




# Remote Teacher Actions of Mathematics Teachers in Higher Education

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## ABSTRACT

**Background:** the investigation of teacher actions in face-to-face teaching has become a fertile line of research both in mathematics and in other areas. The pandemic moment that Brazil has been going through since March 2020, which forced teaching to take place remotely, provided conditions for the research to be extended to this type of teaching. **Objectives:** investigate teacher's actions in remote education to understand what teachers actually did and do in their classes in this teaching format. **Design:** This research is characterised as qualitative, with the focus of observation on synchronous and asynchronous classes held by teachers. **Setting and Participants:** Eleven teachers who teach mathematics in higher education remotely at different institutions in the state of Paraná participated in the research. **Data collection and analysis:** Data were collected through interviews conducted via Google Meet, recorded, transcribed and analysed using discursive textual analysis. **Results:** From the analysis, the remote teaching actions were grouped into two moments, called *Poscênio* [Backstage] and Execution. The Backstage covered a set of seven actions (Self-education, Acquire, Organise, Elaborate, Send, Communicate, and Evaluate) that involved 35 different microactions, when the teacher carried out the preparation of the discipline and classes, as well as their closings asynchronously. The Execution moment comprised six actions (Operationalise, Write, Explain, Answer, Wait, and Interrupt) and 24 microactions, in which the teacher synchronously put into practice what was prepared in Backstage. **Conclusions:** Based on the results (large number of actions and micro-actions in Backstage), we conclude that remote teaching has required a great effort from teachers in the search for information and elaborate planning for the realisation of classes, which perhaps explains the anxieties revealed by them during interviews.

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## **Ações docentes remotas de professores que ensinam matemática no ensino superior**

### **RESUMO**

**Contexto:** A investigação sobre ações docentes no ensino presencial tornou-se uma linha de pesquisa fértil, tanto em Matemática quanto em outras áreas. O momento pandêmico que o Brasil passa desde o mês de março de 2020, que impôs que o ensino acontecesse de forma remota, propiciou condições para que a pesquisa fosse estendida também a esta modalidade de ensino. **Objetivos:** Investigar as ações docentes no ensino remoto, para entender o que de fato os professores fizeram e fazem, em suas aulas, nesse formato de ensino. **Design:** Esta pesquisa caracteriza-se como qualitativa, tendo como foco de observação as aulas síncronas e assíncronas realizadas pelos professores. **Ambiente e participantes:** Participaram da pesquisa onze professores que ensinam Matemática no Ensino Superior de forma remota em diferentes instituições do estado do Paraná. **Coleta e análise de dados:** Os dados foram coletados por meio de entrevistas realizadas via *Google Meet*, gravadas, transcritas e analisadas por meio da Análise Textual Discursiva. **Resultados:** A partir das análises, as ações docentes remotas foram agrupadas em dois momentos, denominados Poscênio e Execução. O Poscênio abrangeu um conjunto de 7 ações (Autoforma, Adquire, Organiza, Elabora, Envia, Comunica e Avalia), que envolveram 35 microações diferentes, nas quais o docente realizou o preparo da disciplina e das aulas, bem como os seus fechamentos de forma assíncrona. O momento Execução compreendeu 6 ações (Operacionaliza, Escreve, Explica, Responde, Espera e Interrompe) e 24 microações, nas quais o professor colocou em prática de forma síncrona o que foi preparado no Poscênio. **Conclusões:** Com base nos resultados (grande número de ações e microações no Poscênio), concluímos que o ensino remoto tem exigido dos professores um grande esforço na busca por informações e um elaborado planejamento para a realização das aulas, o que talvez explique as angústias reveladas por eles durante as entrevistas. **Palavras-chave:** ação docente; ensino remoto; educação matemática; formação de professores; ensino superior.

### **INTRODUCTION**

As of March 2020, with the advent of the Covid-19 pandemic, emergency remote teaching (ERT) was imposed on schools. With this form of teaching, a novelty for most students and teachers, many changes and adaptations were necessary, which directly implied in the teaching work, generating numerous questions related to teaching and learning. The

institutions sought to get organised to guide teachers and students through this new reality. However, it was noticeable that there was no time for such arrangements, and classes continued to occur as the norms were being elaborated.

Given those adaptations, and upon often incomplete instructions -as there were no precedents for similar situations-, basic education and higher education teachers continued with their teaching activities remotely. In view of this process, we started to ask ourselves what was happening in those remote classes and how teachers organised themselves, elaborated their plans, and developed their lessons.

With such concerns, we started to investigate the actions in remote teaching of teachers who teach mathematics in higher education. The question we sought to answer and whose results we explained in this article was the following: What do teachers who teach mathematics in higher education do to organise and teach classes in emergency remote teaching?

## **THEORETICAL FRAMEWORK**

Many studies describe theories that address what teachers should do in the classroom, considering only their duties. This fact was verified in a study by Passos (2009), in which the author analysed the bibliographic production of articles published in five national journals in the area of mathematics education from 1976 to 2007. Among other considerations, this research showed that most of the papers investigated were intended to explain the teachers' duties, i.e., what they should do, based on guidelines, laws, and methodologies, and not what they actually did.

We understand that teachers must be in contact with research in this area because it instructs them about norms and obligations, giving subsidies for their class organisation. However, it is essential that the studies also cover another perspective, one more focused on the teachers' actual practices.

In this sense, Tardif and Lessard (2008) instigate the discussion by asking and answering:

But how to overcome the moralising and normative points of view on teaching? By privileging the study of what teachers actually do instead of prescriptions about what they should or should not do. (Tardif & Lessard, 2008, p.36-37)

What teachers do is what we identify as the “teaching action”, which can be better defined as the “action that the teacher develops in the classroom, with a view to teaching and learning” (Arruda, Passos, & Dias, 2017, p.2399) or the “act performed by the teacher, which can occur both from prior planning and the teacher’s spontaneous attitudes in their entirety” (Borges, Broietti, & Arruda, 2021, p.3). Therefore, the teaching action is what the teacher does in class, whether planned or spontaneous actions. Thus, we distanced ourselves a little from the duties assigned to bring us closer to the teachers’ factual duties.

Several authors, such as Andrade (2016), Benicio (2018), Piratelo (2018), Assai (2019), Filgueira (2019), and Santos (2019), have focused on exploring teaching actions in the classroom. In line with such works, this research proposes a study on those actions within the scope of remote teaching, instead of in face-to-face teaching, as those authors mentioned. We must highlight that this study is part of a research program that investigates the teaching actions, student actions, and their connections, detailed in Arruda, Passos, and Broietti (2021).

### **The Emergency Remote Teaching (ERT)**

The ERT was proposed and implemented to meet a need brought about by Brazil and the world. In the face of the pandemic of the so-called Coronavirus (SARS-COV-2), which causes the acute respiratory infection Covid-19, social distancing has become a sanitary measure, necessary to prevent contagion and even help people’s survival. When little was known about the virus and the means to combat or control it, education professionals had no choice but to organise and implement this new teaching format.

Even with some similarities, the ERT is different from the already known Distance Learning (DE). According to Joye, Moreira, and Rocha (2020), in DE, teaching is shared with other professionals, while in remote teaching, the teacher is responsible for ‘practically everything’, from preparing the class to the formatting of videos. Besides the fact that students in DE know from the beginning of the course the conditions in which it will occur.

In the interviews conducted in this study, we identified that the participating subjects (higher education teachers) used communication platforms to constitute an *online* classroom. Most of them used *Google Meet*, a service developed by *Google* for communication, and *Microsoft Teams*, a unified communication and collaboration service. Platforms such as *Classroom* and *Moodle* were also largely used at this time, since they allow the

organisation of folders with files, and the creation of forums for discussion, among other useful items in this class format. Thanks to the help of those means of communication, it was possible to build the ERT and achieve the minimum conditions for teaching. We emphasise that this research will not raise issues such as the quality of the teaching offered in the ERT or the conditions of the students to participate in the classes.

In the ERT, classes are classified as synchronous and asynchronous. In synchronous classes, the teacher connects with their students through a virtual classroom, which are computed as the workload of their discipline. Based on the data collected, we clarify that, even though the teacher schedules a specific time (different from the class time) to answer students' questions or doubts, it is not considered a synchronous class, and the teacher can count the workload. Asynchronous classes are part of the class hours that the teacher must fulfil in their modules, but they can be carried out asynchronously, without having a virtual classroom, i.e., the teacher can provide activities for their students to solve on their own or send them video classes to watch.

In view of those aspects of what can be assumed by synchronous and asynchronous, and considering the interviews we conducted with higher education teachers who teach mathematics in the ERE format, we decided to identify the teaching actions of the respondents by focusing on synchronous and asynchronous classes and the entire organisation that the teacher had to do to make them happen.

## **METHODOLOGICAL PROCEDURES**

This research is qualitative, and data collection occurred through semi-structured interviews with higher education teachers who taught mathematics in the remote mode. Eleven teachers from public and private educational institutions from the state of Paraná were selected. The interviews took place in January 2021, conducted via *Google Meet*. Some teachers were approached *a posteriori* via *WhatsApp* to add to the data already collected. The interviews were recorded through *Google Meet* and transcribed.

In the transcripts, we indicated the interviewer by letter E, and the teachers by P1 to P11 -to ensure the anonymity of the participants-, according to the order of the interviews.

The material obtained from the transcripts of the interviews became our *corpus*. We then followed the steps of the discursive textual analysis (DTA)

described by Moraes and Galiazzi (2011), which are: disassembling the text (unitarisation), establishing relationships (categorisation) and capturing the new emerging.

The so-called unitarisation “implies examining the texts thoroughly, fragmenting them to reach constituent units, statements referring to the phenomena studied” (Moraes & Galiazzi, 2011, p.11), the so-called units of analysis.

The second stage concerns establishing relationships, called categorisation. This process “involves building relationships between the base units, combining and classifying them, bringing together those unitary elements in the formation of sets that bring together close elements, resulting in category systems” (Moraes & Galiazzi, 2011, p.12).

The stage of capturing the new emerging follows from the previous two, which allows the emergence of a new understanding, which must be communicated, criticised, and validated to form a metatext, which provides an insight into the new combinations of the elements built (Moraes & Galiazzi, 2011).

Following the steps described by Moraes and Galiazzi (2011), considering our *corpus*, it was possible to identify the actions that emerged from the analysis of the speeches of the interviewed teachers, interpreting the similarities between the testimonies. Thus, we named the actions by verbs recorded in the present tense, which represents what the teachers did, for example: (They) Write, Explain, Organise. Those actions were organised in two stages, *Backstage* and *Execution*, which we defined in the next section. These moments were identified in the first stage described in the DTA, where we fragmented them to find new meanings. From them, two groups of actions emerged, one related to the Backstage and the other to Execution. For each set of actions, there were also microactions, the descriptions of which are given below.

The actions were always written in the first capital letter and recorded in the present tense (current time). They are related to class preparation, in the case of those that were part of the Backstage moment, or the teachers’ acts when teaching the synchronous class, in the case of those that are related to the Execution moment.

Each of the actions was sub-categorised and, therefore, called microactions. They also have the first capital letter, and their names were expressed in words or sentences, which have verbs or nouns, and which

represent a ‘class’. This class is specific to each microaction and was elaborated considering similarities in acts performed by teachers and that we were able to identify through the reports presented during the interviews. We must explain that a specific microaction of an action may have the same name as that of another action; however, it refers to different microactions since each one is related to different actions. For example, the categories Send and Elaborate, have subcategories called Activities.

## DATA AND ANALYSES

We organised this section into two subsections to present the Backstage and Execution moments, exposing the actions and microactions that make up each of them, with explanations about these categorisations and excerpts from the interviews that elucidate the allocations.

### Backstage

This first moment concerns all the preparation that the professional has to perform before and after class, all the work ‘behind the cameras’, backstage, to make the class happen. Therefore, we named this moment *Poscênio*, defined by the *online* Portuguese dictionary Dicio<sup>1</sup> as “Behind a theatre stage; backstage”. We know that Backstage also happens in face-to-face teaching. However, in our research, we observed that the ERE entails more tasks of different domains that the teacher had to develop, such as the constant and diversified use of technologies.

Thus, the Backstage covers a set of actions that the teacher performs to prepare the discipline, and of the classes, and for their closings, conclusions. For this moment, in view of the data collected, seven actions emerged from our interpretations, which were organised as manifested by the teachers, considering the order of the analysis of the interviews (therefore, we did not organise them in alphabetical order). They are: Self-form, Acquire, Organise, Elaborate, Send, Communicate, and Assess.

Each action was enumerated and preceded by POS, which indicates that it is part of the Backstage moment. For example, we use POS1 to indicate Self-form, which is the first Backstage action. We present the microactions corresponding to each of the actions in Tables 1 to 7. As they are in greater

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<sup>1</sup><https://www.dicio.com.br/poscenio/>

quantity when compared to the actions, they were organised in alphabetical order to simplify this presentation and are encoded by POS, followed by the number referring to the corresponding action, followed by a letter in alphabetical order, depending on their position of appearance. For example, the first microaction of the Self-form action is represented as POS1a. In the Tables, we also bring excerpts from the interviews that elucidate such microactions. We emphasise that for each of them, there are numerous comments, however, we chose to select only one due to the limitation of pages of an article.

The first action – Self-form – POS1, represents all the microactions that the teachers carried out to get instructed in this period of remote classes, seeking knowledge and developing ways and/or strategies to organise and teach their classes, since it was a format without ready references. These are formation courses that the teachers themselves sought to overcome difficulties or improve their practices for this new teaching situation, or courses and meetings offered by the teachers’ institution at the time of the interview.

In Table 1, we bring this action followed by its microactions and excerpts that elucidate our allocations.

**Table 1**

*POS1: Self-form*

<b>Microactions</b>	<b>Excerpts of the interviews</b>
POS1a – Learn to deal with programs	P4: <i>It was, for example, Teams, Meet, using Meet, I also had to learn some other resources it had, right.</i>
POS1b – Watch videos	P7: <i>[...] and then I searched for videos on the internet about the experience with the digitising table.</i>
POS1c – Search for documents	P2: <i>The main information I sought was about what could be used in the institute. [...] Then, at the institute, a document was organised with the information we could use, suggestions for activities, suggestions for assessments, for classes.</i>
POS1d – Share materials	P8: <i>[...] and I also got to take slides from colleagues too, and it was very good.</i>
POS1e – Ask other teachers	P1: <i>Before starting classes I asked more experienced teacher friends how they were going to do in remote teaching.</i>
POS1f – Participate in courses/meetings	P6: <i>So, all the teachers had the opportunity to take some courses, offered by the University’s DE teaching.</i>



There are six microactions related to Self-form. Letter a - Learn to deal with programs- expresses the process that the teacher had to do to learn how to use the necessary programs for remote teaching. For example, *Microsoft Teams, Google Meet, Classroom, Moodle, GeoGebra, PowerPoint* and others. POS1b, Watch videos, refers to the teacher looking for videos that could instruct them in some way for their classes, which are specific methodologies, or even help them use some specific equipment, as the excerpt in Table 1 points out. Search for documents, letter c, refers to the teachers searching for documents that support this teaching, documents about the new criteria to be followed, teaching in general, or specific documents for their institution.

POS1d, Share materials, indicates the exchange of materials between teachers. For example, PDF materials, such as books, handouts, and slides from some disciplines. It contemplates the act of receiving or providing other teachers with those files. Ask other teachers, POS1e, refers to the teachers talking to their colleagues to educate themselves about class issues, share ideas, and ask questions. The last microaction of the Self-form action, letter f, Participate in courses/meetings, indicates these teachers' attendance in courses or seminars offered by the institution in which they worked or not.

**Table 2**

*POS2: Acquires*

<b>Microactions</b>	<b>Excerpts of the interviews</b>
POS2a – Borrow	P8: <i>So the department lent it to me, and then, I have this notebook with me to this day.</i>
POS2b – Electronics	P7: <i>I bought the digitising table.</i>
POS2c – Specific materials	P4: <i>But specifically for the classes, I had to buy [...]. Other than that, consumables, such as cardboards, barbecue skewers, erasers.</i>
POS2d – Furniture	P5: <i>I had a double bed, I got rid of the double bed, bought a single bed and brought the office here to my room to be more closed, and I started teaching here.</i>
POS2e – Programs	P4: <i>I had to buy a program for editing and for videos, for editing better quality videos.</i>
POS2f – Utensils for writing	P11: <i>The whiteboard, that I didn't have either.</i>

The second Backstage action, POS2, is Acquire. In this action, we grouped the microactions identified in the interviews about the things the

teachers had to buy - or chose to buy by defining their methodology-, or borrow for their classes. The teachers' statements show that they acquired electronic materials necessary for the classes (since they were online), manipulable materials used in some specific didactics of a class, and even furniture to organise the environment where they needed to work. We also identified some loans of materials from the University itself. We inserted this second action and its microactions in Table 2, maintaining the pattern of Table 1.

There are six microactions related to the POS2 action. They represent this action of acquiring. The letter a, Borrow, refers to the materials that the teachers borrowed from their institutions for remote teaching, as the excerpt in Table 2 in POS2a highlights. The loans identified in the interviews were of notebooks, in some teachers' cases. Electronics comprises POS2b, and refers to the teachers' purchase of electronics for their classes, including notebooks, interactive tables, headsets, and mobile phone supports. POS2c – Specific materials – includes those materials that the teachers had to buy to use with a specific teaching strategy, for example, buying cardboards to build mathematical games with the students.

POS2d – Furniture – covers the furniture teachers had to buy for their classes since most worked remotely from their homes. As the excerpt in POS2d elucidates, P5 had to buy a single bed so that his desk could fit into his bedroom, which was where he would impart his online classes. In letter e, Programs, we have the microaction that refers to the programs that some teachers had to buy. We know that some platforms and programs allow free access, but more specific ones must be purchased. The last microaction (f), Utensils for writing, refers to that equipment that was purchased for the purpose of writing during classes, which includes a whiteboard, markers, and sulfite sheets. Note that in this specific case, we insert non-electronic utensils.

In POS3 action – Organise – we accommodate the microactions related to the organisation of the modules. Within this organisational action, there were necessary microactions and others carried out by choice to this type of teaching, such as creating links to classes, printing tests for correction, and scanning material. And others that were usual in face-to-face classes, such as inserting students' notes in the institution's system and registering presence. However, we noticed that, in some cases such as registering a presence, teachers performed microactions differently from what they did in face-to-face teaching because they were accessing new programs and tools that they did not have or did not know how to deal with previously.

In Table 3, we insert information about the Organise action.

**Table 3***POS3: Organise*

<b>Microactions</b>	<b>Excerpts of the interviews</b>
POS3a – Contact the students	P4: <i>Each discipline had a group, so we communicated there as well.</i>
POS3b – Correction of activities	P8: <i>So, for example, they were not careful to put the name, so it was hard for me to print it, because, when I did it, I took that lot and the tests had no name, so I had to put them on it.</i>
POS3c – Scan material	P1: <i>I scan the sheets that I used.</i>
POS3d – Modules	P10: <i>And then I chose to take Calculus I, because in this emergency semester it was voluntary.</i>
POS3e – Download	P4: <i>Teams itself has the resource, I request it to download, so you go there and ask for the participants' list.</i>
POS3f – Links/agenda	P2: <i>[...] Google Meet, where we scheduled the classes inside Google's classroom.</i>
POS3g – System	P1: <i>There was a portal. Where we put the assessment, the assignment scores, all right.</i>

There are seven microactions of POS3, the first of which is Contact the students, which refers to the organisation of communication that the teacher had with their students outside the synchronous classes, such as organising groups of disciplines on *WhatsApp*, opening forums on *Moodle*, and including a monitor on platforms to help them with the students' doubts. Letter b, Correction of activities, encompasses the actions that the teacher did to correct the activities or facilitate this action. For example, because the students' names appeared in the system, many did not insert their names on the test sheet. However, the sheets do not bring the students' names on them when printed, and some teachers had to write down the students' names one by one to correct them. Others who gave assessment activities of participation in the classes checked whether the students had viewed the videos posted.

POS3c – Scan Material – considers the act of scanning, or transforming into PDF, the files were used in class. The excerpt that elucidates this microaction shows that P1 scanned the class notes he had written on the sulfite

sheets<sup>2</sup>. The next microaction, Modules, composes POS3d, and covers the teachers' organisation of the disciplines, the module they would likely offer remotely, the elaboration of disciplines shared with other teachers, which was possible in some institutions in the ERE, and the appraisal of other teachers' teaching plan, which some teachers were required to do.

Letter e, Download, covers the teachers' downloads, which are from attendance lists, exams, works or videos, i.e., materials that were necessary to 'download'. POS3f – Links/agenda – are entitled to the act of generating links that would be provided to students, such as access to the online classroom, or that would serve to view recordings. They also include scheduling classes using *Google Calendar*<sup>3</sup>. Finally, System is the letter g of POS3 and refers to the organisation of the institution's system in which the student accesses information such as absences and grades inserted by the teacher.

**Table 4**

*POS4: Elaborate*

<b>Microactions</b>	<b>Excerpts of the interviews</b>
POS4a – File	P8: [...] <i>So, for example, if there were eight sheets, I took a picture of the eight sheets and sent them.</i>
POS4b – Activities	P5: <i>But preparing the tests themselves was not as complex as I thought it would be, but the assessments were very difficult.</i>
POS4c – Asynchronous study materials	P10: <i>I did the PDF on Latex, I also drew on Latex, then when there was an animation, I would put links, or YouTube, with videos that I had done with some quick explanation when I thought things would not be so well explained, only in writing.</i>
POS4d – Class notes	P1: <i>Elaborated in a notebook. He wrote what he was going to impart in each class.</i>
POS4e – Teaching plan	P6: <i>We had to send a form that is the planning of the module, every beginning of the semester, and we had to</i>

<sup>2</sup> Some teachers wrote the content on a sulfite sheet as if it were a frame while transmitting it. For this broadcast, they would put the mobile phone in a holder, and film their writing.

<sup>3</sup> *Google Calendar* is a service available by *Google*, to schedule events that are remembered to the generator link and to third parties, as long as they are inserted in the contact list.

*adapt this form for the remote period and had to insert a lot of things.*

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The fourth action of the Backstage moment, POS4, is Elaborate. It contains five microactions and refers to the act of constructing materials, such as works, exercises lists, assessments, handouts, slides for classes, video recordings, and others. That is, everything that the teacher elaborated to be used in his class, whether synchronous or asynchronous, or even to serve as complementary material for the students. Table 4 presents this action with its microactions and the excerpts that elucidate them.

The first microaction, POS4a – File –, is related to test correction. It concerns the preparation of files that some of the teachers created for this occasion, including the typed manuscripts, written with the help of the digital table, or some PDF editing program. When the student requested a view of the test, the teacher sent those notes or made an appointment to present it to the interested party. POS4b refers to Activities. This microaction encompasses all the activities that the teacher elaborated. By activities, we understand the files sent to the students for them to solve, and that would serve as an assessment form, such as tests, works, exercises lists, among others.

Asynchronous study materials compose POS4c and are related to materials that the teacher prepared, and that would serve for a study outside the synchronous class, such as recording video classes and making handouts. The letter d of the POS4 is Class notes and covers the teacher's class preparation. As in face-to-face teaching, it is a material that guides their explanations, and the content taught. Some teachers made these notes handwritten, others on *slides*. The POS4e microaction, Teaching plan, is the last microaction of the Elaborate action and is related to the process of development and construction of teaching plans, didactic guideline, sheets, i.e., any organisations that were subsequently sent to students or to the coordination of courses, including the organisation of the discipline/module.

Assuming that several of the materials that teachers elaborated or recorded were sent to students, the fifth category corresponds to the Send, POS5 action, and indicates the teacher's act of sending texts, tests, slides, links, videos, and materials in general to students, everything that was sent or posted on some platform for students access. This action includes five microactions, presented in Table 5.

In POS5, the letter a refers to the microaction File on test correction. This microaction concerns the act of sending the file that was prepared in POS4a. As well as POS5b, Activities, it refers to sending the activities the teacher prepared in POS4b. The letter c of POS5, Links, indicates sending the *links* the teacher created either for the synchronous class or for its recording, which is often made available to students through the link or even through a *YouTube* video, for example. Asynchronous study materials, POS5d, and Teaching plan, POS5e, indicate the referral of materials that were prepared by the teacher in POS4d and POS4e, respectively.

**Table 5**

*POS5: Send*

<b>Microactions</b>	<b>Excerpts of the interviews</b>
POS5a – File on test correction	P11: <i>But some say: teacher, send me this chat by email, I just want to know my scores on each question.</i>
POS5b – Activities	P1: <i>[...] and those tests were posted on a portal.</i>
POS5c – Links	P9: <i>I finished the class, I expected to generate the link to the class, I already provided the class link, the activities link, the slides.</i>
POS5d – Asynchronous study materials	P1: <i>I scan and send it to them [the class notes].</i>
POS5e – Teaching plan	P2: <i>And then we also sent a script of what the classes would be like for them.</i>

Table 6 shows the Communicate action and its respective microactions. This action has four microactions and concerns the teachers' contact with their students outside the synchronous class, which happened by email, *WhatsApp*, and platforms, which may be live, or not, as we noticed in the selected excerpts.

POS6a, Email, indicates the communication that the teacher had with the students through this email. Platform is the second microaction of POS6. It contemplates the teacher/student communication made through the platforms they had access to, such as *Moodle* and *Classroom*. Classroom, POS6c, is the contact through the online classroom in *Google Meet* or *Microsoft Teams*, but at times outside the synchronous class. Finally, *WhatsApp*, letter d of POS6, refers to the contact by *WhatsApp*, whether in groups of disciplines or privately with a student.

**Table 6***POS6: Communicate*

<b>Microactions</b>	<b>Excerpts of the interviews</b>
POS6a – Email	P1: <i>I received a lot of e-mails, like, “Oh, I couldn’t answer the call yesterday, can’t you give me a presence?”</i>
POS6b – Platform	P9: <i>So, in the first week, so-and-so would post, and if there was any doubt, if they could not solve it, they would post it there in the forum, I would also be there discussing, clarifying those doubts [...].</i>
POS6c – Classroom	P2: <i>[...] we had a chat as we are doing now, a call, right, with that specific student, to be able to answer their specific questions too.</i>
POS6d –WhatsApp	P2: <i>Sometimes I would finish the class and some student would say: “Teacher, even with your explanations I did not understand so-and-so”. Then I redid it, then I answered it on WhatsApp.</i>

The last category of the Backstage moment is Assess, POS7, and its two actions are described in Table 7. This action involves the microactions of assessing students, i.e., making corrections and assigning them grades. These actions allowed the teacher to assign students grades regarding the delivery and/or presentation of tasks or participation in classes. We identified different assessment forms, from works in videos to be delivered, exercise lists, seminar presentations, and written assessments. In general, we identified that what brought the most concern on the part of the interviewed teachers was to decide what would be the most appropriate way to assess their students in this remote teaching, and, later, how to correct it, which required more time of dedication than in face-to-face teaching, according to the testimonies.

**Table 7***POS7: Evaluates*

<b>Microactions</b>	<b>Excerpts of the interviews</b>
POS7a – Activities	P3: <i>I would look and open a spreadsheet in Excel, put the questions and give the grades on the side. It put the name, the questions and the note on the side.</i>
POS7b – Participation in classes	P6: <i>I divide the subject’s grade into 20% participation, which is a systematised participation.</i>

In POS7a, Activities, there are all the assessments that involved the delivery of some activity by the students, namely tests, works, exercise lists, videos, or seminar presentations. In Participation in classes, POS7b, we considered the grades that the teacher attributed to participation in synchronous classes. The teachers scored based on questions answered, resolutions of indicated exercises, and times when doubts were clarified.

Table 8 groups all seven actions and 35 Backstage microactions .

**Table 8**

*Backstage: actions and microactions*

<b>Actions</b>	<b>Microactions</b>
Self-form	Teachers learn to deal with programs; Watch videos; Searches for documents; Share materials; Inform themselves with other teachers; Participate in courses/seminars
Acquire	Borrow; Electronics; Specific materials; Furniture; Programs; Utensils for writing.
Organise	Contact with the students; Correction of activities; Digitise material; Modules; Download; Links/agenda; System.
Elaborate	File on test correction; Activities; Asynchronous study materials; Lesson notes; Teaching plan.
Send	File on test correction; Activities; Links; Asynchronous study materials; Teaching plan.
Communicate	Email; Platform; Classroom; <i>WhatsApp</i> .
Assess	Activities; Participation in classes.

Below, we discuss the second moment, called Execution.

### **Execution**

The second moment, called Execution, concerns what the teacher did during class time, in the case of remote teaching, in so-called synchronous classes. When they perform what they planned and perform other unplanned actions, but which are important for the class such as answering students' questions, making some revision perceived as necessary. The online dictionary Dicio<sup>4</sup> brings that *execução* means: "Action of executing, of making a project be carried out; realisation, application, make effective: execution of events".

<sup>4</sup><https://www.dicio.com.br/execucao/>



And it is exactly this meaning that it occupies here: to accomplish, to put into practice what has been prepared.

At this moment, we related six categories, i.e., actions that occurred during the synchronous class emerged from the analytical process. Like in the first moment, we organised those actions as identified in the teachers' reports during the interviews, following our order of analysis of the transcripts. These actions are: Operationalise, Write, Explain, Answer, Wait, and Interrupt.

Each of the actions is enumerated and preceded by EXE, which indicates that they are part of the Execution moment, just as we did at the first moment. For example, we use EXE1 to indicate Operationalise, which is the first Execution action. We present the microactions corresponding to each of the actions in Tables 9 to 14. For microactions, we used the criterion of organising them in alphabetical order, since they are in greater quantity and can occur at different class times. And for a better explanation, we call each of the microactions by EXE, accompanied by a number referring to the action to which it corresponds, and a letter that indicates its alphabetical order. For example, the first microaction of EXE1 is indicated by EXE1a. Excerpts taken from the interviews that elucidate such microactions also make up the Tables. We also emphasise that, for each of these microactions, there are justifications in more than one interview, but here we will present only an excerpt by microaction, maintaining the presentation pattern of the Backstage moment.

EXE1 – Operationalise – is the first Execution action, has seven microactions and brings with it the intention of leaving something ready to use, prepare. This action encompasses microactions related to the possibility that the synchronous class will happen in general, or serve as an introduction to them. For example, access to links to enter the online classroom, turn cameras and microphones on or off, talk to students, start recording the class, check messages from students. In Table 9, all microactions and excerpts from the testimonies that exemplify them are listed.

The first microaction of Operationalise was coded by EXE1a and called Access. It establishes acts related to accesses, such as accessing the synchronous class link, accepting it so that students can enter the online classroom, and the teacher's transition to different groups of students trained in *Google Meet* or *Microsoft Teams*, which was an organisation that could be done (dividing students into groups in the same online classroom). EXE1b, Camera/Microphone, indicates the teachers' operations in relation to these items, for example, asking students to turn on or off their microphones or their

cameras, turning off the student’s microphone and the teacher turning on or off their own camera or microphone.

**Table 9**

*EXE1: Operationalise*

<b>Microactions</b>	<b>Excerpts of the interviews</b>
EXE1a – Access	P11: <i>Some entered straight away, others had to accept it, it depends on whether they had the institutional email or not.</i>
EXE1b - Camera/microphone	P4: <i>The problem is like this, when someone forgot the microphone on, right, but then we have the feature by which we can turn off the person’s microphone.</i>
EXE1c – Call	P7: <i>I generated a link on Google form, then I passed the link there in the chat for them to access.</i>
EXE1d – Share screen	P: <i>You shared your screen in Google Meet for your sheet to appear, is that so?</i> P1: <i>That’s right.</i>
EXE1e – Chat with the students	P2: <i>Yes, we all talked about isolation, how they were feeling, you know.</i>
EXE1f – Record class	P6: <i>We record all [synchronous] classes for students to watch later, but it is not the same thing, right.</i>
EXE1g – Check messages	P8: <i>Now, when I usually had my cell phone, they put it there in the chat, then I could see it and I already answered it.</i>

The letter c, Call, contemplates how the teacher called the roll during synchronous classes, which happened through *links* on the *Google Forms*, orally, or the teacher asked students to write “present” in the *chat*, without calling them in any order. EXE1d is the microaction Share screen, and indicates the sharing of the screen (from the notebook, mobile phone, tablet, interactive table) in the online classroom, so that students could see the slides, for example, or what the teacher is writing on the digital blackboard, tablet, or sulfite sheet, an act that could be performed through *Google Meet* or *Teams* tools, or by some external program.

The next microaction of Operationalise is EXE1e, called Chat with the students. It covers the conversations that the teacher had with the students during classes on various topics, including conversations about the pandemic, about the students’ lives, and also feedback that the teacher asked about their

classes and methodologies. EXE1f, Record class, indicates the operation of the teacher recording the synchronous class, among the teachers interviewed, which occurred through the “Recording” tool. The last microaction is Check messages, and establishes the verification of messages sent by students, whether through chat or *WhatsApp*.

EXE2 is the Write action. With the analyses, we identified that in remote teaching, the methodologies chosen by teachers are varied and, consequently, the way they ‘pass on’ or write the content. The slide, the board, the tablet, the interactive table, and the online pics are some of the forms identified for this writing and that were grouped in the two EXE2 microactions. We also emphasise that the act of drawing graphs or figures, which commonly appear in mathematics classes, is also covered in the Write action.

Following the same pattern as the other Tables in this section, Table 10 brings details about this action.

**Table 10**

*EXE2: Write*

<b>Microactions</b>	<b>Excerpts of the interviews</b>
EXE2a – Computer	P10: Then <i>I started using Google framework, the Jamboard was working well.</i>
EXE2 b – Manuscript	P11: <i>Yes, I used a board and a marker and had the support on top, where we could leave the mobile phone, so I filmed my writing board.</i>

For EXE2a – Computer – we assume that it represents the microactions of the teacher to write on means that use the computer, *notebook*, or the main electronic means that the teacher used to carry out the classes. For example, writing on slides, on the online board, in GeoGebra. Letter b, Manuscript, refers to handwriting, which can be done with pen and paper, by the digital table, tablet, or some other instrument that would enable this writing, without using the computer, but shared or projected on it.

EXE3 Explain, encompasses the ways the teacher used to explain the content, or the origin of the class, giving examples, solving exercises, conducting discussions, reading tests. These forms may vary according to the teaching strategy that was used. Table 11 shows this action and its five microactions.

**Table 11***EXE3: Explain*

<b>Microactions</b>	<b>Excerpts of the interviews</b>
EXE3a – Activities	P1: <i>During the whole class I solve the test and then I ask questions.</i>
EXE3b – Discuss	P4: [...] <i>and then, we had the synchronous classes, to discuss those materials [that the students elaborated].</i>
EXE3c – Write	P1: <i>So I wrote, and explained.</i>
EXE3d – Ask	P8: <i>I was passing on the contents, the theoretical part, the examples and talking to the students, I called one, I called another to see if they could answer.</i>
EXE3e – Material	P8: <i>So my first classes were all by slides. I was passing on the contents, the theoretical part, the examples, and talking to the students.</i>

EXE1a, Activities, refers to explaining the activities proposed to students and their resolutions, such as assignments, tests, exercises, explanations based on student resolutions, among others. The EXE1b microaction Discuss encompasses discussions about content, in which there is a dialogue with students, with an exchange of experiences and suggestions. Write, EXE1c, indicates the explanation that is made by the teacher together with the writing, which is on the sheet of paper, on the blackboard, digital table, *notebook*, or other possible means. The fourth microaction, EXE1d, Ask, indicates the teacher's explanation made through questions that lead students to reflect on something. The last microaction, EXE1e, Material, establishes the teacher's explanation through materials, such as slides or PDF files the teachers used.

The fourth EXE4 action, Answer, represents the way the teacher answered to students. In the ERE, this practice had alternations, since even in the synchronous class, the teacher had contact in several ways with the students, which can be through the camera and the microphone, through chat, through *WhatsApp*. Therefore, this contact took place orally and in writing. Table 12 shows the Answer action and its two microactions.

The EXE4a microaction is the Orally, which represents the teacher's oral answers, using his/her microphone. The teacher's answer also happened in a written way, which is represented in the EXE4b microaction, In writing, which contemplates the teacher's answers made in writing by chat or *WhatsApp*, for example.

**Table 12***EXE4: Answer*

<b>Microactions</b>	<b>Excerpts of the interviews</b>
EXE4a – Orally	P11: <i>Orally, I did not turn off the microphone in class.</i>
EXE4b – In writing	P11: <i>The situation that I answered through the chat was test applications, in the sense that I am here as support, I will be silent, but if you need you can contact me.</i>

The next action, EXE5, Wait, exposes the teacher's act of waiting during the synchronous class. This Wait is related to the progress of the class, among them: waiting for the students to copy, waiting for them to solve a requested exercise or a program that will be used at the moment (waiting for it to 'open'). In this sense, the two EXE5 microactions were allocated in Table 13, which represent such hopes.

**Table 13***EXE5: Wait*

<b>Microactions</b>	<b>Excerpts of the interviews</b>
EXE5a – Students' actions	P3: <i>Well, some yes, because when I would change sheets, some would say: wait a little bit more.</i>
EXE5b – For access	P6: <i>It was cool, but the didactic time is different, so, for you to move a piece when we're here together, it's super-fast, and in the remote, the computer crashes, the internet falls, the time of thought changes, interaction changes completely, and then those things.</i>

There are two microactions related to the Wait action. The first, EXE5a, Students' actions, as its name already says, refers to waiting for actions taken by students, but which are related to the class. For example, if the student asks the teacher to wait for him to copy the content, for them to solve exercises the teacher indicated, or for their answer. The second microaction, EXE5b, For access, indicates the teacher's waiting for access to programs, websites, or tools related to the class content or their didactics at the moment.

The last Execution action, called Interrupt, EXE6, establishes the teachers' action when interrupting the class or postponing it. This fact occurred for various reasons, grouped in the microactions such as having to answer the bell or intercom, external noises disturbing the class, asking for students' collaboration in class, parallel conversations or lack of participation, among others. This action and its respective microactions and the excerpts that elucidate them are presented in Table 14.

**Table 14**

*EXE6: Interrupt*

<b>Microactions</b>	<b>Excerpts of the interviews</b>
EXE6a – Answer buzzer/intercom	P3: <i>The intercom rang [...] I stopped [the class] and answered it.</i>
EXE6b – Noise	P6: <i>I open the microphone, all the dogs on the street bark. My dogs stay here. It happened when the churros' car passed by, the dogs barked.</i>
EXE6c – Technical problems	P7: <i>Yes, it happened that the internet dropped, I think twice.</i>
EXE6d – Break	P5: <i>What they asked me was to take a break in class. A class asked me, they said: Teacher, can you give us a few minutes to go to the toilet?</i>
EXE6e – Ask for commitment	P4: <i>But I had to scold them several times about commitment, right. Look, you're not engaged.</i>
EXE6f – Third party messages	P5: <i>The preceptorship staff, they entered the two Calculus classes.</i>

The first interruption microaction is EXE6a, Answer the buzzer/intercom, and indicates the teacher's action to have to stop class to answer someone who was calling, either by the buzzer, or by the intercom, or in some other way, since several teachers taught the classes in their homes. EXE6b, Noise, represents the microaction of interrupting class due to some external noise, such as dogs barking or a sound car passing by. Technical problems, EXE6c, signal the pause due to problems such as internet dropping for the teacher or several students at the same time or electric power dropping where the teacher is teaching the class.

Break, EXE6d, represents an interval for relaxation in classes, which also happened in remote teaching. Some teachers claimed that, because it is tiring to be in front of the computer screen for a long time, they chose to do this moment during classes. The EXE6d microaction Ask for commitment,

represents an interruption that the teacher had to do to ask the students to participate in the classes since it did not always happen spontaneously in the ERE. The microaction also represents when the teacher had to interrupt parallel conversations in the chat or orally. Finally, EXE6f, called Third party messages, represents the interruption for someone to give a message to the students, which may be a coordinator, monitor or preceptor, as described in the interviews.

Table 15 groups all six actions and 24 microactions of the Execution.

**Table 15**

*Execution: actions and microactions*

<b>Actions</b>	<b>Microactions</b>
<i>Operationalise</i>	Access; Camera/microphone; Call the roll; Share screen; Chat with the students; Record class; Check messages.
<i>Write</i>	Computer; Manuscript.
<i>Explain</i>	Activities; Discuss; Write; Ask; Material.
<i>Answer</i>	Orally; In writing.
<i>Wait</i>	Students' actions; For access.
<i>Interrupt</i>	Answer buzzer/intercom; Noise; Technical problems; Break; Ask for commitment; Third-party messages.

## FINAL CONSIDERATIONS

Based on the references adopted and convinced of the importance of conducting investigations that are based on what the teacher does to teach their classes, we developed this research that aimed to answer the following question: What do teachers who teach mathematics in higher education actually do to organise and teach classes in emergency remote education? To this end, we resumed definitions of teaching actions, which served as a guide for the organisation of the search for the desired answer. The teaching actions are assumed in this article as the acts performed by the teacher during their classes, during class planning or execution.

As already informed, the data were collected through interviews with eleven teachers who teach mathematics in higher education in different institutions in the state of Paraná. We asked teachers what they actually did when preparing and executing their classes in remote education.

From the interviews and based on the DTA for data analysis, we identified two moments that divide the teaching actions: Backstage and Execution. We observed that the Backstage covered a set of seven asynchronous actions (Self-form, Acquire, Organise, Elaborate, Send, Communicate, and Assess), which involved 35 different microactions, in which the teacher carried out the preparation of the modules and the classes, as well as their closings. The Execution moment comprised six synchronous actions (Operate, Write, Explain, Answer, Wait, and Interrupt) and 24 microactions, in which the teacher put into practice what was prepared in the Backstage.

First, we observed that among the various teaching actions developed by the teacher who teaches mathematics in higher education at the ERE, some had already been categorised in previous research in face-to-face teaching, such as the Write, Explain, and Wait actions found in Andrade (2016).

However, what most caught our attention is that the Backstage moment presented a greater number of actions and microactions than during Execution, indicating the weight of the preparatory actions in the ERE classes. In other words, remote teaching has required from teachers a great effort in the search for information and preparation and elaborate planning for the classes. Perhaps this explains why the professionals revealed their anxieties about this type of teaching during the interviews, in the sense of not feeling prepared and confident for the processes they had to perform remotely.

This teachers' lack of confidence and the reasons that led them to carry out the actions identified in the analyses, i.e., their intentions, can be explored in future research, as the data obtained show us such investigative developments.

## **AUTHORSHIP CONTRIBUTION STATEMENT**

MMP supervised the development of VCR's research project, whose results are presented in this article. VCR was responsible for the preliminary data collection and analysis. MMP and SMA contributed to data analysis and the final version of this article.



## DATA AVAILABILITY STATEMENT

The data supporting the results are available at <https://drive.google.com/drive/folders/156QOJ3mimXxhYpo8gHiGc7v202fDtOqN?usp=sharing>

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