequately formulated or discussed, including new methodological strategies and data collection instruments.

With this article, we intended to favor the understanding of the topics that were covered, as an encouragement to other researchers and students in the field of Mathematics Education, so that they may use it as reference in the development of further research in this field.

References

ABAR, C. A. A. P. Articulações teóricas sobre a abordagem documental do didático.Theoretical articulations on the documentary approach of didactics. *Educação Matemática Pesquisa:* Revista do Programa de Estudos Pós-Graduados em Educação Matemática, [s.l.], v. 21, n. 5, p.217-229, 6 nov. 2019. Portal de Revistas PUC- SP. DOI: http://dx.doi.org/10.23925/1983-3156.2019v21i5p217-229.

ASSIS, C.; BÉNECH, P. Pesquisa-Ação-Formação: reflexões para a prática profissional a partir do PREMa-EB. *Unión,* San Cristobal de La Laguna, n. 57, p. 01-12, 2019.

CAI, J.; MORRIS, A.; HOHENSEE, C.; HWANG, S.; ROBISON, V.; HIEBERT, J. Research Pathways Education, That Connect Research and Practice. *Journal for Research in Mathematics,* v. 50, n. 1, p. 2–10, 2019.

COLL, C.; POZO, J. I.; SARABIA, B.; WALLS, E. *Os conteúdos na reforma:* ensino e aprendizagem de conceitos, procedimentos e atitudes. Tradução Beatriz Affonso Neves. Porto Alegre: Artmed, 1998.

GUEUDET, G.; TROUCHE, L. Towards new documentation system for mathematics teachers? *The International Journal on Mathematics Education-*ZDM, Springer, v.71, p.199-218, 2009.

GUEUDET, G.; TROUCHE, L. Do trabalho documental dos professores: gêneses, coletivos, comunidades: o caso da Matemática. 2015. *Em teia,* 6(3). Tradução de Katiane de Moraes. Disponível em: https://periodicos.ufpe.br/revistas/emteia/article/view/2243.

IGLIORI, S.C.B. Projeto: *Pensar os Recursos do Ensino de Matemática Ensino Básico- PREMa – EB.* 2019. Currículo lattes em http://lattes.cnpq.br/0345215431099831 , p.6.

PEPIN, B.; GUEUDET, G. Studying teacher collaboration with the documentational approach: from shared resources to common schemes? *Teachers of mathematics working and learning in collaborative groups Proceedings of ICMI Study 25, p.* 158-165, 2020.

RABARDEL, P. *People and technology: a cognitive approach to contemporary instruments.* Paris: Université Paris 8, 2002.

TEIXEIRA, P. C. A. *Construindo novas ferramentas didáticas em matemática: professores, aula e recursos tecnológicos.* 171 f. Tese (Doutorado) - Curso de Ciências da Educação, Universidade Nova de Lisboa, Lisboa, 2014.

VANDERCLEYEN, F.; L'HOSTIE, M.; DUMOULIN, M.-J. *Le groupe de codéveloppement professionnel pour former à l'accompagnement des stagiaires: conditions, enjeux et perspectives.* Québec: Presses de l'Université du Québec, 2019.

VERGNAUD, G. Toward a cognitive theory of practice. In SIERPINSKA, A.; KILPATRICK, J. (eds.). *Mathematics education as a research domain: a search for identity* (p. 227-241). Dordrecht: Kluwer, 1988

Received in May 2020.

Approved in October 2021.