

Impacts of the pedagogical residency program on everyday school life and on teacher training: challenges in pandemic times

Impactos del programa de residencia pedagógica en el cotidiano escolar e en la formación del profesor: desafíos en tiempos de pandemia

Impacts du programme de résidence pédagogique sur le quotidien scolaire et sur la formation des enseignants : défis en temps de pandémie

Impactos do programa de residência pedagógica no cotidiano escolar e na formação de professores: desafios em tempos de pandemia

Elcio Pasolini Milli¹

Instituto Federal do Espírito Santo (Ifes)

Mestre em Educação em Ciências e Matemática

<https://orcid.org/0000-0002-6459-6291>

Maria Auxiliadora Vilela Paiva²

Instituto Federal do Espírito Santo (Ifes)

Doutorado em Matemática

<https://orcid.org/0000-0003-2713-1345>

Abstract

This paper presents the impacts of the Pedagogical Residency Program (PRP) on everyday school life and teacher education, considering the challenges posed by the Covid-19 pandemic. It consisted of a collective movement of reflections and discussions on teaching practice with ten undergraduate residents of the mathematics teaching degree course, a basic education teacher as a preceptor and a professor of the degree course as the advisor, who met weekly from October 2020 to March 2022. The qualitative research used semi-annual reports, experience reports, recordings of the meetings, residents' narratives, intervention lesson plans, discussions in the Virtual Learning Environment (VLE) forums, participant observations in the classes given by the residents, the planning and assessment meetings of the activities and the registers from those observations. Basic education treated as a space for knowledge production contributed to the consolidation of different teaching knowings and the program made it possible for those knowings to dialogue with initial and continuing education. The conclusion was that basic education, while producing knowings, starts to benefit directly from the movements that the program promotes inside and outside classrooms and that, above all,

¹ elciopmilli@gmail.com

² dora@ifes.edu.br

benefits students in basic education. Public policies such as the PRP value the professionalization of teachers and contribute to reflection and discussion on the importance of education and the professional identity of teachers.

Keywords: Teacher training, Mathematics education, Collective discussion, Basic education.

Resumen

Este artículo presenta los impactos del Programa de Residencia Pedagógica (PRP) en el cotidiano escolar y en la formación docente, considerando los desafíos planteados por la pandemia de la Covid-19. Consistió en un movimiento colectivo de reflexiones y discusiones sobre la práctica docente con diez residentes de pregrado de la carrera de enseñanza de las matemáticas, un docente de educación básica como preceptor y un docente de la carrera como orientador, quienes se reunieron semanalmente de octubre de 2020 a marzo de 2022. La investigación cualitativa utilizó informes semestrales, relatos de experiencia, grabaciones de los encuentros, relatos de los residentes, planes de estudio de las intervenciones, discusiones en los foros del Ambiente Virtual de Aprendizaje (AVA), observaciones participantes en las clases impartidas por los residentes, reuniones de planificación y evaluación de las actividades y los registros de esas observaciones. La educación básica tratada como un espacio para la producción de saberes contribuyó a la consolidación de diferentes saberes docentes y el programa posibilitó que esos saberes dialogaran con la educación inicial y continua. La conclusión fue que la educación básica, al mismo tiempo que produce saberes, pasa a beneficiarse directamente de los movimientos que el programa promueve dentro y fuera de las aulas y que, sobre todo, beneficia a los estudiantes de la educación básica. Políticas públicas como el PRP valoran la profesionalización del profesorado y contribuyen a reflexionar y debatir sobre la importancia de la educación y la identidad profesional de los docentes.

Palabras clave: Formación del profesorado, Educación matemática, Debate colectivo, Educación básica.

Résumé

Cet article présente les impacts du Programme de Résidence Pédagogique (PRP) sur la vie quotidienne de l'école et la formation des enseignants face aux enjeux de la pandémie de Covid-19. Il s'agissait d'un mouvement collectif de réflexions et de discussions sur la pratique pédagogique composé d'une dizaine de résidents inscrits au cours de mathématiques, d'un enseignant de l'éducation fondamentale en tant que précepteur et d'un enseignant du cycle

d'enseignement en tant que conseiller, se réunissant chaque semaine, d'octobre 2020 à mars 2022. La recherche, de nature qualitative basée sur l'analyse documentaire, a utilisé comme instruments de production de données les rapports semestriels, les rapports d'expérience, les enregistrements des réunions, les récits des résidents, les plans de cours des interventions, les discussions dans les forums de l'Environnement Virtuel d'Apprentissage, les observations participantes dans les classes enseignées par les résidents, les réunions de planification et d'évaluation des tâches et les enregistrements obtenus dans ces observations. Il s'est concentré sur la consolidation des différents savoirs pédagogiques, le rapprochement de l'éducation fondamentale et de l'enseignement supérieur, la création d'un espace de production de connaissances collectives, ainsi que le dialogue du programme avec la formation initiale et la pratique pédagogique. Il a été constaté que l'éducation de base, en même temps qu'elle produit des connaissances, commence à bénéficier directement des mouvements que le programme promeut à l'intérieur et à l'extérieur des salles de classe et qui, surtout, profitent à ses élèves. De plus, les politiques publiques telles que le PRP valorisent la professionnalisation des enseignants et contribuent aux réflexions et discussions sur l'importance de l'éducation et l'identité professionnelle des enseignants.

Mots-clés : Formation des enseignants, Enseignement des mathématiques, Discussion collective, Enseignement de base.

Resumo

Este artigo apresenta os impactos do Programa de Residência Pedagógica (PRP) no cotidiano escolar e na formação docente perante os desafios da pandemia de Covid-19. Constituiu-se de um movimento coletivo de reflexões e discussões da prática docente composto por dez residentes licenciandos do curso de matemática, um professor da educação básica como preceptor e uma professora do curso de licenciatura como docente orientadora, reunidos semanalmente, de outubro de 2020 a março de 2022. A pesquisa, de cunho qualitativo baseada em análise documental, utilizou como instrumentos de produção dos dados os relatórios semestrais, os relatos de experiência, as gravações das reuniões, as narrativas dos residentes, os planos de aula das intervenções, as discussões nos fóruns do Ambiente Virtual de Aprendizagem (AVA), as observações participantes nas aulas ministradas pelos residentes, as reuniões de planejamento e de avaliação das tarefas e os registros obtidos nessas observações. Centrou-se na consolidação de diferentes saberes docentes, aproximando a educação básica e o ensino superior, gerando um espaço de produção de saberes coletivos, bem como possibilitando que o programa pudesse dialogar com a formação inicial e a prática docente.

Verificou-se que a educação básica, ao mesmo tempo em que produz saberes, passa a ser beneficiada diretamente com os movimentos que o programa promove dentro e fora das salas de aulas e que, sobretudo, beneficia seus estudantes. Ainda, políticas públicas como a PRP valorizam a profissionalização docente e contribuem para reflexões e discussões sobre a importância da educação e da identidade profissional do professor.

Palavras-chave: Formação de professor, Educação matemática, Discussão coletiva, Educação básica.

The impact of the pedagogical residency program on everyday school life and teacher training: challenges in times of pandemic

The Brazilian education system has been significantly impacted by the challenges posed by the pandemic. Basic education, which previously relied on in-person teaching, has shifted to a new setting built on new interfaces for social relations and interactions. Many of these have been adapted for a virtual environment, while others have emerged through professional, social and cultural networks.

According to the Anísio Teixeira National Institute for Educational Studies and Research (Inep)'s survey, entitled 'Educational Response to the Coronavirus Pandemic in Brazil', 99.3% of Brazilian schools suspended in-person activities in 2020 (Inep, 2021). This led to changes in both the school's sphere of activity and access to schooling in general. Teaching and learning mathematics in the context of basic education was no different. A new landscape emerged that was different from anything experienced until then.

In light of the recent changes to face-to-face, virtual, hybrid and remote learning environments, the impact on social interactions and subsequent interference with the initial and continuing training of teachers is evident. Therefore, it is crucial to consolidate the environment for developing teaching expertise through partnerships and collective knowledge exchange in the production of various types of academic and pedagogical knowledge related to practice. Public policies that promote the professionalisation of teaching careers should value these aspects.

In this sense, we highlight the space created by the Pedagogical Residency program (PRP), which brings together the knowledge of primary and higher education teachers and mathematics students at the Vitória campus of the Federal Institute of Espírito Santo (Ifes). The space for dialogue, freedom of teaching, autonomy and respect for colleagues were essential for consolidating a productive environment that met the program's demands alongside the challenges of school life.

Similarly, it was important to recognise that dialogue should not be structured hierarchically, but rather developed through encounters between different experiences and knowledge. This approach values collective discussions in the appropriation and (re)signification of knowledge in teacher training. Research by Giraldo et al. (2017), Barbosa (2017), Menduni-Bortoloti (2016), Paiva (2018), Paiva et al. (2021) and Paiva (2023) points to a theoretical and methodological perspective that values the relationships between the individual and the collective. This perspective investigates concepts through their pedagogical and contextual aspects, as well as the vision of those who study them. Knowledge is situated

in action. This perspective contributes to continuing and initial teacher training by emphasising the knowledge and experiences of participants and valuing collectivity in the acquisition of teaching-specific knowledge. It also incorporates knowledge emerging from professional practice as a formal component of initial teacher training.

It is worth noting that, in the 1980s, research literature on teaching knowledge tended to focus on what individual teachers knew, rather than considering the relationships between individuals and the collective. The emphasis was therefore on what individual teachers knew or did not know, rather than on developing a professional teaching culture specific to teaching (Davis & Renert, 2014).

Throughout this research, conducted four decades later, we highlight professional training in a broader sense as a professional culture comprising not only knowledge, practices and behaviours, but also professional identity. In training, we focus not on performance in specific tasks, but on developing a professional identity that enables individuals to structure their relationship with school mathematics and the world, and to interpret and understand situations around them in new ways (Charlot, 2005; Davis & Simmt, 2006). Consequently, existing knowledge is expanded, new knowledge is acquired and produced, and the reality and context of this practice are modified.

The concept that 'being a teacher requires specific knowledge of the profession' (Paiva, 2018, p. 61) is defended. This refers to teaching knowledge, which is understood as dynamic and emerging from professional practice (Davis & Renert, 2014), and which contributes to the development of a teaching identity.

This article aims to present the impact of the Pedagogical Residency program on everyday school life, considering the challenges of teacher training in the context of the Covid-19 pandemic. We highlight reflections and possibilities for work in a training and investigative scenario of the practice itself, from which all involved benefit, and in which the main transformations in teacher training take place, impacting the teaching of mathematics in basic education (Ramos et al., 2023; Zetum et al., 2023; Pereira, Milli & Paiva, 2022; Silva et al., 2021; Vieira et al., 2021).

Thus, we organized the text by first presenting our initial thoughts on the Brazilian situation and the impact of the Covid-19 pandemic. Next, we set out theoretical and methodological reflections to help us understand the research scenario involving different professionals. We then present the collective environment for studies, the socialisation of experiences and the training and improvement of teaching practice. We also discuss the analytical aspects of the experiences lived in this training context. Finally, we propose ways in

which the Pedagogical Residency program can contribute to the training of future mathematics teachers.

Teaching residency program and teacher training

Teacher training in Brazil has been a topic of discussion since the last century, facing numerous challenges along the way. When we consider initial training, we must think about what knowledge is fundamental to teacher professionalisation. But what knowledge is essential for teaching practice? How do teacher training students relate to this knowledge? In this sense, we aim to understand how individuals categorise and organize their world, how they give meaning to their experiences, particularly their school experience, and how they perceive the world, thereby constructing and transforming themselves (Charlot, 2005, p. 41). According to Charlot (2000), knowledge is a representation of an activity and of the subject's relationships with the world, themselves, and others. Accordingly, 'there is no knowledge that is not inscribed in relations of knowledge' (Charlot, 2000, p. 63). He therefore assumes that education should not merely be an accumulation of intellectual content, but should focus on the processes that lead the individual to develop a relationship with knowledge.

In line with this perspective, Davis & Renert (2014) argue that the relationship with knowledge is established in the field of knowledge production when constructing the teacher's disciplinary knowledge, with Mathematics for Teaching being directed towards research and the evolution of concepts.

[...] The mathematical knowledge of teachers cannot be reduced to a catalogue of facts that can be taught and tested. While it may encompass some of these aspects, the most crucial aspect of mathematical knowledge for teaching is an attitude towards the development of concepts. Teachers need more than access to an established body of knowledge; they need the means to unpack, interrogate and elaborate on their mathematics, in other words, to substructure it (Davis & Renert, 2014, pp. 75–76).

In this sense, the Pedagogical Residency program has contributed to consolidating critical training that permeates the relationship between primary and higher education, in terms of understanding the establishment of teaching knowledge and the inseparability of mathematics, as well as how this is established in practice, with a view to building Mathematics for Teaching.

This is emphasised in the program's implementation guidelines, which aim to "support Higher Education Institutions (HEIs) in implementing innovative projects that encourage articulation between theory and practice in undergraduate courses, conducted in partnership with public elementary education networks" (Ministry of Education, 2018, no page number).

The program was established by Ordinance No. 38 on 28 February 2018 and is one of the actions that form part of the National Teacher Training Policy. The policy aims to improve teacher training through pedagogical practice developed in undergraduate courses and promote the immersion of student teachers in basic education schools during the second half of their undergraduate course.

To fulfil this purpose, the Mathematics Teaching Residency program at the Vitória campus of the Federal Institute of Espírito Santo (Ifes) was developed with a focus on teaching knowledge and the relationships established with this knowledge. As outlined in the document prepared by this institute, practice is central to knowledge production.

[...] The Ifes Institutional Pedagogical Residency Project, including its subprojects and centres, is of paramount importance for the initial training of teachers at our institution for the following reasons: (i) The RP focuses on teacher training and the constitution of practical knowledge to improve the professionalisation and autonomy of future teachers enrolled in various degree programs at Ifes; ii) The program establishes and strengthens pedagogical articulations in monitoring students in the field school through the supervision of teachers and preceptors, as well as dialogue between the IES, the state network (SEDU-ES) and municipal education secretariats (SEMEs). Their collaboration is essential in producing and organizing school experiences and pedagogical practices that permeate the teacher–student relationship. (iii) It is implemented based on conscious decision-making processes guided by relationships shared by all participants in the Institutional Project (Ifes and SEMEs) (Federal Institute of Espírito Santo, 2020, p. 5).

This space, created through collaborative efforts, is crucial for the initial and ongoing training of its members, given the connections between the various forms of knowledge that arise from teaching practice and the theoretical and methodological aspects of research. This perspective is directly aligned with the proposals of the national guidance document of the PRP, in accordance with the guidelines of the Coordination for the Improvement of Higher Education Personnel (Capes), regarding the following objectives: 'Encourage the training of teachers at the higher education level for basic education, leading the student to actively engage with the relationship between theory and professional teaching practice' (Brazil, 2020, p. 1), and 'Strengthen and expand the relationship between Higher Education Institutions (HEIs) and public basic education schools for the initial training of basic education teachers' (Brazil, 2020, p. 1).

In training, we therefore focus not on performance in specific tasks, but on developing a professional identity that enables individuals to structure their relationship with the world and construct new ways of interpreting situations and events. This allows them to expand their

knowledge and understand others through the articulation between higher education and basic education.

In their contribution to this discussion, Cochran-Smith and Lytle (2010) define three conceptions of teacher learning: knowledge for practice, knowledge in practice and knowledge of practice. According to them, the first two conceptions distinguish between formal and practical knowledge, while the third conception encompasses both.

Teachers need to treat their own classrooms and schools as sites for intentional inquiry, while also interrogating and interpreting the knowledge and theory produced by others, in order to generate the knowledge required to teach well (Cochran-Smith & Lytle, 2010, p. 3).

Practice produces knowledge, and teachers learn by discussing and reflecting collectively on their practice to develop a theoretical understanding of mathematics and connect it to social, cultural and political issues. According to these authors, teachers learn by participating in communities that systematically and intentionally research teaching and learning, which is one way to enhance the appropriation of knowledge for teaching and professional development.

By engaging with the perspectives of teacher training in the context of the working environment and investigating the practice itself, the Pedagogical Residency program brings higher and basic education closer together. This addresses one of the major challenges identified by Felix Klein at the beginning of the 20th century, who referred to the dual gap between levels of education. The author was one of the first to identify the central problem in teacher training: the double discontinuity. He noted that the mathematics taught in university courses was unrelated to what would later be taught in basic education, and that what was learned in school did not align with university teaching either. It is as if scientific and school knowledge cannot converse or be problematised, but instead are configured as Mathematics for Teaching, a perspective adopted in this text.

Furthermore, when considering the existing challenges in initial teacher training, we link discussions to the obstacles imposed by the pandemic. While we had previously experienced double discontinuity, other factors exacerbated these gaps in the context of social isolation caused by the pandemic. However, despite facing so many problems, the mathematics team at PRP Ifes Vitória (of which we are a part) came together to address these difficulties. They established dialogue between higher education institutions and primary schools, investigating concepts and planning practices in secondary school classrooms to contribute to

reducing social inequalities. To this end, we present the contributions of the Pedagogical Residency program to the training of mathematics teachers.

A collectively built path

In line with the proposal set out in this text to present the impact of the Pedagogical Residency program in Mathematics on everyday school life, particularly in relation to the challenges of teacher training posed by the Covid-19 pandemic, we set out our methodological approach. To this end, it was important to discuss the relationships established between teaching knowledge and initial teacher training in mathematics. We emphasise the importance of this area in developing teacher identity, as it encourages reflection on the construction of knowledge that is essential for teaching practice.

In this sense, this text articulates a qualitative research proposal to promote reflections and discussions on teaching practice. We opted for qualitative research based on documentary analysis (Lüdke & André, 1986) to discuss the impacts generated by the Pedagogical Residency program on everyday school life, as evidenced by the documents prepared during this project. According to Lüdke and André (1986), documentary analysis is a procedure that uses methods and techniques to collect, analyse and understand data in documents of various types.

Documents are a powerful source of evidence to support a researcher's claims and statements. They represent a 'natural' source of information. Not only do they provide contextualised information, but they also arise in a specific context and provide information about that same context (Lüdke & André, 1986, p. 39).

Thus, the documents produced during the program brought us closer to the perceptions and experiences that took place in the context in which teaching knowledge was constructed. This made the description and analysis of the data more accurate, since we were dealing with complex and dynamic social phenomena, especially in relation to the educational scenario in which they were produced.

Furthermore, monitoring and participating in the entire PRP implementation process dynamically and in line with the program's previously defined proposals also enabled us to reflect on our own teacher training. Lüdke and André (1986, p. 38) state that documentary analysis '[...] can be a valuable technique for approaching qualitative data, either by supplementing the information obtained by other techniques or by revealing new aspects of a theme or problem.'

We wrote descriptive and reflective documents in the form of follow-up reports on actions taken, experience reports and field diaries monitoring school activities. To complement

this documentary corpus, data and subsequent analysis were produced using other documents, such as teaching projects, student reports, curriculum guidelines, intervention forms, task scripts, work plans, curriculum and pedagogical guidelines. Audio and video recordings of collective discussions and photographic records of interventions, conferences and planning meetings were also used.

This created a documentary and prescriptive framework to analyse the phenomenon through complementary techniques, contributing to individual and collective observations and deepening the analysed aspects.

It should be noted that elements of the observations made during classes taught by residents, as well as during planning and evaluation meetings of interventions, were adopted to produce research data. These elements were supplemented by records of observations, semester reports of each module, residents' narratives, discussions in Virtual Learning Environment (VLE) forums and WhatsApp groups, publications at scientific events and observations and recordings of classroom interventions. A Moodle room was created for posting, interacting and recording each group's work, and for organizing each semester's work plan chronologically, in order to structure and systematize the collective work.

This virtual environment was set up as a collective space for residents, preceptors and supervising professors to bring members of this group closer together. To further strengthen these relationships, we maintained continuous contact via a WhatsApp group, where we were free to post updates, discuss activities, and share our anxieties, uncertainties, insecurities, challenges, successes, and our desire to develop our work in a serious and committed manner.

These documents were fundamental to evaluating and refining the work methodology, as they covered what was working well and what still needed improvement.

The collective evolution of the working group is notable in terms of professional improvement, maturation in pedagogical practices, improved communication channels, respect for each professional's way of working, and the importance of getting to know each other and appreciating these differences in an educational setting.

In light of this, it is crucial to examine teaching practices and pay close attention to the associated pedagogical processes and how they evolve in collaborative settings involving teachers, trainee teachers, and students in primary education. Through this articulation of different types of knowledge, the classroom becomes a space for investigating and producing new knowledge.

Work proposals and development strategies

In this section, we present the project plan alongside proposals for collaborative work on developing the PRP. We emphasize collective planning, as well as theoretical and methodological study strategies and proposals for intervention in basic education. In this context, we emphasize the collaborative working partnership established between the preceptor teacher, the supervising teacher and the resident teacher trainees, encouraging freedom of expression and knowledge sharing in a dialogue-based environment.

The Pedagogical Residency program in Mathematics was developed over a year and a half by the Federal Institute of Espírito Santo (Ifes)'s Vitória campus, in partnership with the Almirante Barroso State Elementary and Secondary School, which is part of the state public school system and is also located in the municipality of Vitória. The work plan was divided into three semesters, with project planning in accordance with the demands of the elementary school and the various stages experienced during the pandemic. Each semester included a plan consisting of different stages, which structured the semester's work. This was important for organizing the activities developed in the PRP, coordinating them with the academic semester of the Ifes degree course and associating them with the academic quarters of the field school (the elementary school that receives the residents).

The structure presented in Figure 1 comprises the stages defined collectively through weekly meetings, together with the sequential development of each stage, which is covered during each semester according to the workload allocated to the PRP.

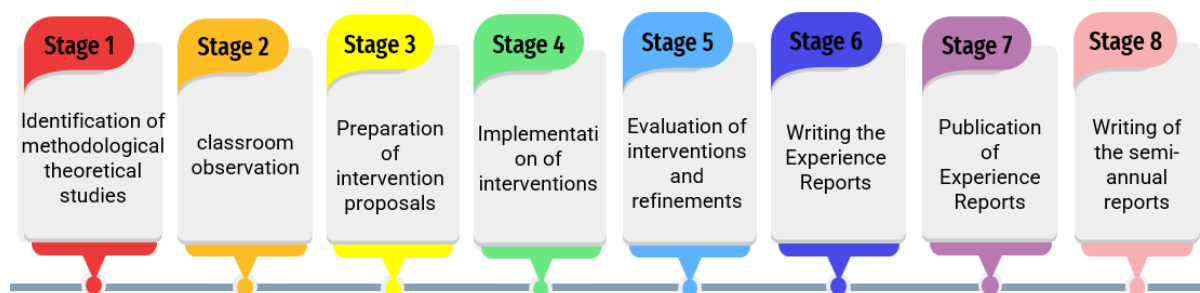


Figure 1

This is the organizational chart of the PRP's six-month plan, prepared by the authors.

These steps were coordinated in response to demands arising from basic education, primarily guided by the state education network of Espírito Santo's prescribed curriculum. In light of the pandemic, the Espírito Santo State Department of Education (Sedu-ES) launched EscoLAR, a program of non-classroom pedagogical activities (APNPs), regulated by State

Ordinance No. 048-R/20. The program aimed to provide schools and teachers with resources to support them in the teaching and learning process during remote learning.

Curricular guidelines were developed alongside this program, based on the state basic school curriculum. Some content was prioritised and given greater emphasis in this process, resulting in the 2020 Curriculum Readjustment document. This document analysed and classified 'skills and objects of knowledge' (Espírito Santo, 2020, p. 3) to support teaching planning in light of the impacts caused by the pandemic.

However, given the various challenges facing the educational landscape, the PRP also suffered as a result of the pandemic, which was a new experience for us all, including education and mathematics professionals. The school routine was affected in various ways, with changes to the student support system ranging from face-to-face to hybrid and remote learning. The school's pedagogical monitoring had to be adapted to incorporate training in technological innovations, as well as documents and reports from the state government and the needs of the school community. This was complicated by a lack of access to electronic equipment and quality internet, as well as a lack of human and intellectual resources to access and develop tasks on remote service platforms.

Additionally, the school and the PRP had to adapt teacher training in light of changes to large-scale assessment systems such as the Basic Education Assessment System (Saeb), the Quarterly Internal Diagnostic Assessment of Learning (Paebes) and the National High School Exam (Enem). Furthermore, the changes implemented in Espírito Santo since 2019, including the secondary education reform and the implementation of the New Espírito Santo Secondary Education System in 2022, are noteworthy³.

Although this was the reality, we highlight that, considering various considerations, the PRP in Mathematics at IFES Vitória developed actions that valued collective discussions and the transformation of professionals in mathematics teaching and learning. Beyond the pedagogical processes, we emphasise the dynamic movement that developed during the

³ Access: <https://sedu.es.gov.br/novo-ensino-medio-capixaba>.

program's three-semester duration, as well as the learning outcomes and impact on teacher professionalisation.

Theoretical and methodological studies were integrated into the planned actions during the three semesters of the PRP. Topics studied included Problem Solving (Onuchic & Allevato, 2011); Investigation in Mathematics Classes (Ponte, Brocado & Oliveira, 2019); Problematic Mathematics (Giraldo, 2017); Critical Mathematics Education and Scenarios for Investigation (Skovsmose, 2000, 2014); Inclusive Mathematics Education (Skovsmose, 2019); Notions of the Semantic Field (Lins, 2004, 2012); and Concept Study (Davis & Smitt, 2006; Campos & Paiva, 2019). These studies were permeated by collective moments of discussion and broadening of understanding, with reflections on the interventions to be carried out in the classroom. This process allowed us to revisit our concepts and experiences of what it means to be a teacher, and of how we develop our professional identity in contact with our peers. Following interventions based on some of these theories, new reflections were consolidated, primarily to support the analysis of interventions and refine teaching proposals, considering the classroom as a space for mutual learning.

In this regard, we highlight the views of two participants presented in the biannual report on the first module of the program.

The main difference between PRP and other activities on the course is its constant focus on teaching and preparing students to reflect on various aspects of teaching practice, such as planning, developing activities and analysing results. We always consider what worked well in the interventions carried out and how they could be improved in future, because the intervention is not just a one-off action, but something that we can study further (Module 1 Report – February 2021).

Classroom and pedagogical work shape and transform everyone involved in the teaching and learning process day after day. It is also important to always consider the student to be a co-protagonist in the educational process — an active agent, rather than a passive recipient of information. Reflecting on collectively performed behaviours and practices enables us to celebrate successful mobilisations and intensify planning with the aim of correcting aspects that did not work out very well in a new application of the task. Thus, residents acquire teaching knowledge that is important for their professional development (Module 1 Report, March 2021).

It could be argued that the considerations highlighted by the residents emphasise the importance of collective exchanges during study and reflection in the classroom. The dynamic process of collectively planning, executing and evaluating a pedagogical practice benefit from

the different observations of residents and teachers since interventions are made by the whole group. This aligns with the assertion that 'teachers are vital participants in the production of mathematical possibilities, giving form and substance to cultural mathematics — not only formal mathematics, but also the diversity of culturally situated practices, perspectives, and applications' (Davis & Renert, 2009, p. 45). This emphasises that practice is a space for producing knowledge, where understandings and meanings emerge and are experienced by residents, preceptors and advisors. Reflecting on these practices collectively was fundamental to bringing about changes in the planning and practices of these future teachers.

Furthermore, it is clear that the PRP was established as a space for ongoing training, in which the intervention did not generate momentary reflections, but rather a constant movement of thinking about the object of study articulated with theoretical studies and classroom practice. Thus, we perceived the articulation of teaching knowledge permeated by collective analysis and the awareness of everyone in the professional training process.

It is important to highlight that we faced great challenges during the first semester, as we were still getting to know each other and needed to align proposals with the objectives and expectations of each member of the working group. As a form of articulation, we shared our concerns, desires, and objectives and, together, in the large group, we defined a path to follow. “Through collective discussions, the content knowledge was problematized, investigated, reflected upon, and (re)signified. This sharing highlighted the relevance of individual and collective knowledge not being dichotomized” (Campos et al, 2023, p.70).

Faced with this reality, we became increasingly convinced that it is in the collective that we learn and changes occur in our teaching identities. When we referred to some of these difficulties, the students spoke up.

We are aware of the difficulties caused by the pandemic and the challenges posed by remote teaching activities in this new scenario, but we are learning to overcome them with the support of everyone involved in this subproject. While no one could have anticipated this situation, we have always been prepared to support each other through any difficulties. At this time, the support of all involved, including scholarship recipients and teachers, is extremely important (Module 1 Report, February 2021). Despite the pandemic and the need for social distancing, we hold weekly online meetings to plan lessons, discuss texts to enhance our learning and collaborate on our lesson plans. These online meetings are enriching. We have been able to familiarise

ourselves with the school via video calls, and some colleagues have conducted online lessons with students in classrooms and with residents in their homes. In addition, we have received contributions from colleagues and teachers based on their experiences (Module 1 Report – March 2021).

Based on the residents' comments and reflections, we concluded that significant learning had occurred in the areas of concepts, teaching practice, colleague interaction, and the perception of school as a knowledge production space, as proclaimed by Cochran-Smith and Lytle (1999). Overall, the residents were a more cohesive group by the end of module 1, eager to move forward.

I have high hopes for the next semester. After all, the program has great potential. Furthermore, I have the support of an advisor and a mentor with extensive experience in education (Module 1 Report, April 2021).

By this point, professional ties had grown stronger, there was a greater collective understanding of the program, and the classrooms had become familiar spaces for the residents. Knowledge exchanges were more focused, and residents felt more comfortable and confident when presenting their proposals and conducting interventions.

To organize the development of classroom interventions, residents drafted proposals in consultation with teachers, based on a theme to be addressed at the field school that school term. These proposals, along with lesson plans following the Action Plan model proposed by the Espírito Santo State Department of Education, were presented to the group at weekly meetings.

These lesson plans presented the learning objectives in terms of competencies and skills in accordance with the Sedu-ES curriculum guidelines, as well as the concepts to be discussed and formalized, the tasks to be developed during the intervention week, the resources to be used to complete these tasks, and the methods of evaluation for the intervention.

All planned classes were accompanied by a work plan and a questionnaire created via Google Forms, which allowed students to evaluate the residents' intervention by considering the sequence of activities to be applied. During weekly meetings, the media and software used in the interventions were first presented and discussed in the group, and the tasks were validated by all members before being developed in the elementary school. This planning strategy

worked very well to improve the proposal, as well as facilitating reflection and learning in the development of a pedagogical proposal.

This demonstrated that individual experiences were brought to the collective to be reconfigured as expanded knowledge. As Davis (2014, p. 33) states, 'Individual knowledge and collective knowledge cannot be dichotomized; collective possibilities are involved and unfold into individual understandings.' Such reflections allow us to infer the strength of teaching collectives, since teachers' implicit mathematical knowledge began to be reconfigured in the group through questions that generated new knowledge.

The PRP was a movement aimed at acquiring and improving essential knowledge for professional practice. In this sense, our actions during the second module's six-month period were aimed at preparing students to take on leadership roles and develop professionally through constant reflection and interaction with their peers.

By this stage, residents were familiar with the classes and more autonomous, contributing to conceptual and investigative discussions of the various concepts that make up the Basic State School Curriculum of Espírito Santo. Alongside the Problem-Solving methodology used since the first module, discussions based on Skovsmose's (2000, 2014) theory of Critical Mathematics Education permeated this module.

During the planning and in-depth study phases, we therefore conducted studies on content experienced at school, considering both the concepts and the knowledge developed in the school environment and educational practice. Based on the theoretical perspective of Critical Mathematics Education, the team engaged in work that included cultural and social aspects in the discussions and reflections of the group of residents, and consequently with the students at school.

The teaching and learning process was underpinned by the methodological perspective of problem solving (Onuchic & Allevato, 2011), articulated with concept inquiry (Davis & Smitt, 2006; Campos & Paiva, 2019) in the classroom. This provided opportunities for the acquisition of diverse knowledge through reflection and collective discussion. The tasks developed at the school were planned and prepared jointly by the supervising teacher, the residents and the supervising professor.

We emphasized collective discussions as a means of appropriating knowledge for teaching purposes, meaning that our weekly meetings were characterized by collaborative construction. Thus, plans initially proposed by pairs of residents were discussed and re-elaborated by everyone, resulting in a collective plan. The first elements of this process emerged in the first module and were consolidated with greater emphasis in the second module, constituting a space for reflection and the appropriation of teaching knowledge.

During this period, the preceptor delivered face-to-face classes, during which residents participated in developing their lesson plans via videoconferences on Google Meet. Initially, there were concerns about this dual approach, with face-to-face classes for students and synchronous remote classes for residents. However, we were pleasantly surprised by how well these interventions developed.

It is worth noting that the preceptor's role in welcoming his students in person and the residents synchronously was essential for educational practices to proceed as well as possible, encouraging participation from basic education students and supporting residents in discussions. Several students and classes were taught through shared teaching, where preceptors and residents worked together in the same class. This exchange of experiences between those with classroom experience and those learning how this space works changes their perceptions and ideas about teaching and school, providing a valuable opportunity to discuss teaching knowledge in development.

With regard to planning and experience during the pandemic, the residents' comments in Module 2 reports demonstrate their practical knowledge, showing how access to a new approach to the classroom is configured as a situated culture, providing a fresh perspective on teaching. This is consistent with the views of Charlot (2000, 2005) and Cochran-Smith and Lytle (1999).

Two statements from PRP participants stand out on this issue: one from the preceptor's report and the other from a resident student.

One of the most important lessons learned during this period was the significant impact that well-planned investigative lessons can have. A unique feature of the Teaching Residency was that it allowed residents to experience the same challenges faced by teachers during the pandemic. This enabled each resident to find different ways to

enhance the teaching and learning process in remote classes (Module 2 Report – September 2021).

In this module, I experienced teaching differently, with more time available for preparation and the task itself. This enabled more discussion and reflection on the entire experience. I think that maintaining this pace, with a few adjustments, will also make for a very interesting task in the next quarter (Module 2 Report – September 2021).

It could be said that the reflections developed by the professor and the resident are similar to the appreciation of a teaching career and demonstrate the respect that should be shown for work carried out in the classroom. We emphasize that our training was collaborative. By discussing practice and allowing new knowledge to emerge through collective reflection, we were able to recognize our potential to educate ourselves through action. In this context, socializing practices and producing knowledge through collective reflection became a training space for the advisor, the resident teacher trainees and the preceptor.

This makes us reflect on how teachers and future teachers acquire the knowledge they need to teach mathematics. From the outset, we recognize that both experienced and future teachers learn throughout their careers, and that this learning is inextricably linked to their experiences. Treating practice as a means of acquiring knowledge and valuing it as a form of training has transformed our understanding of teacher training (Paiva & Gualandi, 2023, p. 142).

Interactions between the school and the institute through this group enabled training in which practical knowledge (Cochran-Smith & Lytle, 1999) contributed to our professional development.

The interventions were evaluated at weekly meetings. The residents, who conducted the teaching process, and the attendees, who recorded their observations, focused their attention on the action in order to understand the process and reconsider the ideas and concepts proposed during the intervention. The dialogues established during the interventions were also considered when evaluating and restructuring our statements and observations to achieve a broader understanding of the phenomenon. As Charlot (2005) says, it is a process in which the individual becomes the bearer and generator of meaning, playing a leading role in the production of teaching knowledge.

As we progressed through the program, we reiterated our collective planning actions, theoretical studies and report writing in the third and final module. At this point, we introduced some in-person interventions, generating new momentum for the program and leaving the group feeling both excited and anxious.

According to the residents, their experiences in the final semester of the PRP provided valuable learning opportunities and increased their motivation to interact with teachers and students at the school. They emphasized that the in-person intervention enabled them to obtain additional information from the school environment that remote assistance did not provide, such as students' comments, gestures and expressions, and dialogue that was more focused on the class objectives. Some of the highlights they mentioned are transcribed below.

It is also important to acknowledge the collective commitment of everyone involved in the intervention, from the program residents and supervising professor to the supervising teacher and students. Thanks to this participation, we were able to develop our perspective as future teachers by sharing suggestions, criticism and experiences, thus once again fulfilling the objectives of the Pedagogical Residency program (Module 3 Report – March 2022).

Contact with other teachers and trainee teachers in the field school classrooms provided us with the opportunity to reflect on our teaching practices and improve our professional identity. Thus, we also developed our teaching skills through interaction with others, based on experimentation and dialogue, and by considering a democratic approach to knowledge production involving the participation of teachers, residents and students in basic education (Module 3 Report – March 2022).

Thus, by reflecting on the residents' experience and professional development throughout the program, we started to analyse the interventions as a process of developing Mathematics for Teaching collectively, in an investigative and reflective manner. Throughout this process, our views on teacher training evolved. Furthermore, we analysed the attitude of a teacher who, when reflecting collectively, viewed the classroom as a space for improving their practice through research and expanding teaching concepts (Davis & Renert, 2014).

The next step was to start writing experience reports for technical-scientific events and for submission to magazines and journals. We understood that the residents had adopted this investigative approach, which is intrinsic to teaching identity (Ramos et al., 2023; Zetum et al., 2023; Pereira, Milli & Paiva, 2022; Silva et al., 2021; Vieira et al., 2021).

Table 1 below presents the intervention experiences worked on during the three PRP development modules. It describes each intervention's module and year of implementation, title, content, theoretical and methodological references that guided teaching practice, work strategies aligned with the teaching proposal and consultation format.

Tabela 1.

Experiências de intervenções desenvolvidas no Programa de Residência Pedagógica

Year/ Module	Title of the Intervention	Content	Theoretical/methodological references	Work Strategy	Type of Service
2020 Module 1	Do you know how much you earn and how much you spend?	Introduction to Financial Mathematics	Problem Solving Perspective	Use of a Digital Mathematical Performance (PMD) and questionnaire in Google Forms	All Remote Google Classroom
2020 Module 1	Problem Solving involving Chances and Possibilities: adaptation of the Monty Hall Problem	Probability	Problem Solving Perspective	Classroom dialogue with slide presentation and questionnaire in Google Forms	All Remote Google Meet
2021 Module 1	"Pirate in search of treasure" problem	Point, distance between points, midpoint	Perspective of Problematic Mathematics	Classroom dialogue using a video class and questionnaire in Google Forms	Hybrid: Students in-person and residents via Google Meet
2021 Module 1	Line Equation, angular coefficient and slope-intercept	Line Equation, angular coefficient and slope-intercept	Software and technologies for teaching mathematics	Classroom dialogue using Geogebra software and questionnaire in Google Forms	Hybrid: Students in-person and residents via Google Meet
2021 Module 1	Problem Solving about Affine Function	Affine Function	Problem Solving Perspective	Classroom dialogue using a video class and questionnaire in Google Forms	All Remote Google Meet
2021 Module 2	Information Processing and Streaming platforms	Reading, interpretation and construction of graphs and tables	Critical Mathematics Education and Scenarios for Research	Classroom dialogue with slide presentation and questionnaire in Google Forms	Hybrid: Students in-person and residents via Google Meet
2021 Module 2	Financial Mathematics and the construction of wheelchair ramps	Financial Mathematics; Simple and Compound Interest; Percentage	Mathematics Education Inclusive Perspective	Classroom dialogue with slide presentation and questionnaire in Google Forms	Hybrid: Students in-person and residents via Google Meet
2021 Module 2	Trigonometry in the right triangle and the trigonometric ratios in Geogebra	Trigonometry in the right triangle- sine, cosine and tangent	Software and technologies in an investigative perspective	Classroom dialogue with slide presentation and questionnaire in Google Forms	Hybrid: Students in-person and residents via Google Meet
2021 Module 2	Exponential function and Covid-19	Exponential function	Notions of the Semantic Field	Classroom dialogue with slide presentation and questionnaire in Google Forms	Hybrid: Students in-person and residents via Google Meet
2021 Module 3	Linear Systems and relative position between lines	Linear Systems and relative position between lines	Investigation in Mathematics Classes	Classroom dialogue with slide presentation and questionnaire in Google Forms	All In-person

2021 Module 3	Perspectives on geometric solids and the construction of sculptures with matchbox	Geometric solids and perspectives	Concept Study	Classroom dialogue with manipulable material and questionnaire in Google Forms	All In-person
2021 Module 3	Problem Solving involving Probability	Probability	Notions of the Semantic Field	Classroom dialogue with manipulable material and questionnaire in Google Forms	All In-person
2022 Module 3	Financial Mathematics and the relationship with PA and PG	Simple and compound interest, Arithmetic and Geometric Progressions	Concept Study	Classroom dialogue and questionnaire in Google Forms	All In-person

In light of all these experiences, and in the process of writing about and researching our own teaching practices alongside the collective reflections we have developed, we would like to highlight some of the contributions provided by the PRP. We consider two areas that are relevant in this regard: the initial training of teachers and its impact on the school environment.

Furthermore, our experiences in the PRP enabled us to revisit our classroom practices and contemplate the formation of our teaching identities. By talking with our peers, students and maths teachers, we created a space where different working perspectives came together, enabling us to connect with the knowledge that constitutes our profession. This process changes how we see ourselves as teachers when talking with others, thus transforming us as maths educators.

The training process enables us to recognise that, by placing ourselves in an uncertain and vulnerable position during our lessons, we are strengthened by adopting a humble stance and embracing the opportunity to learn from others. By opening our classrooms to other teachers, we enabled them to experience and contribute to our practices, thus improving the quality of teaching and offering different perspectives. We listen more closely to our primary school pupils and treat them in a more welcoming and attentive manner. This has enabled us to identify different perspectives that often go unnoticed during a 50-minute class when discussing a particular topic with a group of over 40 people.

We understand basic education as a space for producing knowledge (Davis & Rennert, 2014; Cochran-Smith & Lytle, 1999; Paiva, 2023), which contributes to consolidating different

teaching methods when teachers adopt an investigative, problematising stance and contribute their experiences to collective discussions. The PRP, as we experienced it, facilitates dialogue between these types of knowledge and initial and continuing education. This is because basic education and higher education have common educational objectives. Through teaching practice and school mathematics, future teachers develop their Mathematics for Teaching knowledge, which is the result of collective discussions and an open-minded approach that allows knowledge to emerge or be reinterpreted.

Another key aspect of this program was establishing a dialogue through observing our peers' teaching practices. Sharing the classroom with other professionals created a cooperative space in which we could work together to achieve a common goal, despite our different experiences. This alignment generated changes in experimentation as we reviewed our own practice. Therefore, by listening to our peers' suggestions and criticisms or engaging in the planning, validation and evaluation of collective teaching practices, we developed professionally and contributed to consolidating new knowledge.

It is also important to acknowledge the interaction between the various mathematical cultures that converge in this learning environment. These dialogues involve the 'different mathematics' brought to the classroom by teachers, residents, and basic education students, and they are closely related, thus establishing relationships between school mathematics, everyday mathematics, and academic mathematics. This is because they belong to the same field of knowledge and constitute the same field of science.

Thus, as we brought together aspects that had emerged from different spaces and classroom interventions, the knowledge changed and a different educational scenario began to emerge. These exchanges improved teaching resources, particularly the production of teaching materials as a pedagogical tool for mathematics education. As a result, primary school students benefit from a more dynamic mathematics education, with methodologies that differ from traditional approaches and consequent discussions of mathematics that generate new meanings in their learning processes.

Teachers and residents also benefited from collective training. They were constantly challenged to devise strategies to solve or minimise educational problems, particularly in the

teaching and learning of mathematics. They also put themselves in the position of students, recognising that teaching and learning are two sides of the same coin and that they can improve their professional knowledge through this process.

Finally, we emphasize that the PRP contributed essentially to the collective production of knowledge through experimentation and dialogical movements in a democratic space for knowledge production with the co-participation of teachers and students. Thus, whether in the classroom, in meeting spaces, in AVA forums, in writing reports, or in discussions beyond these spaces, it was through collective work that we improved professionally, learned to be teachers, and became professionals attentive to listening to others with a view to changing our realities.

Final remarks

Returning to the objective of this article — to present the impact of the Pedagogical Residency program on everyday school life in the context of the challenges of teacher training posed by the Covid-19 pandemic — we made some observations. Firstly, we were able to articulate this proposal by encouraging reflections on the potential contributions of the PRP as a training space for mathematics teachers.

In this way, we valued the dialogue and knowledge that was built collectively between the mentor teacher in primary education, the supervising teacher in higher education and the trainee resident teachers who moved between these spaces during their initial training through the PRP, and who may practice their profession in these academic spaces after completing their teaching degree.

Furthermore, we would like to emphasize that, in this experience, elementary school became a training space and benefited directly from the program's activities inside and outside the classrooms, which undoubtedly had a positive impact on elementary school students. We also view elementary school as a space for producing knowledge and for teacher training, whether continuing or initial. Experiencing the work environment to consolidate teaching knowledge and encourage reflection towards a professional identity has become fundamental, even for those not directly involved in elementary education.

Additionally, we emphasize the need for public policies, such as the Pedagogical Residency program, that priorities teacher professionalization. We hope that these reflections and discussions will contribute to the teaching profession receiving the respect and appreciation it deserves.

References

- Barbosa, J. C. (2017). Uma abordagem discursiva para a matemática para o ensino. In Congreso Iberoamericano de Educación Matemática, 8., Madrid. Actas.
- Campos, A. P. de M., & Paiva, M. A. V. (2019). Percepções de professores que ensinam matemática: O que é medir? Revista eletrônica Sala de aula em Foco – Ifes, 9(1), 15-27.
- Brasil, Capes. (2020). Edital Programa Residência Pedagógica edital n.1, 2020. <https://www.gov.br/capes/pt-br/centrais-de-conteudo/06012020-edital-1-2020-residencia-pedagogica-pdf>
- Campos, A. P. de M., Paiva, M. A. V., & Soares, M. A. V. (2023). Investigação do conceito de área com professores que ensinam matemática: (Re)significação de saberes de matemática para o ensino. In M. A. V. Paiva (Org.), Matemática para o ensino na formação de professores (1ª ed., vol. 1, pp. 59-82). Vitória: Edifes.
- Cochran-Smith, M., & Lytle, S. L. (1999). Relationships of knowledge and practice: Teacher learning in communities. Review of Research in Education, 24, 249-305. American Educational Research Association.
- Cochran-Smith, M., & Lytle, S. L. (2009). Inquiry as stance: Practitioner research for the next generation. Teacher College Press.
- Charlot, B. (2000). Da relação com o saber: Elementos para uma teoria. Porto Alegre: Artmed.
- Charlot, B. (2005). Relação com o saber, formação dos professores e globalização: Questões para a educação hoje. Porto Alegre: Artmed.
- Davis, B., & Simmt, E. (2006). Mathematics-for-teaching: An ongoing investigation of the mathematics that teachers (need to) know. Educational Studies in Mathematics, 61(3), 293-319.
- Davis, B., & Renert, M. (2014). The math teachers know: Profound understanding of emergent mathematics. New York: Routledge.
- Giraldo, V., Rangel, L., Menezes, F., & Quintaneiro, W. (2017). (Re)construindo saberes para o ensino a partir da prática: Investigação de conceito e outras ideias. In IV Seminário Nacional de Histórias e Investigações de/em Aulas de Matemática, Campinas. Anais... VI SHIAM. Campinas: CEPEN, 1-18.
- Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (Inep). (2021). Resposta educacional à pandemia de COVID-19. Diário Oficial da República Federativa do Brasil, Brasília.
- Instituto Federal do Espírito Santo. (2020). Projeto Institucional do Programa Residência Pedagógica do Ifes – 2020-2021. Instituto Federal do Espírito Santo, Vitória.

- Lins, R. C. (2004). Matemática, monstros, significados e Educação Matemática. In M. A. V. Bicudo & M. de C. Borba (Orgs.), *Educação Matemática: Pesquisa em movimento*. São Paulo: Cortez.
- Lins, R. C. (2012). O modelo dos campos semânticos: Estabelecimento e notas de teorizações. In C. L. Angelo et al. (Orgs.), *Modelo dos campos semânticos e educação matemática: 20 anos de história* (pp. 11-30). São Paulo: Midiograf.
- Lüdke, M., & André, M. E. D. A. (1986). *Pesquisa em educação: Abordagens qualitativas*. São Paulo: Editora Pedagógica e Universitária.
- Menduni-Bortoloti, R. D. (2016). Um estudo sobre a matemática para o ensino de proporcionalidade (Tese de Doutorado). Programa de Pós-Graduação em Educação, Universidade Federal da Bahia, Salvador.
- Ministério da Educação (MEC). (2018). Portaria Nº 38, de 28 de fevereiro de 2018. Institui o Programa de Residência Pedagógica. Diário Oficial da República Federativa do Brasil, Brasília.
- Onuchic, L. dela R., & Allevato, N. S. G. (2011). Pesquisa em resolução de problemas: Caminhos, avanços e novas perspectivas. *Bolema*, 25(41), 73-98.
- Paiva, M. A. V. (2018). Proeja's classroom as a teacher training space. *Revista Internacional de Pesquisa em Educação Matemática – RIPEM*, 8(2), 60-71.
- Paiva, M. A. V., Cade, N. V. L., & Giraldo, V. (2022). Uma matemática problematizada para o ensino de equações diofantinas lineares na formação inicial de professores. *Revista Acta Latino-americana de Matemática Educativa*, 33(1), 591-600.
- Paiva, M. A. V., Sousa, T. B. de, & Campos, A. P. de M. (2021). Experiências formativas embasadas na matemática para o ensino e no concept study. In *Seminário Internacional de Pesquisa em Educação Matemática, Uberlândia. Anais eletrônicos...* Uberlândia: SIPEM.
- Paiva, M. A. V., & Gualandi, J. H. (2023). Investigação de conceito na formação inicial: Saberes de matemática para o ensino. In M. A. V. Paiva (Org.), *Matemática para o ensino na formação de professores* (1ª ed., vol. 1, pp. 140-158). Vitória: Edifes.
- Pereira, A. G. de M., Milli, E. P., & Paiva, M. A. V. (2022). Covid-19 e plataformas de streaming: Intervenções no Programa Residência Pedagógica à luz da Educação Matemática Crítica. *Revista Paranaense de Educação Matemática*, 11, 542-556.
- Ponte, J. P., Brocado, J., & Oliveira, H. (2019). *Investigações matemáticas na sala de aula*. Belo Horizonte: Autêntica.
- Ramos, L. S., et al. (2023). Resolução de sistemas lineares: Uma proposta de intervenção matemática na residência pedagógica. *Revemat*, 18, 1-21.
- Rangel, L. G., & Maculan, N. (2014). Matemática elementar e saber pedagógico de conteúdo: Estabelecendo relações. *Professor de Matemática On Line*, 2(1), 1-14.
- Skovsmose, O. (2000). Cenários para investigação. *Bolema*, 13(14), 66-91.
- Skovsmose, O. (2014). *Um convite à educação matemática crítica*. Campinas: Papirus.
- Skovsmose, O. (2019). Inclusões, encontros e cenários. *Educação Matemática em Revista*, 64, 16-32.

- Silva, F., et al. (2021). Você sabe quanto ganha e quanto gasta? Uma experiência remota no Programa Residência Pedagógica. In IX Seminário Nacional da Licenciatura em Matemática, Cachoeiro de Itapemirim. Anais eletrônicos.
- Vieira, D. M., et al. (2021). O ensino de equação de retas por meio do Geogebra: Uma experiência remota. In XII Encontro Capixaba de Educação Matemática, Cachoeiro de Itapemirim. Anais eletrônicos.
- Zetum, A. F. S., et al. (2023). Rampas de acessibilidade e a construção de significados para seno, cosseno e tangente: Uma experiência no Programa de Residência Pedagógica. Educação Matemática em Revista, 28, 1-11.