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Didactic resources and digital technologies used by teachers who teach mathematics during the pandemic in Brazil

Recursos didáticos e tecnologias digitais usados por professores que ensinam Matemática em tempos de pandemia no Brasil I

Recursos didácticos y tecnologías digitales utilizados por profesores que enseñan Matemáticas en tiempos de pandemia en Brasil

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Abstract
In this text, we will present part of a previous study that investigated the use of teaching resources and technologies during the pandemic by teachers who teach mathematics in the public basic education network. The research followed a qualitative-quantitative approach, using the Google Forms tool as a data collection instrument. The data presented was collected with the participation of 430 teachers over 42 days. Given the results, it was observed that many digital technologies began to be used as teaching resources, including WhatsApp and Google Classroom. We hope this work contributes in some way to the teaching of mathematics in the public basic education network and that it can provide support for future studies related to mathematics education.
Keywords: Mathematics Teaching. Pandemic. Teachers Who Teach Mathematics. Didactic Resources. Technologies.

Resumo
Neste texto, será apresentado parte dos resultados de um estudo que teve como objetivo investigar o uso de recursos didáticos e tecnologias por professores que ensinam Matemática na rede pública da Educação Básica em tempos de pandemia. A pesquisa seguiu uma abordagem quali-quantitativa, utilizando como instrumento de coleta de dados a ferramenta do Google Formulários. Os dados apresentados foram coletados com a participação de 430 professores durante 42 dias. Diante dos resultados, observou-se que muitas Tecnologias Digitais passaram a ser utilizadas como recursos didáticos, dentre elas, o WhatsApp e Google Sala de Aula. Espera-se que este trabalho possa contribuir de alguma maneira com o ensino de Matemática na rede pública da Educação Básica e que possa dar subsídio a futuros estudos relacionados à Educação Matemática.
Palavras-chave: Ensino de Matemática. Pandemia. Professores que Ensinam Matemática. Recursos Didáticos. Tecnologias

Resumen
Este texto, presentaremos parte de los resultados de un estudio que tenemos como objetivo investigar o uso de recursos didáticos y tecnologías por profesores que enseñan Matemática en la red pública de la Educación Básica en tiempos de pandemia. A pesquisa, siga un abordaje cuali-cuantitativo, utilizando como instrumento de coleta de datos a ferramenta do Google Formulários. Los datos presentados foram coletados con la participación de 430 profesores durante 42 días. Diante dos resultados, observe que muchas Tecnologías Digitales pasan a ser utilizadas como recursos didáticos, entre ellas, o WhatsApp y Google Sala de Aula. Esperamos que este trabajo pueda contribuir de alguna manera con el aprendizaje de Matemática en la red pública de Educación Básica y que pueda dar subsidios a futuros estudios relacionados con Educación Matemática.
Palabras clave: Enseñanza de las Matemáticas. Pandemia. Profesores que Enseñan Matemáticas. Recursos Didácticos.

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1. Introduction

In this work, we aim to present part of the results of a study carried out with teachers who teach mathematics in the Brazilian public basic education schools in remote teaching during the COVID-19 pandemic. Furthermore, the research addressed some of the challenges of teaching mathematics in such a scenario, listing the teaching resources and technologies used by mathematics teachers.

The research followed a qualitative-quantitative approach, using the Google Forms tool as a data collection instrument. The data was collected over 42 days, between June 21st and August 2nd, 2021, with 430 teachers who teach mathematics in Brazilian public education schools[4].

Given researchers' desire to better understand the Brazilian education scenario during the pandemic, interest in research development arose. On this occasion, the authors were motivated by the following questions: What teaching resources and technologies were used to teach mathematics during pandemic-times remote classes?[5] What are the limitations and potential of these resources? What were the challenges teachers who teach mathematics in the public basic education network faced during the pandemic?

In this work, we will focus on teaching resources and technologies used by teachers who teach mathematics in the public basic education network during the COVID-19 pandemic. For this, in the first section, based on authors such as Borba, Silva, and Gadanidis (2014), Branco *et al.* (2020), and Corrêa and Brandemberg (2021), we will address the teaching resources and technologies used in remote teaching. The research will be detailed in the second section, covering its trajectory and the participants' profiles. The third section will disclose Google Forms information about such resources. Our readers will be presented with the questions, the data collected, and a summary. Finally, we will reflect on the data indicated.

2. The COVID-19 pandemic and the use of teaching resources and digital technologies

The World Health Organization (WHO) announced the COVID-19 pandemic caused by the virus called SARS-CoV-2 in March 2020, and with this, several actions were taken to prevent the virus from spreading. One of them was to replace face-to-face teaching with remote teaching in Brazilian schools. In that scenario, as Corrêa and Brandemberg (2021) point out, remote classes were a short-term emergency solution since the intention was to continue pedagogical activities, reducing the adverse effects on the students' learning. Remote teaching is distinguished from distance learning, as the former is not configured as a teaching modality; distance learning has a long-term methodology, structure, and quality that guarantees distance education (DE).

4 This work expands two scientific communications: one presented at the IX EMEM (Encontro Mineiro de Educação Matemática) – Minas Gerais Meeting of Mathematics Education in October 2021 and another at the XIV ENEM (Encontro Nacional de Educação Matemática) – National Meeting of Mathematics Education, in July 2022. However, when the first text was submitted, the research was ongoing, and only 156 respondents were considered. In this expansion, in addition to addressing more questions, we are considering 430 participants.

5 In this text, we presented only data related to this first research question, i.e., we focused on the use of teaching resources and technologies by teachers who teach mathematics in the public basic education network.

In remote teaching, using technology, which arose from the need to produce new knowledge, stands out. According to Corrêa and Brandemberg (2021), technology is a human production that aims to overcome the challenges and problems that have been imposed and present since prehistory, such as paper, pencils, the wheel, the radio, the television, and the computer. Borba, Silva, and Gadanidis (2014) state that technological innovations have developed rapidly and are a strong characteristic of our society. White *et al.* (2020) highlight the importance of this exponential technological growth, which has resulted in changes in the development of culture, art, health, interaction, and education, among other things.

Due to this diversity, some expressions are adopted to mention more specific groups. According to Corrêa and Brandemberg (2021), the term information and communication technologies (ICT) refers to electronic and technological devices, both older and more recent, that are intended to inform and communicate, such as newspapers, radio, television, computers, the Internet, smartphones, and tablets. The authors mention that, when talking about technology, the word "new" should be avoided. However, some researchers use the expression "new technologies" to refer to digital technologies (DTs), also known as digital information and communication technologies (DICTs). From this point of view, the term DICT covers the most current electronic and technological devices that work through digital and not analog means, such as the smartphone, the computer, the tablet, and others that allow the user to browse the Internet.

Although many technological tools are available for the pedagogical area, according to Branco *et al.* (2020), educational institutions still have a long way to go to enable more technological teaching and learning. The National Common Curriculum Base (BNCC) recommends the involvement of institutions, families, and the community with actions in which it is possible to "select, produce, apply, and evaluate teaching and technological resources to support the teaching and learning process" (BRASIL, 2018, p. 17).

Even before the pandemic, implementing DICTs in everyday school life presented many challenges, such as limited access to the Internet, the lack of available resources, and the infrastructure of schools, especially those in the public network. In addition, Branco *et al.* (2020) emphasize that teacher education is necessary to prepare teachers to use them better in their teaching practices and become part of what the authors call digital culture.

Valencia (2020) presents a theoretical discussion about the importance of using technologies in mathematics teaching and learning, especially during the social isolation caused by COVID-19. There were two possibilities in this scenario: the opportunity or the setback in mathematics education. According to the author, each aspect would be linked to the dedication and responsibility of teachers, institutions, students, and their families. Mathematics teachers should rethink their teaching practices, as remote classes "generate new conditions of time and space for learning; innovative teachers are needed who allow students to rediscover mathematics by constantly monitoring their learning process" (VALENCIA, 2020, p. 3).

Borba, Silva, and Gadanidis (2014) discuss the four phases of technologies in mathematics education, pointing out mathematical activities, theoretical perspectives, and other factors that characterize each phase. In the first phase, which took place around 1985, the use of simple or

scientific calculators and computers was discussed. Terms such as information technologies (IT) or computational technologies began to be used to refer to computers and software.

The second phase occurred in the first half of the 1990s, with the popularization and greater accessibility of computer use and more exploration of IT as a teaching resource. It was a phase marked by the creation of several educational softwares focused on function representations and dynamic geometry. With an easy programming language that did not require much knowledge from teachers and students, the softwares allowed dynamism in geometry, making it possible to "use, manipulate, combine, visualize, and virtually construct geometric objects, allowing new paths of investigation to be traced" (BORBA; SILVA; GADANIDIS, 2014, p. 23).

The highlight of the third phase, in 1999, was the Internet, which teachers and students used in education to obtain information and means of communication. In this phase, marked by ICTs, the authors mention that distance continuing education courses began to be offered, emphasizing discussion forums, chats, emails, and Google. The fourth phase of technology use began around 2004, and the term DT began to be used more often. The Internet connection quality improved, resulting in a significant increase in resources that required Internet access. In 2014, the year in which the authors wrote about the four phases, they highlighted the following DT as teaching resources: portable mobile technologies, YouTube, Skype, Facebook, GeoGebra, WolframAlpha, Moodle, and Wikipedia. From 2014 to the present day, many other DTs have been created, and existing ones have improved.

With the COVID-19 pandemic, many digital technologies, even those not aimed at teaching and learning, began to be used as teaching resources. Teachers had to make an unplanned and accelerated transition to remote teaching. Corrêa and Brandemberg (2021) emphasize that teachers are not adequately qualified for this change, as many teacher education courses do not include DTs in their curricula. In such a scenario, teachers had to adapt to remote classes, connecting the DICTs with the teaching and learning process. Therefore, teachers faced the "challenge of transforming themselves into modern professionals, seeking to develop skills that an educator must hold today, aware of their role in the information and communication era" (Corrêa; Brandemberg, 2021, p. 41).

Technology is increasingly constant in our daily lives; for example, we interact on social networks, conduct various searches, watch videos, and perform other tasks. However, according to Barros *et al.* (2022), technology deserves special attention when used as a teaching resource because teachers lack deeper skills and knowledge, as everyday use is insufficient for teaching. The authors reinforce that new proposals must be implemented in teacher education courses based on curricula that aim to improve teachers, as many teachers got lost in the face of new demands when trying to use a diversity of technological resources presented in the form of remote teaching.

According to Silva *et al.* (2021), the educational system was not prepared for education based on digital spaces: on the one hand, not all teachers could teach remote classes, and, on the other hand, not all students were used to attending them in this format. This difficulty generated the need to rethink digital inclusion for teachers and students. Although this has been discussed since the beginning of technological development, little has been done. According to the authors, the pandemic reaffirmed the inequality of those most excluded from the digital world since many

students, due to their financial conditions, did not have access to the Internet or mobile phones to follow their tasks and classes.

In our form, specifically designed for the research, we use the term teaching resources and technologies to cover all types of technology used as teaching resources during the pandemic, such as printed sheets, textbooks, Google Meet, and WhatsApp platforms. In this text, as per Corrêa and Brandemberg (2021), we will use the terms digital information and communication technologies or digital technologies when referring to "devices that will be used to access classes and other digital content made available or built to be accessed through internet browsing by teachers and students in general at this time of pandemic" (Corrêa; Brandemberg, 2021, p. 38).

Therefore, when using these terms, we will be referring mainly to platforms, multiplatforms, and applications, which are technological tools aimed at communicating, sharing, and working on computers, smartphones, tablets, or some other electronic and technological devices which in turn, requires the Internet, as it works digitally. Some examples are email, Facebook, Google Forms, Microsoft Teams, Google Meet, WhatsApp, and YouTube, among others. Although people used these DICTs in different functions before the pandemic, the need for remote classes meant they had to be used for teaching.

3. The research

The researchers' interest in investigating teachers' use of teaching resources and technologies arose from their desire to understand better the Brazilian education scenario during a pandemic. In this context, the authors were motivated by several questions. However, for this work, we chose to present only data related to the use of teaching resources and technologies by teachers who teach mathematics in the public basic education network. In other words, we focus on the following question: What teaching resources and technologies were used in mathematics teaching in remote classes during the pandemic?

As mentioned, this study aimed to investigate the use of teaching resources and technologies by teachers who teach Mathematics in the Brazilian public basic education network during the COVID-19 pandemic. The research used Google Forms as a data collection instrument over 42 days between June 21st and August 2nd, 2021, with the participation of 430 collaborators.

The research followed a qualitative-quantitative approach. That is, when collecting data, we worked with both qualitative and quantitative questions. According to Gamboa (1997, p. 106), "In research [...], results and data expressed in numbers are often used. However, the analysis becomes qualitative if interpreted and contextualized in light of broader social dynamics."

We have chosen not to create or delimit analytical categories, considering we would need a project with more resources and researchers available. Our intention, then, is to present the data collected and outline some reflections on the role of DTs in remote teaching during the pandemic in mathematics teaching in Brazil.

4. The research path

The course of this study is divided into four phases. In the first phase, a bibliography review was carried out regarding the main themes involved in the investigation, such as technology used as a teaching resource and remote teaching in current times, among others. In the second phase, we created 32 questions for the Google form. At this stage, some tests were also carried out with volunteer teachers, as well as revisions and adjustments, to ensure that the language was not difficult to understand and that the questions aligned with the research objective.

The third phase began with the publication of the link to the research form for teachers who teach mathematics in the Brazilian public basic education network via social media such as Facebook, Instagram, WhatsApp, and emails of institutions that offer pedagogy, mathematics, and postgraduate courses in the education field. The fourth phase consisted of organizing, analyzing, and disseminating research data to society, such as this work, enabling reflections on mathematics teaching during the pandemic. In the next section, we will present the participants' profiles.

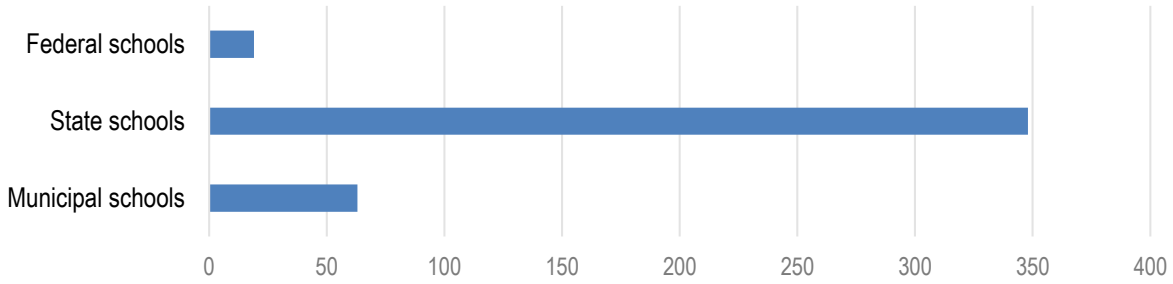
5. Participants' Profiles

In this topic, we will detail the research participants' profiles. The survey revealed that 66.8% (287) were female, 33% (142) were male, and 0.2% (1) reported another. Regarding age range, at the time of the research, 2.6% (11) were from 21 to 25 years old, 7.7% (33) from 26 to 30, 14.9% (64) from 31 to 35, 20% (86) from 36 to 40, 17.8% (77) from 41 to 45 years old, 14.9% (64) from 46 to 50, 12.8% (55) from 51 to 55 years old, 6.3% (27) from 56 to 60, 2.3% (10) from 61 to 65, and 0.7% (3) from 66 to 70.

When participants were asked in which state in Brazil they taught mathematics in the public basic education network during the pandemic, we had 14 states, remembering that our country has 26 states and one Federal District. Minas Gerais had the most, with 79.8% (343) participants, followed by Espírito Santo with 7.9% (34), São Paulo with 6.3% (27), Bahia with 2.1% (9), Piauí with 0.9% (4), the states of Pará and Maranhão each with 0.7% (3), and, finally, the states of Amapá, Ceará, Mato Grosso, Mato Grosso do Sul, Pernambuco, Rio de Janeiro, and Santa Catarina, with 0.2% (1). The number of participants in Minas Gerais is because the announcement was more disseminated in that state, where the researchers reside. During the research, the dominant education levels were the final years of elementary school (284 respondents, 66%) and high school (237 respondents, 55.1%).

Graph 1 illustrates the answers to the questions about the scope of the public basic education network where the participants work. Regarding the level of basic education, 1.2% (5) of the participants worked in early childhood education, 10.5% (45) in the initial years of elementary school, 66% (284) in the final years of elementary school, and 55.1% (237) taught mathematics in high school.

Graph 1: Scope of teachers' activity

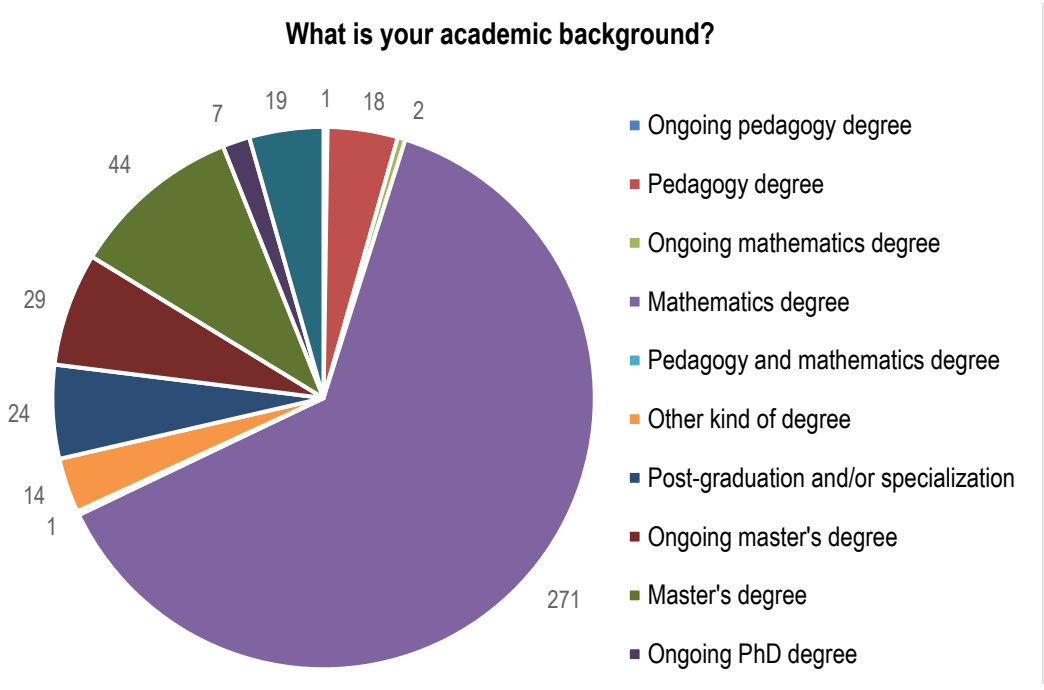


Source: Prepared by the authors (2024)

In this question, research participants could select multiple options as an answer, as this is the reality of Brazilian teachers' work.

Next, Graph 2 presents teachers' academic education at the time of the research. The graph shows that 63.03% (271) of participants had a teaching degree in mathematics, followed by a complete master's degree, with 10.2% (44), and a master's degree in progress, with 6.8% (29).

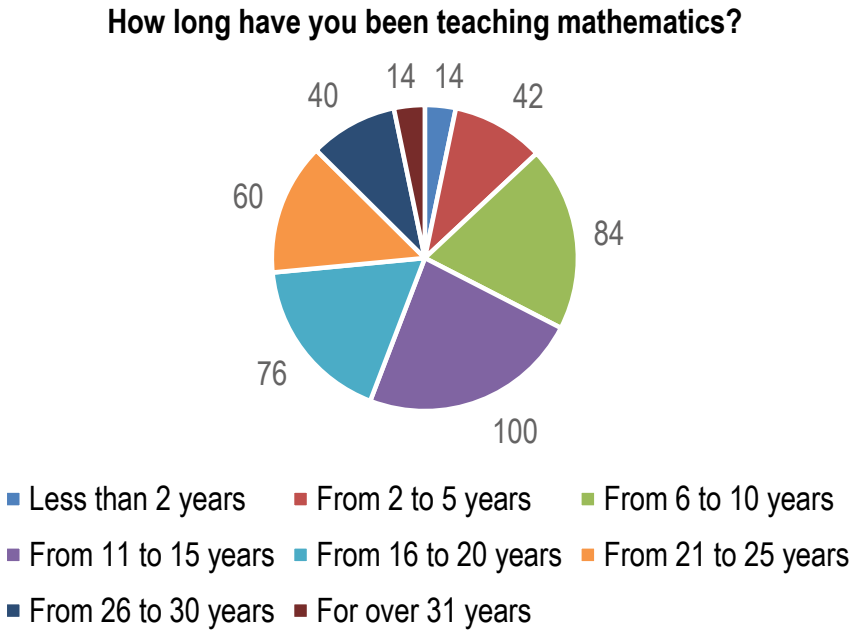
Graph 2: Teachers' academic education



Source: Prepared by the authors (2024)

Participants were asked for how long they had been teaching mathematics, from which we obtained the following data:

Graph 3: Teachers' working time

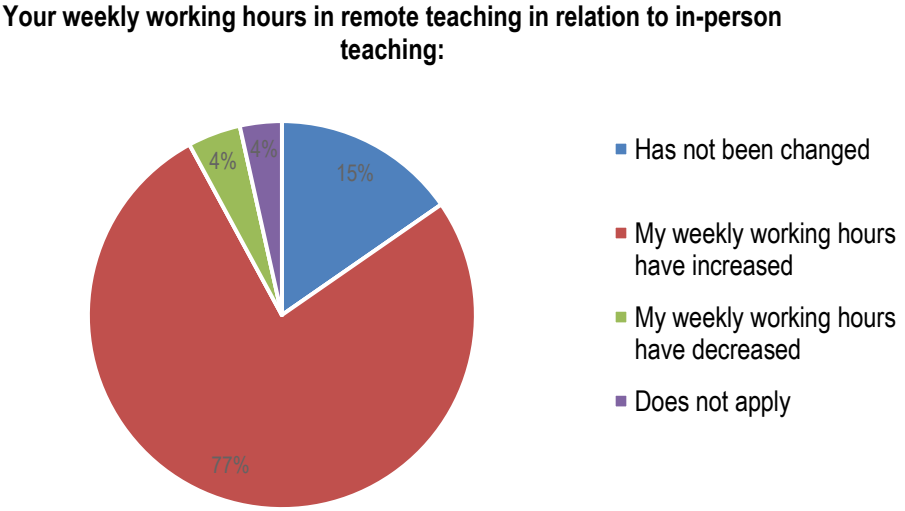


Source: Prepared by the authors (2024)

Graph 3 shows a diversity among the participants regarding the time they taught mathematics. Most of them, 23.3% (100), had been teaching for 11 through 15 years, followed by 19.5% (84) for 6 through 10 years and 17.7% (76) for 16 through 20 years.

We questioned teachers whether their working hours changed in remote education compared to face-to-face teaching, as seen in Graph 4.

Graph 4: Teacher's weekly working hours in remote teaching compared to in-person teaching



Source: Prepared by the authors (2024)

The graph reveals an increase in working journey hours – for approximately 77% (330) of participants. In the next section, we will disclose some research results, with a focus on digital technologies as teaching resources.

6. Some of the search results

In this article, we will disclose data from six questions in the form section on the use of resources and technologies. We will present each question to the reader, as well as the data collected and a summary of this information. In Table 1, we outline the data for the following questions: What resources were used in mathematics teaching during the pandemic? What resources were used in mathematics teaching before the pandemic? For these two questions, we listed some resources and indicated that, if the teacher selected the "Other" option, they should specify the answer. We highlight that survey participants could select multiple options as an answer. We chose to place the answers to both questions in the same table to allow the reader to make a possible comparison of the data.

Table 1: Use of resources before and during the pandemic

Recursos	Recursos utilizados no ensino de Matemática em tempos de pandemia	Recursos utilizados no ensino de Matemática antes da pandemia
Canva	108	18
Email	293	98
Facebook	47	22
Printed sheets delivered to students without Internet access	267	0
Interactive sheets of LiveWorksheets	12	10
Genially	1	0
Google Forms	331	49
Google Classroom	356	35
Jamboard	97	9
Kahoot	34	7
Textbook	235	344
Mentimenter	19	3
Microsoft Teams	10	4
Padlests	31	3
Meet Platform	330	20
Zoom Platform	33	3
Socrative Platform	5	2
Quizlet	11	7
Interactive classroom	22	38
WhatsApp	375	129
Wordwall	49	4
YouTube	264	136
I didn	2	26
Others	75	157

Source: Prepared by the authors (2024)

Table 1 reveals an increase in the use of many digital technologies. For example, Google Classroom started to be used by 356 (82.8%) teachers, whereas before the pandemic, it was used by only 35 (8.1%). On the other hand, the textbook, considered a teaching resource, was used by 235 (54.7%) during the pandemic and was previously used by 344 (80%) of teachers.

YouTube was one of the resources most used during the pandemic, selected by 264 (61.4%) of teachers, and it was also one of the most used before the pandemic, selected by 136 (31.6%) of teachers. However, considering the research data, the use of YouTube as a teaching resource in remote classes during the pandemic grew by approximately 94.1%. Before the pandemic, it was mentioned by teachers as the second most used resource, with textbooks being the first.

The information in Table 1 suggests that some resources for mathematics teaching have been replaced in remote teaching. Furthermore, an increase in the use of DTs as new teaching resources to teach mathematics was noted by most teachers. For Valencia (2020), introducing digital technologies into the mathematics teaching and learning process implied replacing traditional activities, which were previously carried out with pencil and paper, with these new technological tools, which require new methodologies and assessment strategies since, according to the author, the focus should be on promoting student learning and not on facilitating the teacher's work.

We had various answers from those who marked the "Other" option in the first question. We highlighted, with one (0.2%) answer each, the following resources: Bitemogi, cell phone, datashow, Dudamath, Geniol, Graspable Math, Jingzaw, Lomi, Pluzzes, teaching material prepared by the government[6], Microsoft Whiteboard, Nearpod, Notes Writer, OBMEP portal, hosting sites, and Speactic. With two (0.5%) answers: screen recording, Excel, PowerPoint, and Powtoon. With three (0.7%) answers: Seneca and Telegram. With four (0.9%), the Moodle Platform. With five (1.2%), Khan Academy and Graphics Tablet. Fifteen (3.5%) answered GeoGebra.

Of those who marked the "Other" option in the second question, we highlight that they had one (0.2%) answer for each resource: practical classes, notebook, high school collection from the Brazilian Society of Mathematics Education (Sociedade Brasileira de Educação Matemática - SBEM), RPG game, games created collaboratively with students, digital games, digital whiteboard, manipulative materials, teaching material prepared by the government, golden material, calculation spreadsheets, Brazilian Public School Mathematics Olympiad (Olimpíada Brasileira de Matemática das Escolas Públicas - OBMEP) portal, classroom, computer room, and geometry software. They each had two (0.5%) answers: blackboard, material prepared by the school's mathematics group, and physical pedagogical resources. With three (0.7%): data show and Khan Academy. With four (0.9%): educational games, printed sheets, and concrete material. Furthermore, 15 (3.5%) of the participants answered GeoGebra. Despite GeoGebra presenting 15 (3.5%) of the answers to both the first and second questions, only seven (1.6%) participants said they used it before and continued using it during the pandemic.

In questions 1 and 2, we can note some technologies used as teaching resources mentioned in the four phases of technologies in mathematics education addressed by Borba, Silva, and Gada-

6 These are materials created and distributed by basic education teaching networks free of charge to assist teachers in activities carried out remotely or to be delivered in printed form to students who did not have access to the Internet.

nidis (2014), especially in the third and fourth phases. In the third phase, the authors mention the use of discussion forums, chats, emails, and Google.

Emails were a widely used resource during the pandemic, according to 293 (68.1%) participants. Before the pandemic, according to 98 (22.8%) of the answers, it was the fourth most used resource. Borba, Silva, and Gadanidis (2014) state that with the improvement of the Internet from 2004 onwards, there was a growth in the use of mobile or portable technologies and DTs, such as YouTube, Facebook, GeoGebra, and Moodle. It is also possible to observe that Google's latest features, such as Google Forms, Google Classroom, and Google Meet, were the most used resources during the pandemic.

Complementary to this, the question –How did you learn about the use of new resources in teaching practices during the pandemic? – helped us understand how teachers learned these new resources. We highlight that survey participants could select multiple options as an answer. In Table 2, we have the data for this question:

Table 2: Teacher learning about the use of new resources in teaching practices during the pandemic

Mode	Quantity
Course offered by the institution you work for	108
Course offered by other institutions	293
Courses I took on my own	47
Through Internet tutorials	267
Learned on your own	12
With the help of another co-worker	1
With sons	331
With students	356
Participating in study and collaborative groups	97
Already used	34
I didn	235

Source: Prepared by the authors (2024)

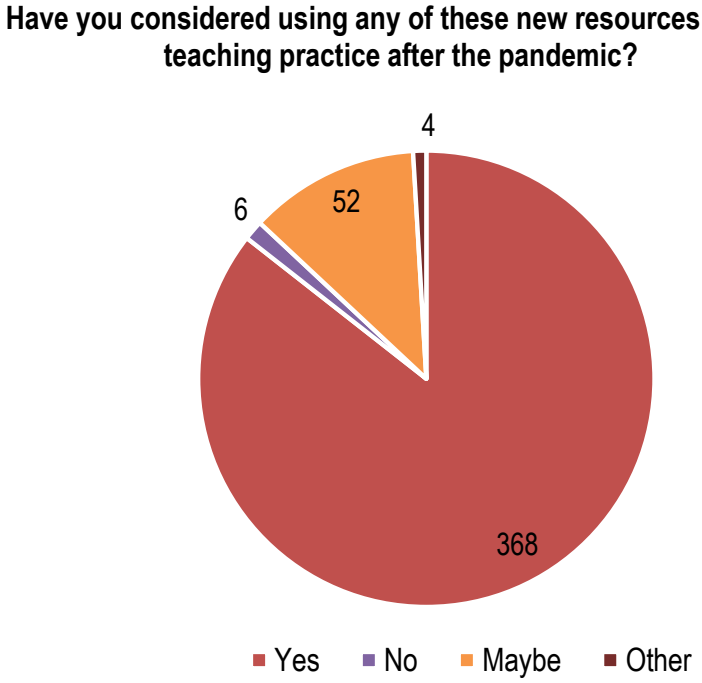
From the data in Table 2, we noticed some concern on the part of some institutions about teaching new resources to teachers, as 208 (48.4%) of the participants reported that they took courses offered by the institutions where they work. We had an indication of teacher autonomy who learned through Internet tutorials, 332 (77.2%) teachers. Furthermore, there was evidence of collaboration, with greater emphasis on the 255 (59.3%) teachers who learned from their colleagues.

Given the challenge teachers faced in the new pandemic scenario, new discussions regarding the teacher education process are necessary. According to Silva *et al.* (2021), education focused on using digital resources, the ways of working with them, and the production of activities based on them is relevant. Furthermore, there is an urgent need to find solutions so that teaching activities not only instigate students' curiosity and interest but are also in line with school and student reality.

Next, teachers were asked if they had considered using any of these resources that were new to their teaching practice after the pandemic. In this question, we list some options: "Yes," "No," "Perhaps," and "Other." We indicated that if the teacher selected the "Other" option, they should specify the answer. We highlight that survey participants could select only one option as an answer.

In this question, it was evident that most teachers, 368 (85.6%), gave positive answers to the question, followed by 52 (12.1%) who said "Maybe." We received affirmative answers from the participants who indicated the "Other" option. However, it was evident that the use of some of these DTs was conditioned on something, such as having access to certain tools in the classroom or even as an aid to teaching specific mathematical content. Graph 5 shows the data for this question:

Graph 5: Use of new resources in teaching practice after the pandemic



Source: Prepared by the authors (2024)

Regarding the use of technological resources in the mathematics teaching and learning process, Valencia (2020) says that good practices can be implemented, aiming to improve the development of students' mathematical thinking. The author mentions that mathematics teaching and education, in general, would not be the same after the pandemic because these technological resources would be present in a new school routine. However, this would require everyone involved to be properly prepared. Silva *et al.* (2021) stated that the use of DTs as resources would remain after the COVID-19 pandemic, as "education is in a continuous process of evolution, it is not inert in the face of what occurs around it, and the *digital technologies* are potentially transformative in this field" (SILVA *et al.*, 2021, p. 169, authors' emphasis).

Table 3 provides data on the fifth question: What has been the main contact form between teachers and students? We list some options in this question. We indicate that if the teacher selects the "Other" option, they should specify the answer. We highlight that survey participants could select only one option as an answer.

Table 3: Main form of contact between teachers and students

Mode	Quantity
Via email	10
Via Facebook	1
Via Google Classroom	107
Via Microsoft Teams	2
Via WhatsApp	273
In-person in schools, when students withdraw from activities from time to time	8
I have no contact with students	2
Other	25

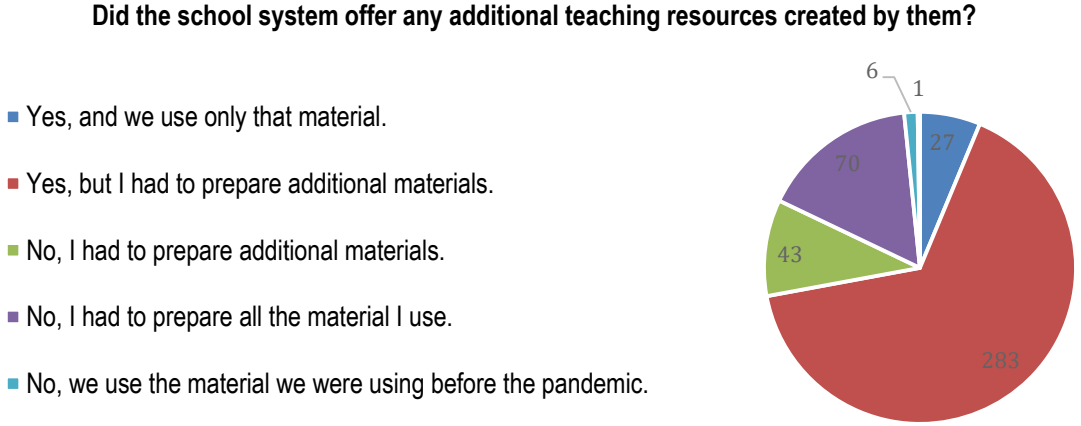
Source: Prepared by the authors (2024)

From the information in Table 3, we note that, even with a diversity of resources used, the WhatsApp messaging application, with 273 (63.5%) of the answers, was the main means of communication between teachers and students, followed by Google Classroom, with 107 (24.9%) of the participants.

In the "Other" option, we obtained varied responses, including Telegram, Zoom Meetings, and in-person, with one (0.2%) answer in each. Seven (1.6%) via Moodle and twelve (2.8%) via Google Meet. Let us remember that this platform is one of the resources of Google Classroom, also used for other purposes by society.

Finally, in Graph 6, we have the results to the question: Did schools offer any additional teaching resources prepared by them? In this question, we listed the options, and survey participants could select only one option as an answer.

Graph 6: Offer of some additional teaching resources prepared by the education network



Source: Prepared by the authors (2024)

The data in Graph 6 shows that, even when schools did not offer complementary teaching materials, most teachers also needed to prepare their own complementary materials.

The alternative "Yes, but I needed to prepare additional materials" was selected by 283 (65.8%) participants; the alternative "No, I had to prepare all the material I use" was selected by 70 (16.2%), and the alternative "No, I had to prepare additional materials" by 43 (10%).

Silva *et al.* (2021) reiterate that, before the pandemic, teachers used several materials in face-to-face classes, many of which were aimed at increasing the visibility of mathematical concepts. However, given the new pandemic scenario, some resources, such as boards, papers, compasses, rulers, and others had to be adapted to meet the demands of virtual teaching. Therefore, it was necessary to resort to digital platforms or look for new tools to assist the teaching task. The authors highlight that, in many schools, the government did not provide these resources, leaving the teacher to purchase new materials, a condition for the development of their classes, especially those that required drawings and other resources, such as graphics tablets and the platforms on which they are applied.

In the next section, we will reflect on the data presented.

7. Some last considerations

The COVID-19 pandemic had impacts on education. In this situation, remote teaching, which was seen as a temporary emergency solution, required schools, teachers, students, and families to adapt. In education, DTs began to be used as teaching resources. Due to the great difficulty that DTs impose, including the need for digital electronic devices and Internet access, some schools maintained some previously used teaching resources, considering that many students had vulnerable socioeconomic conditions.

Given this context, this work aimed to disseminate data from a study focusing on the use of teaching resources and technologies by teachers who teach mathematics in the public basic education network during the pandemic. We received feedback from 14 states, 343 (79.8%) from Minas Gerais.

When participants were asked how long they had been teaching mathematics, the answers were 6 to 10 years (84 respondents, 19.5%), 11 to 15 years (100 respondents, 23.3%), and 16 to 20 years (76 respondents, 17.7%). Regarding working hours, 76.7% (330) said that working hours increased in remote classes during the pandemic.

Given the 430 answers from research participants, we highlight that, regarding the use of teaching resources and technologies, many DICTs started to be used as teaching resources, among them some predominately, such as WhatsApp (375 responses, 87.2%) and Google Classroom (356 responses, 82.8%). Others that were already present in the teaching practice of some teachers gained even more strength, such as email (before: 98 respondents, 22.8%; after: 293 respondents, 68.1%), Google Forms (before: 49 respondents, 11.4%; after: 331 respondents, 77%) and YouTube (before: 136 respondents, 31.6%; after: 264 respondents, 61.4%). The textbook, which before the pandemic was one of the prevailing teaching resources, reduced a little, but remained one of the most used (before: 344 respondents, 80%; after: 235 respondents, 54.7%).

Given the above, we noted that some technologies mentioned in the four phases of mathematics education and discussed by Borba, Silva, and Gadanidis (2014) were present in mathema-

tics remote teaching during the pandemic, especially those in the fourth phase when the Internet was improved. Furthermore, this period was characterized by mobile devices, YouTube, Facebook, GeoGebra, WhatsApp, Moodle, and Google resources, such as Google Meet, Google Classroom, and Google Forms, among others.

We had an indication of teachers' autonomy to learn how to use new resources in their teaching practices during the pandemic; for example, 77.2% (332) of teachers said that they learned through Internet tutorials. This data takes us to Branco *et al.* (2020), who mentioned the need for teacher education focused on teacher preparation and the use of digital technology as a teaching resource in their teaching practices, especially in times of constant online connection and dependence on the Internet. We hope that studies like this can lead teacher educators to reflect on the need to rethink curricula to accommodate this demand.

Most teachers (368 answers) are considering continuing to use new resources in their teaching practice after the pandemic. Despite this, 12.1% (52) selected the "Yes" and 1.4% (6) the "No" alternative, possibly considering the challenges of implementing the DICTs in everyday school life. In this context, the lack of resources, the lack of infrastructure in schools, and the limited access to the Internet were factors taken into consideration by the research participants. We highlight that there must be public policies aimed at minimizing these difficulties, as these problems especially affect the public education network.

We hope this work somehow contributes to mathematics teaching in public schools, either through the possibility of implementation or through the adaptation of resources for teaching mathematics in face-to-face classes and, if necessary, in remote classes. Furthermore, we hope this study can provide support for future studies in the mathematics education field.

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