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Mathematics Teachers' Pedagogical Practices in Emergency Remote Teaching in a Brazilian Municipality

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Abstract

In this article, we reflect on pedagogical practice, linking it to the aspects and contexts that emerged with the implementation of emergency remote teaching. The objective is to investigate Mathematics teachers' perceptions of the work developed and the support received during pedagogical practices in the emergency remote teaching period. To better understand this issue, an exploratory and descriptive study with a qualitative approach was conducted, analyzing data collected from a study involving eight mathematics teachers from primary and secondary education. The results indicate that teachers faced significant challenges in balancing remote activities with their personal lives. However, they believe that mathematics teaching practices in the remote setting provided meaningful learning experiences for their pedagogical actions. Consequently, some experiences from emergency remote teaching will be incorporated into in-person Mathematics classes. The study also found that teachers' frequent participation in social media groups helped them in the development of activities. Ultimately, this study may serve as a reference for approaches that consider teaching pedagogical practices.

Keywords

pedagogical practices; mathematics teaching; pandemic; emergency remote teaching; digital technologies

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Práticas pedagógicas de professores de matemática no ensino remoto emergencial em um município brasileiro

Resumo

Neste artigo, refletimos sobre a prática pedagógica, associando-a aos aspectos e contextos surgidos com a implementação do ensino remoto emergencial. O objetivo é investigar a percepção dos professores de Matemática sobre o trabalho desenvolvido e o apoio recebido durante as práticas pedagógicas no período de ensino remoto emergencial. Para entender melhor essa questão, foi realizada uma pesquisa exploratória e descritiva, com abordagem qualitativa. Apresentamos a análise e discussão dos dados coletados de uma pesquisa com oito professores de Matemática da Educação Básica. Os resultados indicam que os professores enfrentaram dificuldades significativas para conciliar as atividades remotas com a vida pessoal. No entanto, consideram que as práticas de Matemática no ensino remoto proporcionaram aprendizagens significativas para suas ações pedagógicas. Além disso, algumas experiências do ensino remoto emergencial serão incorporadas às aulas presenciais de Matemática. A participação dos professores em grupos de redes sociais foi frequente e auxiliou na elaboração das atividades. Este trabalho pode servir como referencial para abordagens que considerem a prática pedagógica docente.

Palavras-chave

práticas pedagógicas; ensino de matemática; pandemia; ensino remoto emergencial; tecnologias digitais

Prácticas pedagógicas de los profesores de matemáticas en la enseñanza remota de emergencia en un municipio brasileño

Resumen

En este artículo, reflexionamos sobre la práctica pedagógica, asociándola a los aspectos y contextos surgidos con la implementación de la enseñanza remota de emergencia. El objetivo es investigar la percepción de los profesores de matemáticas sobre el trabajo desarrollado y el apoyo recibido durante las prácticas pedagógicas en el período de enseñanza remota de emergencia. Para comprender mejor esta cuestión, se llevó a cabo una investigación exploratoria y descriptiva con un enfoque cualitativo. Presentamos el análisis y la discusión de los datos recopilados en un estudio con ocho profesores de matemáticas de educación primaria y secundaria. Los resultados indican que los docentes enfrentaron dificultades significativas para conciliar las actividades remotas con su vida personal. Sin embargo, consideran que las prácticas de matemáticas en la enseñanza remota proporcionaron aprendizajes significativos para su labor pedagógica. Como consecuencia, algunas experiencias de la enseñanza remota de emergencia serán incorporadas a las clases presenciales de matemáticas. Con este estudio también se encontró que la participación de los docentes en grupos de redes sociales fue frecuente y contribuyó a la elaboración de las actividades. Este trabajo puede servir como referencia para enfoques que consideren la práctica pedagógica docente.

Palabras clave

prácticas pedagógicas; enseñanza de las matemáticas; pandemia; enseñanza remota de emergencia; tecnologías digitales

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Introduction

With the consequences arising from the outbreak of the Covid-19 pandemic and the social isolation established worldwide in 2020, based on guidelines published by official agencies, Brazilian teachers had to propose a new direction for their didactic and methodological approaches in order to teach remotely. In this new format, teachers and students were not physically surrounded by desks, a board, or classroom routines; leading teachers to rethink their strategies for remote instruction and to adapt their pedagogical practices to this format.

In March 2020 in Brazil, after only a month and a few days of in-person classes, school communities at the federal, state, and municipal levels were suddenly faced with regulations, resolutions, decrees, and legislation suspending in-person school activities, due to the high rate of contamination caused by the SARS-CoV-2 virus, responsible for the Covid-19 disease. The reactions of society ranged widely: fear, insecurity, unpredictability, uncertainty, and the reorganization of personal and collective practices.

In the Brazilian context, social inequalities—already present before the pandemic—intensified the learning discrepancies among students, since most of their families do not have internet access or, if they do, rely on pre-paid mobile data plans with limited, slow-speed data. Consequently, the difficulty of interaction between teachers and students intensified throughout the country, as reported by Basso, Fioratti, and Costa (2020).

Antunes (2022) points out that the health crisis caused by Covid-19 in Brazil heightened social, economic, and labor inequalities, revealing the worsening of working conditions and the unequal situations faced by the most vulnerable groups. Issues such as the commodification of healthcare, the expansion of remote work, and its impacts on the working class, underscored the link between capitalism, exploitation, and global crisis.

To ensure the provision of Education during the Covid-19 pandemic, Brazil's Ministry of Education (MEC) adopted several measures, such as making the number of school days in Primary and secondary education more flexible and creating the Emergency Operational Committee (COE) to establish the main guidelines for the Brazilian educational system. Resolution CNE/CP No. 2 of December 10, 2020 (Brazil, 2020) established guidelines from the National Education Council (CNE) authorizing educational systems to use remote activities, counting them toward fulfilling required instructional hours.

Accordingly, this study aims to investigate mathematics teachers' perceptions of the work performed and the support received in carrying out pedagogical practices

during the period in which emergency remote teaching was instituted in a Brazilian municipality.

This text consists of a contextualization regarding education in social isolation, followed by a theoretical discussion of pedagogical practices during the pandemic. The following section outlines the methodology, including the research design and the procedures employed. We then present and discuss the data that emerged from the investigative process— this section constitutes the analytical core of the study— before offering final considerations, not as a definitive product but as insights for future expansions and debates in the field of Mathematics Education.

Theoretical Framework

Practice assumes the dimension of the real; it is materialized through concrete, historically situated actions that manifest within everyday life. It involves the actualization of intentional doing—a synthesis of knowledge, values, and decision-making that derives meaning from lived experience. When qualified as pedagogical, this practice is linked to the scientific field of Pedagogy, which is concerned with understanding, guiding, and problematizing educational processes aimed at human formation.

In this sense, teaching pedagogical practice goes beyond the mere execution of tasks or the mechanical application of teaching methods and techniques. It encompasses the set of intentional actions performed by the teacher around the planning, mediation, and evaluation of educational activities, considering sociocultural contexts, students' needs, and the proposed formative objectives. By acting in this manner, the teacher mobilizes theoretical knowledge and practical experiences to create conditions that favor the construction, expansion, and refinement of learning, contributing to the intellectual, social, and critical development of the individuals involved in the educational process.

According to Sandes and Moreira (2018), the pedagogical practice is regarded as a set of assumptions, beliefs, attitudes, and educational actions carried out by the teacher with the goal of promoting and enhancing learning and cognitive development of students, in partnership with the school community.

Research by Martins and Macêdo (2023), Santos and Macêdo (2023, 2024), and Silva and Macêdo (2025, 2026) highlights that pedagogical practices entail an extremely intense daily routine for teachers, many of whom work in two or more educational institutions. Among the primary demands of in-person teaching are lesson planning, diversifying activities, providing individualized support to students, and adopting innovative and inclusive pedagogical strategies capable of meeting the

needs of different student profiles. With the shift to remote teaching during the pandemic, these challenges were amplified, requiring additional efforts to adapt pedagogical practices and ensure their effectiveness under a context laden with extra difficulties.

In the school context, routines are arranged in a fragmented, homogeneous format, despite the inherently heterogeneous nature of the individuals who compose the school community. Pedagogical practices must accommodate the entirety of these individuals. It is essential to move beyond the idea of pedagogical practice as merely the transmission of knowledge to passive subjects, especially if the aim is to form critical, reflective, proactive citizens (Verdum, 2013).

According to Souza (2005), it is possible to identify two major groups of pedagogical practices: reproductive pedagogical practices and unsettling pedagogical practices. The former reflects the need to establish control over students in the classroom, as most of them are resistant and inflexible to the strategies and educational processes being used. The latter, in turn, trigger a sense of unease among teachers, prompting them to reflect on their own practices and to seek more assertive and effective pathways to teaching. The first set of practices focuses on transferring concepts and content, while the second set encourages questions and inquiries among students based on the sharing of issues and prior knowledge (Souza, 2005).

Teaching competence evolves as it assimilates the understanding that the transformation of pedagogical practice is linked to a conscious practice, which requires continuous reflection throughout its course (Verdum, 2013).

Accordingly, mathematics teacher training should prioritize the interpretation, adaptation, and understanding of curricular topics that reach students, placing a premium on students' prior knowledge and their own lived experiences (Serrazina, 2002).

There is no single methodology that guarantees 100 % effectiveness for mathematics teaching. Various possibilities can support the teaching process: the history of mathematics, digital tools, hands-on materials, and games as methodological resources are examples of such options (Andrade, 2013).

In this regard, Passos and Nacarato (2018) state:

> There is no single educational practice related to Mathematics; there are various paths that are constantly being questioned because they have their reach and limitations. The teacher, familiar with his or her class and the knowledge that circulates in it, needs to have flexibility and autonomy to manage these events. (Passos & Nacarato, 2018, p. 8).

Mathematics teaching is a dynamic approach, as its application allows the teacher not to be confined to one methodology alone. Even a specific real-life situation can serve as the starting point for learning a mathematical concept. For this

reason, it is essential for teachers to continually seek training that will significantly contribute to and be reflected in their pedagogical practice.

Silva, Sousa, and Medeiros (2020) emphasize that mathematics teachers must adapt their methodological approaches in line with students' realities to achieve their proposed instructional objectives. They should also create learning situations that help students realize that mathematical knowledge is socially grounded, rather than mere concepts restricted to the academic setting.

Schools need proactive professionals who can motivate students to pursue knowledge. As Silva, Sousa, and Medeiros (2020) point out, "The teacher is essential for learning to occur, as they act as mediators in the construction of knowledge by linking content to students" (p. 127). This role is particularly critical for mathematics teachers, who confront a chronic challenge: the widespread collective belief, held by most people, that mathematics instruction is boring, incomprehensible, and pointless (Moura, 1993).

Providing continuing education for Brazilian teachers was one of the initial concerns of governments at all levels, as well as of Federal, State, and Municipal Departments of Education, at the outset of emergency remote teaching (Basso, Fioratti & Costa, 2020).

At that point, it became apparent that teachers lacked sufficient mastery of technological and digital resources. This deficit prompted rapid and remote initiatives designed to deliver continuing education programs for these professionals within a short time frame. As Silva, Petry, and Uggioni (2020) state:

> With social distancing measures in effect, driven by distancing policies, schools and, therefore, both students and teachers were compelled to utilize digital tools on a large scale to replace in-person classes. This situation harshly exposed the shortcomings of education in the country [Brazil]. (Silva, Petry & Uggioni, 2020, p. 21-22).

Borges (2016) points out that a 1996 United Nations Educational, Scientific and Cultural Organization (UNESCO) report, led by Jacques Delors, underscores the global interdependence of technological information systems in the 21st century. It highlights the vast possibilities generated by the massive use of these systems while warning of widening gaps and inequalities between wealthy and impoverished nations.

In emergency remote teaching, education reinvented itself, restructured, and reorganized around the incorporation of varied methodologies, creating a new school culture based on technological possibilities in a networked world (Rambo, 2020). Digital tools and platforms gradually found their place in remote classes, becoming a potential — though not the only — strategy for that period.

From this perspective, no matter how effective technologies may be, they will never replace teachers or the dynamics of socialization, interaction, and value formation that teachers present and develop — dimensions that stem from human actions and cannot be performed by technological resources (Schütz & Fuchs, 2020).

Right after the first opportunities for professional development of teachers, pedagogical teams, and administrative staff, along with the promulgation and dissemination of decrees, ordinances, and resolutions throughout Brazil; the first strategies emerged in line with emergency remote teaching. One of the earliest steps was establishing communication with students, which took place primarily via the WhatsApp application. Overall, through collective efforts, schools compiled data regarding internet connectivity for both students and staff, including the internet type and the specific devices available for remote instruction. These details formed part of an initial assessment.

Given the heterogeneity of the Brazilian public school population, distinct student profiles were identified and documented: students without any internet access or devices like computers or smartphones; students with limited mobile internet data and mobile devices; and students with full access to the internet, smartphones, and computers — a pattern that also occurred in other nations like Argentina, as pointed out by González and Arévalo-Wierna (2023).

The first group of identified students received printed materials and assignments prepared by their teachers and distributed through their schools (Schneiders, 2020). In this way, all students enrolled in educational institutions across Brazil had at least some access to the materials proposed during emergency remote teaching.

It is important to note that completing assignments was not necessarily confined to a specific time slot. Because WhatsApp was predominantly used as a support tool, message flow and reception often occurred outside teachers' normal working hours, causing these professionals to work considerably more — even on weekends and holidays. To some extent, this situation invaded the teachers' privacy, as they had to share their personal social media accounts and private phone numbers with a large number of students.

In response to requests from several state departments, digital apps were developed to offer materials such as texts, videos, links, and workbooks as yet another route for instruction. Schneiders (2020, p. 213) highlights a contrasting viewpoint: "Engaging in and teaching [...] doesn't seem to be a good option for historical/civic individuals in training — especially with what appears to be the nearly indiscriminate use of digital apps like cell phones, computers, and televisions."

Oliveira et al. (2020) argue that schools, as spaces of social interaction and learning, long displayed indifference toward the integration of technological realities in the classroom and, consequently, did not adequately keep pace with technological advancements.

Overall, we can identify a range of pedagogical strategies that teachers employed nationwide: online platforms, pre-recorded video lessons shared on social media, digital materials, live online classes, televised instruction, guidance via social media, tutorials in online chats, materials and guidance posted on departmental websites, information and activity guidelines shared with parents or guardians, and the distribution of printed materials, as shown by research conducted by Martins and Macêdo (2023), Santos and Macêdo (2023, 2024), Murga Meler (2024), Ruas, Macêdo, and Crisostomo (2024), and Oliveira and Macêdo (2025).

Hence, the Covid-19 pandemic altered how various social and commercial institutions operated and functioned. It changed not only how students learn and teachers teach but also led to more flexible class times and study schedules, in addition to reshaping how knowledge and learning could be accessed.

Methodology

In striving to understand a subjective phenomenon —teachers' perceptions about their pedagogical practices during remote education— we opted for an investigative perspective grounded in qualitative research.

In a qualitative study, the researcher guides the inquiry by constructing descriptive data about participants, environments, and interaction processes between the researcher and the situation being studied, with the aim of comprehending these phenomena through the participants' perspectives. Thus, the answers to the research question emerge from the viewpoint of those involved in the study (Godoy, 1995).

Because the proposed objective seeks to comprehend a specific phenomenon, the study can be classified as exploratory and descriptive, based on its analytical approaches. Moreover, it is characterized as a case study, given that it describes what was carried out by the research participants in relation to the reality under investigation.

Data collection involved all active mathematics teachers who taught in 2020 and 2021 —totaling eight teachers— employed at public Primary and secondary schools in Capitão Enéas, a municipality in northern Minas Gerais State, Brazil. Teachers were invited via email and WhatsApp. All contacted mathematics teachers in the municipality agreed to participate in the research, and data were collected in the first half of 2022. Table 1 summarizes the teachers' education, year of graduation, age, and time spent teaching.

The data in Table 1 show the diversity in training, length of service, and age of participating teachers, revealing a group with significant professional experience. Most completed their undergraduate studies between 2009 and 2017, primarily holding a Teaching Degree in Mathematics. About half are between 36 and 45 years

old, while others are 46 or older. In terms of years in the classroom, their experience ranges from novice (0 to 10 years) to extensive (20 or more years), though most have between 11 and 20 years of teaching experience. This diversity of teaching experience can influence both the choice of pedagogical practices and how teachers adapt to today's educational demands

Table 1.
Characterization of Study Participants

Teacher	Degree	Year of Graduation	Age	Years of Experience
1	Specialization in Guidance, Inspection, Supervision, and Planning in School Management	2001	46 years or older	20 or more years of career
2	Teaching Degree in Mathematics	2009	46 years or older	11 to 20 years completed
3	Teaching Degree in Mathematics	2009	36-45 anos	11 to 20 years completed
4	Teaching Degree in Mathematics	2010	36-45 anos	20 or more years of career
5	Teaching Degree in Mathematics	2014	36-45 anos	0 to 10 years completed
6	Teaching Degree in Mathematics	2014	26-35 anos	0 to 10 years completed
7	Teaching Degree in Mathematics	2015	36-45 anos	11 to 20 years completed
8	Teaching Degree in Mathematics	2017	36-45 anos	11 to 20 years completed

Note. Own elaboration.

Between 2020 and 2021, four of these teachers were considered at-risk for Covid-19 by the Ministry of Health. Half reported having been infected by the virus that causes the disease, and five had confirmed Covid-19 cases among family members.

Ultimately, all eight research participants reported that some of their personal habits changed at the start of the pandemic. Regarding their pedagogical practices, seven teachers said they were positively influenced by the pandemic.

This study aimed to investigate mathematics teachers' perception of the work they carried out and the support they received in developing pedagogical practices during the period of emergency remote teaching. Broadly, the study was structured based on the contributions from the teachers who formed the core of the analysis. The dialogue between empirical findings and theory was informed by legal documents, regulations, technical notes, and academic literature, as well as data regarding the pedagogical activities implemented by the participants.

Regarding ethical procedures, this study received approval from the Ethics Committee for Research at the State University of Montes Claros (Unimontes), Brazil. The Certificate of Presentation of Ethical Appreciation (CAAE) 53021021.3.0000.5146 was issued in accordance with consolidated terms under 5.158.904.

The data were analyzed based on the categorization technique, as proposed by Gibbs (2009), which consists of a systematic procedure for organizing and interpreting qualitative data. This technique allows for the definition of an analytical approach derived from the empirical material itself, through the identification of regularities, recurrences, and shared meanings present within the *corpus* of analysis. Categorization involves, therefore, the construction of a theoretical and descriptive idea that emerges from the careful and repeated reading of the data, articulating empirical descriptions with conceptual frameworks that enable the understanding of the investigated phenomenon.

In the following section, we present the data derived from the study, covering the information that fits into the category "pedagogical challenges in emergency remote teaching."

Data Analysis and Discussion

The empirical stage of this investigation focused on the pedagogical practices and perceptions of eight basic education mathematics teachers from the municipality of Capitão Enéas (MG), Brazil, who taught during 2020 and 2021 within the context of emergency remote teaching. Data collection was conducted through a structured questionnaire administered via Google Forms, which included closed-ended, open-ended, and multiple-choice questions, as well as five-point Likert scales. This instrument allowed for the capture of teacher stances and the description of experiences, difficulties, and pedagogical strategies adopted during the period. The response scales and categories were organized to cover dimensions such as professional profiles, the impact of the pandemic, and the use of digital tools, providing a blend of quantitative and qualitative data that informed the analysis and understanding of the investigated teaching experiences. Each item in the instrument included the following response options:

- Strongly disagree (if you 100 % disagree with the statement);
- Partially disagree (if you disagree with the statement, but not entirely);
- Neither agree nor disagree (if you are uncertain or neutral about the statement);
- Partially agree (if you agree with the statement, but not entirely);

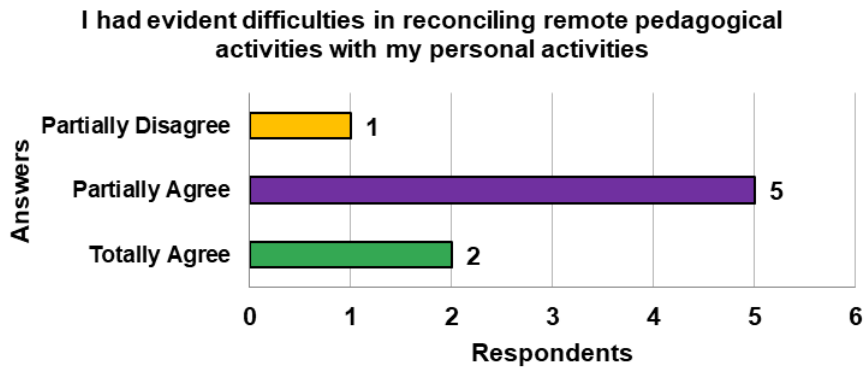
- Strongly agree (if you 100 % agree with the statement).

Challenges of Remote Teaching

This category explores the main hurdles teachers faced while working in emergency remote education, both professionally and personally. It includes the challenge of balancing pedagogical responsibilities with personal life (Figure 1) and the emotional impact resulting from this situation (Figure 2). The data demonstrate that many teachers struggled with workload and forced adaptation, underscoring the need for emotional support and proper working conditions.

Figure 1 presents responses about the difficulty in reconciling remote pedagogical activities with personal life demands.

Figure 1
Difficulties Reconciling Remote Pedagogical Activities with Personal Life



Note. Created by the authors based on research data (2022).

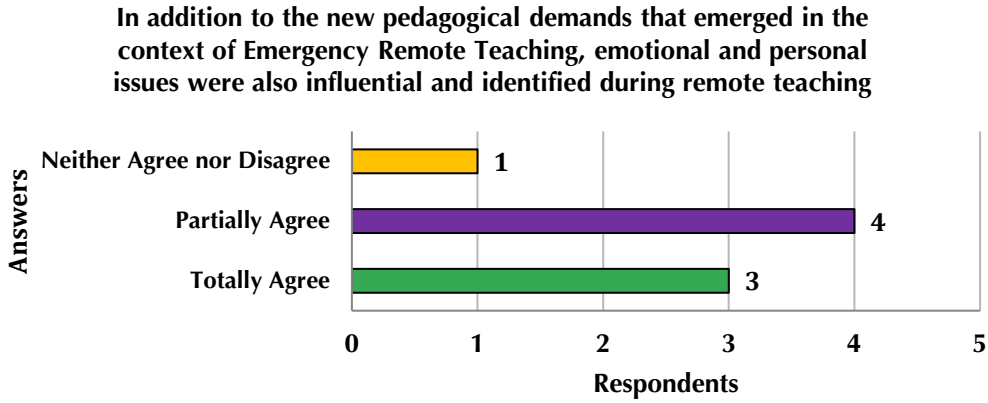
Emergency remote teaching posed significant challenges for teachers, who reported struggling to balance pedagogical tasks with personal responsibilities. This reflects how the heavy workload and new dynamics imposed by remote teaching had a direct impact on teachers' daily routines and overall well-being.

The analysis of the data presented in Figure 1 highlights the evident effort undertaken by professionals while working remotely from their own homes. However, a single respondent stated that they partially disagreed with the statement.

During emergency remote teaching, teachers had to juggle personal life responsibilities, family obligations, and household tasks. Many had their own children to help at home; while guiding their students remotely, they were simultaneously supporting their children in person, creating an excessive workload (Santos & Zaboroski, 2020).

Figure 2 below illustrates participants' views on whether, besides new pedagogical demands arising during emergency remote teaching, emotional and personal issues also became evident during remote teaching.

Figure 2
Emotional Influences Observed While Carrying Out Remote Activities



Note. Created by the authors based on research data (2022).

In addition to pedagogical demands, teachers indicated that emotional and personal challenges were significantly affected during remote teaching. These results highlight the need for emotional support and conditions that reduce the workload during transition periods and times of instructional change.

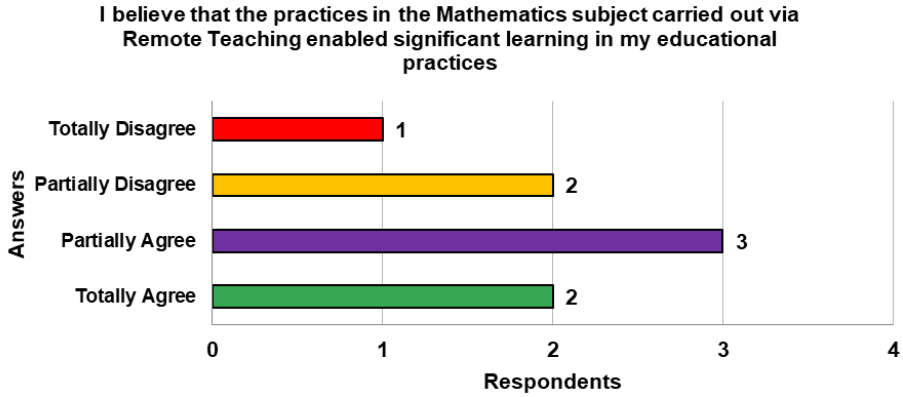
From Figure 2, we can infer that most teachers reported being impacted by emotional issues that intensified during the remote teaching period. These results align with Fioreze et al. (2021), who argue that emergency remote teaching itself revealed teachers' emotional vulnerabilities.

Effectiveness of Pedagogical Practices

This category examines the effectiveness of pedagogical practices applied remotely. It includes an assessment of how remote teaching contributed to meaningful learning (Figure 3) and the differences between remote and in-person activities (Figure 4). The findings suggest that while remote teaching provided learning opportunities, substantial methodological adjustments were necessary to address new demands.

When asked if the pedagogical practices in remote mathematics teaching led to meaningful learning in their educational practice, participants responded as shown in Figure 3:

Figure 3
Possibilities for Learning Through Remote Mathematics Approaches



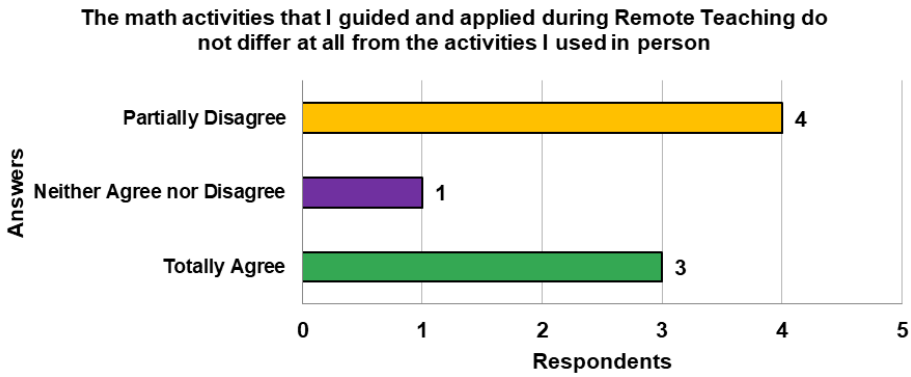
Note. Created by the authors based on research data (2022).

Five out of eight teachers interviewed believe that pedagogical practices used remotely allowed for meaningful learning in their teaching activities. However, two responded that they partially disagreed, and one strongly disagreed —indicating varying perceptions about the effectiveness of remote teaching for producing deep, lasting learning.

According to Behar (2020), the repeated changes required teachers to assume new learning processes, planning, and creative adaptations of lesson plans to develop and apply pedagogical approaches online.

Teachers were also confronted with a statement asserting that the mathematics activities they led and implemented during remote teaching did not differ from those used in-person. The participants' responses are shown in Figure 4 below.

Figure 4
Existence of Differences Between In-person and Remote Mathematics Activities.



Note. Created by the authors based on research data (2022).

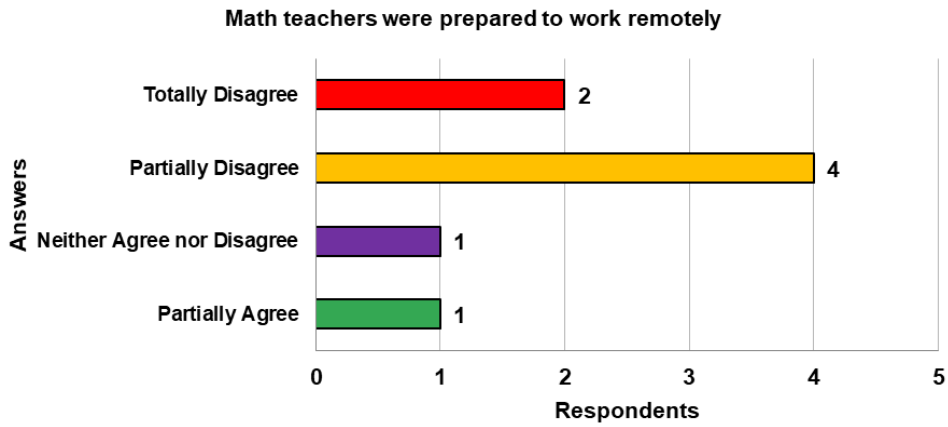
Teachers indicated that remote activities differed substantially from in-person ones. This outcome suggests that remote teaching demanded adaptations to methods and content, employing specific strategies suited to the limitations and possibilities of this teaching modality. Nevertheless, a few teachers classified remote and in-person activities as similar, which seems to contradict the inherent distinctiveness of each educational context.

Preparation and Training

This category focuses on teachers' readiness for remote teaching and the importance of ongoing training. The data show that only a small fraction of teachers felt prepared for remote teaching (Figure 5), reinforcing the need for specialized training. Furthermore, continuing education courses (Figures 6 and 7) were deemed crucial for enhancing instructional practices and assisting in the transition to emergency remote teaching.

As shown in Figure 5, only one teacher felt prepared to teach remotely when emergency remote teaching was introduced. This low level of preparedness reflects a lack of prior training for this instructional mode and highlights how vital it is to strengthen digital competence among teachers.

Figure 5
Teachers' Preparation to Work Remotely



Note. Created by the authors based on research data (2022).

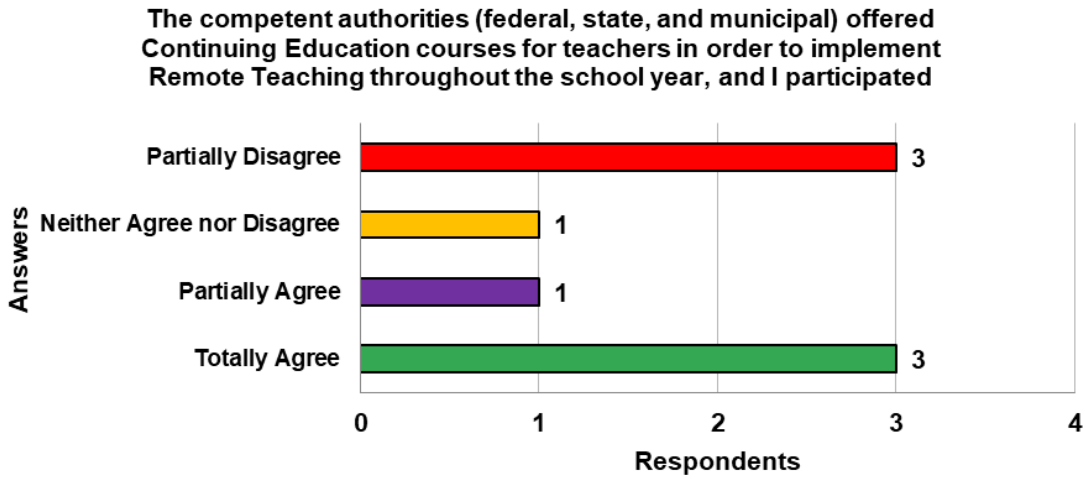
Santos and Halberstadt (2021) argue that Brazilian public education was not prepared to adopt emergency remote teaching throughout the country's educational institutions due to existing weaknesses in the in-person instructional model.

Continuing the discussion, teachers were asked whether any ongoing training programs were offered and whether they participated in them during 2020 and 2021. The data obtained are shown in Figure 6 below.

The data reveal that teachers had access to continuing education courses during 2020 and 2021. Such initiatives were essential in helping them adapt to the requirements of remote teaching, improving their pedagogical strategies and developing necessary competencies for this emergency scenario. However, the range of responses indicates that continuing education offerings remain clearly necessary.

Within this discussion, Macêdo, Almeida, and Voelzke (2016) maintain that success in using computational resources as a methodological tool requires teachers trained for that utilization. Consequently, it is the responsibility of public authorities to provide continuing education programs that help teachers employ such resources effectively. Teachers need to be knowledgeable about and proficient in the tools they incorporate into their teaching (Macêdo, Almeida & Voelzke, 2016).

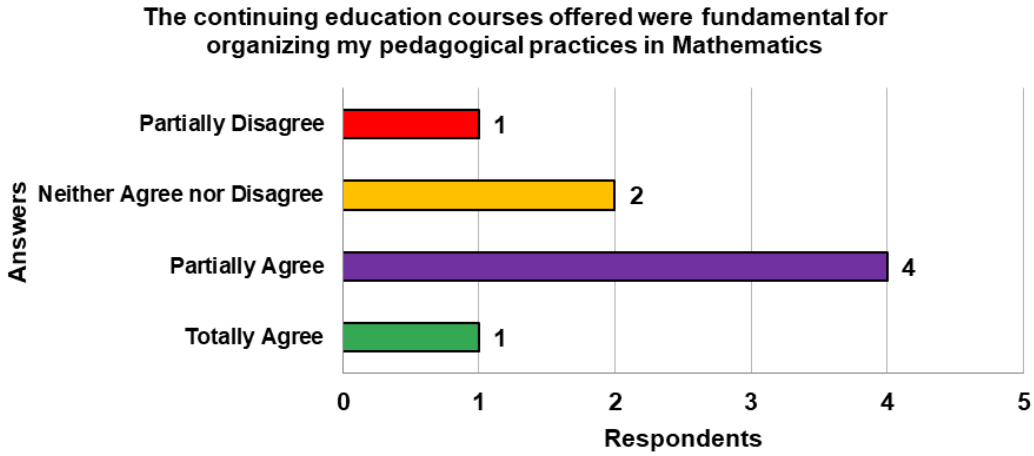
Figure 6
Provision of continuing education courses for teachers



Note. Created by the authors based on research data (2022).

Figure 7, shown next, depicts the respondents' views on the importance of continuing education courses for teachers during the period of emergency remote teaching.

Figure 7
The Importance of Continuing Education Provided to Teachers



Note. Created by the authors based on research data (2022).

Teachers recognized the importance of ongoing training programs during emergency remote teaching. This observation underscores the positive effect of these programs in supporting their work, helping them address technical, pedagogical, and emotional challenges.

Similarly, Flores and Lima (2021) state that "the force of circumstances led to a transformation that happened without adequate reflection, training, or preparation, forcing teachers to adapt their practices." (p. 95)

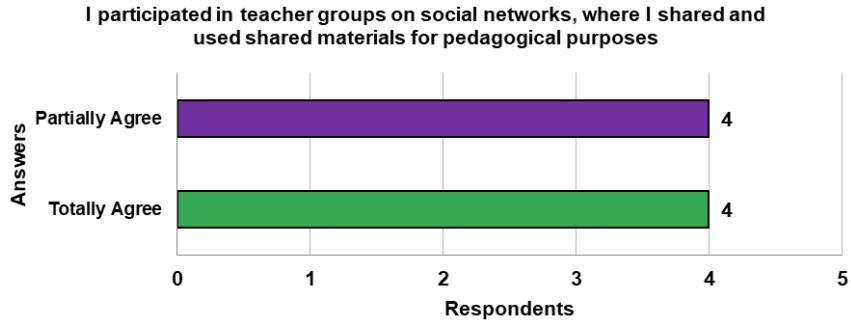
Collaboration and Resources

This category highlights how teachers exchanged materials and made use of teaching resources during remote teaching. The data confirm that teachers employed social media as a forum for pedagogical exchange (Figure 8), emphasizing the role of collaboration. Additionally, a balance existed between teachers creating their own materials (Figure 9) and using textbooks provided by schools (Figure 10), underscoring the importance of blending individual and institutional efforts.

Regarding teachers' participation in social media groups for pedagogical purposes, respondents were asked about exchanging knowledge, teaching materials, and information among peers during emergency remote teaching (Figure 8).

Figure 8

Teachers' Participation in Social Media for Pedagogical Purposes



Note. Created by the authors based on research data (2022).

Teachers reported that they shared their own materials and also utilized resources created by other educators via social media. This demonstrates the role of these platforms as spaces for collaboration and knowledge exchange, broadening pedagogical practices and improving the teaching-learning process.

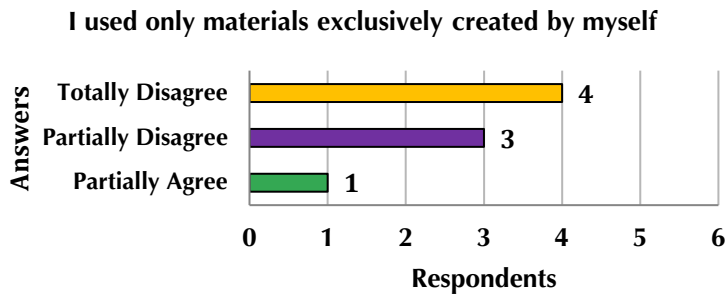
In keeping with this finding, Fioreze et al. (2021) note that amid the pandemic, in-person teaching activities had to undergo a sudden adaptation to the prevailing conditions. There was neither time for advance preparation nor for designing materials suitable for emergency remote teaching, all while the fear of death loomed as a tangible concern.

Teachers were asked whether the materials applied in their remote classes were produced entirely by them (Figure 9).

The teachers largely produced their own materials for remote classes. This autonomy in creating teaching resources shows their effort to adapt content to the needs of remote education, although it may also reflect a lack of suitable institutional materials for this scenario.

Figure 9

Preparation of materials by teachers

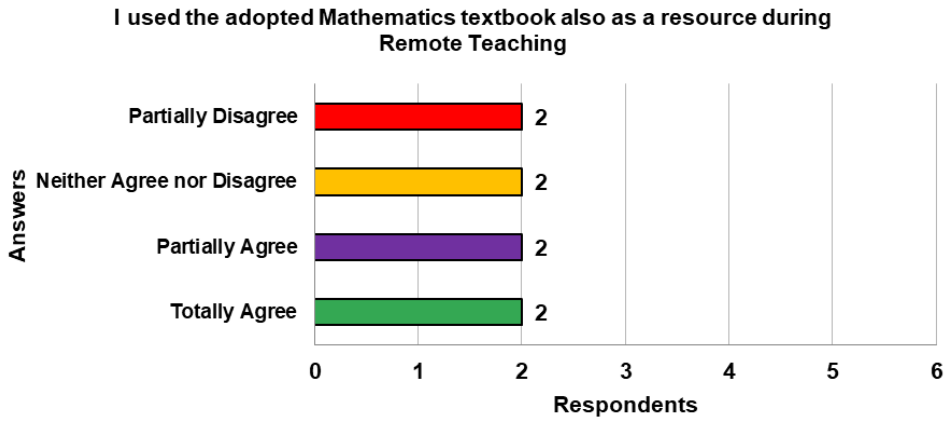


Note. Created by the authors based on research data (2022).

In this regard, Quequi, Fioreze, and Burigo (2021) argue that assistance and support among fellow teachers occurred frequently during emergency remote teaching, as they shared materials and insights, often relying on those more familiar with software, video production, and editing to guide others.

Figure 10, shown below, illustrates teachers' views regarding the use of official Mathematics textbooks during remote instruction.

Figure 10
Use of Textbooks (Research Data, 2022).



Note. Created by the authors based on research data (2022)

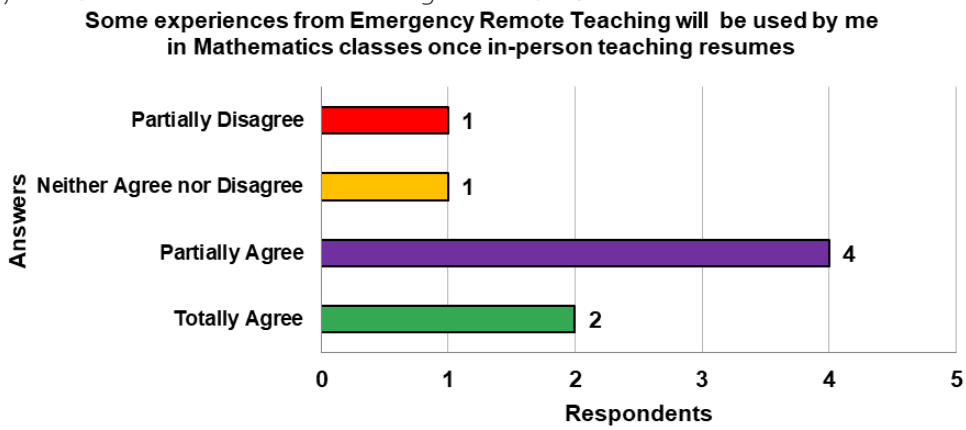
According to Figure 10, there was no uniformity among the participating teachers regarding the use of official mathematics textbooks as a pedagogical resource. It is noteworthy that only two teachers said they used textbooks remotely. Even so, textbooks remain an important support element in pedagogical practices, complementing teacher-produced materials and aiding in structuring and articulating the curriculum.

Adaptation of Practices upon Returning to In-Person Classes

This category reflects teachers' willingness to incorporate the practices and lessons learned during remote teaching into the in-person model (Figure 11). It demonstrates how the remote teaching experience prompted innovations and changes that can be valuable for in-person instruction, including digital strategies, active methodologies, and greater flexibility in conducting classes.

Figure 11

Use of Remote Practices When Resuming In-Person Classes



Note. Created by the authors based on research data (2022).

Many teachers noted that they plan to reuse some of the practices developed during remote teaching when resuming in-person instruction. This suggests the potential for innovating and adapting methodologies used remotely to enhance in-person teaching, ensuring continuity and growth in pedagogical practices.

In line with this observation, Fioreze et al. (2021) point out that the emergency remote teaching experience may alter routines and the organization of school activities in the post-pandemic period.

In the questionnaires, teachers were also asked how they evaluated students in mathematics. The teachers' statements regarding the situations they experienced included:

P-1: "It enabled knowledge creation in a collaborative, flexible, virtual environment."

P-2: "Through evaluation, Programa de Educação Tutorial — Tutorial Education Program (PET), activities."

P-3: "Through the feedback on activities sent to them."

P-4: "Assessment of learning left much to be desired. Students were not honest in completing the activities; teachers knew that most simply copied answers from the internet or from peers. Since that was a general situation, assessment came down to turning in activities on time, in full, and organized. Essentially, punctuality and responsibility in turning in assignments were graded, but it was impossible to measure each student's math understanding under those circumstances."

P-5: "By means of the proposed activities."

P-7: "Through participation and completion of the PETs."

P-8: "According to the levels of student engagement across all assessment strategies."
(Teachers' questionnaire responses via Google Forms, 2021)

Teachers' answers show that evaluations largely relied on participation and the submission and resolution of the activities assigned, especially using the Tutorial Education Program or PETs. While some teachers observed a collaborative, flexible virtual environment, the limitations were evident: many students did not genuinely engage with the content, often resorting to copying answers from the internet or classmates. Consequently, assessments ended up focusing on whether work was completed and turned in on time, rather than on more in-depth analysis of learning — particularly in mathematics.

These statements align with the discussions by Fioreze et al. (2021): "In public schools, grading was mainly based on participation and turning in assignments, given that formal exams could not be conducted. Some public schools did not even discuss how the evaluation process would take place" (p. 51). In terms of evaluation tools, teachers described various methods, but most relied on participation and assignment completion. From the perspective of the teacher cited as P-4, the "cheating culture" prevented her from truly reassessing her teaching methods based on what students learned. Evaluation should allow the teacher to determine whether to proceed with the objectives laid out for the term or to revisit a topic to address students' difficulties (Fioreze et al., 2021).

Regarding the concept of pedagogical practices in the context of emergency remote teaching, teachers conveyed ideas developed through their own experiences:

P-1: "An educational strategy using technology as an ally, to guarantee continuity of the school year."

P-2: "It meant new knowledge in learning."

P-4: "I rate my pedagogical practices as MODERATE. They were not the ideal I had hoped for, because to me, the ideal practice meets its objective. My pedagogical practices were enough to "tick boxes" for bureaucratic issues and do what was possible at the time, but they did not effectively lead students to learn. They fell short of their main goal — lacking that teacher-student contact that truly builds learning."

P-5: "They were difficult to implement."

P-7: "Fair."

P-8: "They were not sufficient; after all, students' difficulties were quite evident."

(Teachers' questionnaire responses via Google Forms, 2021)

The responses show that in the context of emergency remote teaching, teachers saw their pedagogical practices as constrained and challenging. While some recognized the role of technology in ensuring instructional continuity, many felt these practices failed to fully achieve learning objectives, describing them as "moderate"

or "fair." Challenges included diminished opportunities for direct teacher-student interaction. Overall, the teachers regarded these practices as sufficient to meet bureaucratic requirements but insufficient for promoting effective learning, underlining gaps in the educational process.

Based on what teachers experienced during the deployment of emergency remote teaching, they redefined and broadened the concept of pedagogical practices by incorporating the new knowledge they gained during this period. Their statements suggest that while they were teaching their students, they themselves were learning new approaches to facilitate remote learning.

Teachers also specified the changes in their pedagogical practices when comparing in-person and remote instruction:

P-1: "Physical and social contact."

P-2: "It changed, as I can now offer more resources to my students."

P-3: "I became more anxious, more tense. I spent a lot of time worrying about whether I would be able to produce good results by the end of the school year."

P-4: "I learned to value in-person classes even more and how those moments must be maximally utilized. I also learned that we must teach students to study on their own, so they become more independent of teachers for developing their skills, viewing teachers instead as facilitators of learning. That way, if something like remote teaching happens again, they'll know how to learn "on their own," or at least try to."

P-5: "There were many changes, including in teaching itself."

P-7: "Using technology as a teaching resource."

P-8: "It opened up a range of different technological resources."

(Teachers' questionnaire responses via Google Forms, 2021)

Their answers reveal substantial changes in pedagogical practices when shifting from in-person to remote teaching. The most prominent transformation was greater use of technological resources, expanding instructional possibilities. They also noted the loss of physical and social interaction with students, which affected the educational process. Some teachers mentioned heightened anxiety and tension due to adapting to remote teaching and concern for learning outcomes. Yet remote teaching also led to reflections on the need to foster greater student independence. Such changes reveal both the challenges and the lessons learned during emergency remote instruction.

These accounts demonstrate that teachers recognized various transformations in their professional practice, highlighting significant shifts between in-person and remote modalities. Specifically, social interaction, pedagogical opportunities, and emotional dimensions emerged as the primary areas that underwent clear changes during this period. Another data point offered by participants concerned how

communication between teachers and students was conducted over the course of emergency remote teaching:

P-1: "Through a WhatsApp group created by the school administration."

P-2: "Through WhatsApp, phone calls, etc."

P-3: "Through a WhatsApp group."

P-4: "Mainly via phone calls and WhatsApp."

P-5: "Observing all safety measures."

P-7: "Through WhatsApp."

P-8: "Through WhatsApp, video calls, phone calls, and other means."

(Teachers' questionnaire responses via Google Forms, 2021)

Communication between teachers and students during remote instruction occurred predominantly via WhatsApp, used both for groups set up by school administration and for direct interaction. Other tools, like phone calls and video calls, were also mentioned, increasing availability and support for students. In some cases, interactions also followed safety protocols to ensure everyone's well-being. WhatsApp was the main tool due to its widespread accessibility and user-friendliness.

Teaching and learning are two interactive actions that, in this scenario, depended on the resources each participant individually possessed. Regarding pedagogical practices specifically, teachers constantly faced new developments, experiments, use of digital resources, and sudden changes and adaptations that shaped their pedagogical work during emergency remote teaching.

Considerations

Given these findings, it is essential to examine the strategies employed by mathematics teachers to navigate the challenges that emerged during the emergency remote teaching period. The theoretical basis of this qualitative study stemmed from exploratory and descriptive case study research. We aimed to investigate mathematics teachers' perceptions of the work done and the support they received in carrying out their pedagogical interventions during this period, an atypical situation of global proportions that led to a reinvention of the teacher's role.

This reconfiguration of pedagogical practices is highlighted by Moreira, Henriques, and Barros (2020): "The virtual transformation of educational systems that we are now being forced to implement presupposes changes to their models and practices and 'forces' teachers to take on new roles, communicating in ways they are not used to" (p. 354).

The study led to several key conclusions. First, we concluded that the teachers studied faced clear difficulties balancing remote activities with their personal lives. Second, they believe that mathematics practices in remote teaching provided meaningful learning experiences for their educational practice. Third, some emergency remote teaching approaches will be incorporated into in-person mathematics classes. Fourth, these mathematics teachers were not prepared to conduct remote activities at the time they were first implemented. Fifth, some teachers experienced emotional challenges during that period. Sixth, some continuing education opportunities were offered by the appropriate agencies. And finally, teachers' participation in social media groups was frequent and aided in preparing class activities. The data analysis shows that the stated objective was achieved.

From the data shown in Figures 1 and 2, we can see that individual and subjective factors affected teachers' work. Seven of the eight participants noted that balancing remote teaching with personal life was difficult. The same number (seven) indicated that emotional and personal concerns were also affected by remote teaching demands during the pandemic.

Regarding the availability and engagement in continuing education courses among the surveyed teachers, the findings displayed in Figures 4, 5, and 6 suggest heterogeneity in the constructed data, since only one teacher strongly agreed that the courses he or she took were essential to remote pedagogical practices. Four partially agreed, two neither agreed nor disagreed, and one partially disagreed. This leads to a preliminary conclusion that, while governmental bodies at the federal, state, and municipal levels offered training, not all professionals took these courses, and therefore the insights shared during these programs were not incorporated into the teaching practices of some. This corroborates Figure 5, where no respondents strongly agreed that they felt prepared to teach mathematics remotely.

Correlating the data illustrated in Figures 4, 8, and 9 regarding the design of remote pedagogical activities: half of the participants stated that the activities used were not prepared by them but by other professionals; others partially echoed that statement, consistent with the data in Figure 8 indicating frequent teacher involvement in social media to share and utilize materials produced by colleagues. Additionally, the Figure 4 results confirm that most teachers believed there were meaningful differences between their mathematics activities in in-person settings and those deployed remotely.

We hope that the issues raised in this article prompt the broader school community and governmental agencies to pay closer attention to the educational scenarios the study participants described. School dropouts, the lack of basic school supplies, the absence of internet and computers, mental health, and unstable family structures all came to the forefront during teachers' remote activities—these are social

issues requiring special focus and collective measures to achieve truly accessible education for all.

Mathematics teachers faced a challenging scenario. It is apparent there is an urgent need for ongoing professional development in digital tools for teaching mathematics. To tackle this ever-expanding complexity, we must create suitable conditions for ongoing teacher training and ensure the necessary infrastructure for integrating new learning processes into these professionals' methodological practices. Given the wide-ranging change brought by emergency remote teaching, it is unnecessary to reconstruct pedagogical practices from the ground up, as new teaching formats were briefly introduced — during 2020 and 2021 — to teachers and, consequently, their students. Nevertheless, this is still limited in comparison to what is required, and there remains a substantial gap to be filled.

The research reported in this article does not claim to exhaust the subject of mathematics teachers' pedagogical practices during emergency remote teaching. Our reflections aim to support future research and work on the subject in a post-pandemic educational environment, expanding discussion on the teaching of mathematics.

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