

Teaching Practices in Mathematics During COVID-19 Pandemic: Challenges for Technological Inclusion in a Rural Brazilian School

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Abstract

The pandemic caused by COVID-19, on a global scale, brought an unprecedented situation for students from all over the world: the closure of schools. This study presents this theme under the perspective of a rural Brazilian school, located in a town in the interior of the state of Rio de Janeiro. Since the closure of schools as a health strategy for the control of the pandemic, the government of the state of Rio de Janeiro adopted the distance learning for school activities, most of which was achieved through technological mediation. This strategy to face the problem highlight reflections on inequality of access to the internet and the different roles played by the school, in addition to cognitive aspects. Considering as a research object the class of ninth grade of elementary school, and as a research theme their mathematics activities in distance learning, it was possible, through a case study, to analyze advances and setbacks in the learning proposal implemented. It is concluded that Brazil, due to its extensive territorial range and multiple specificities, is not yet prepared to legitimize the use of pedagogical practices in mathematics mediated by technology. Investments in infrastructure and teacher training are necessary so that pedagogical proposals mediated by technology can effectively contribute to the training of students.

Keywords: COVID-19 Pandemic; Closure of Schools; Pedagogical Practices in Mathematics Mediated by Technology; Mathematics Teaching in Brazilian Rural School.

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1. Introduction

Friday, March 13, 2020. Another week of classes ended. It was true that we were still a little unaccustomed to the pace of classes. After all, the carnival had just ended. We were surprised, at the end of that day, by a decree from the governor of the state of Rio de Janeiro: the state schools and universities would close for fifteen days, due to the COVID-19 Pandemic. What teachers, administrators, employees, students and their families did not know is that, with that decree, an uncertain and turbulent period would begin, in which several issues related to the existence and function of the school, as well as the role played by the various actors that composing this complex system would be put to debate. The Brazilian Ministry of Education [1,2,3,4], with Ordinance No. 343, of March 17, 2020 and its successive ordinances (Ordinance No. 345, of March 19, 2020; Ordinance No. 473, of May 12, 2020; Ordinance No. 544, of 16 June, 2020) dealt with the substitution of face-to-face classes with classes in digital media, during the pandemic period by COVID-19 and suspended, in the last act, face-to-face classes until December 31, 2020. Considering such ordinances, the Council State Department of Education of the state of Rio de Janeiro [5] prepared EEC Resolution No. 376, of March 23, 2020, in which it provided, for state school system of Rio de Janeiro and private schools in that state, measures that these institutions would take through distance learning. In this same resolution, it was decided that municipal education councils would have autonomy over the implementation of distance learning for students in their schools. It is in this scenario that this study is occurs. Distance learning is a common practice in Brazilian Higher Education. In the last five years, enrollment in distance learning higher education courses increased by 88.7% according to Carius [6]. However, distance learning in Basic Education is still a challenge for Brazilian educational institutions. The town of Petropolis is located in the mountainous region of the state of Rio de Janeiro. Its estimated population in 2018 was 305,687 people according to the BIGE (Brazilian Institute of Geography and Statistics). According to the 2019 Brazilian Census of Basic Education, the public municipal school system of Petropolis housed 33,482 students, out of a total of 68,037 students (federal, state, municipal and private schools) in the town, that is, 49.21% of students are enrolled in the public municipal school system of Petropolis. In view of the size and complexity of these public municipal school system, actions that minimized the impacts related to the COVID-19 Pandemic were necessary and urgent. In this context, the Municipal Education Department of Petropolis, in decision with the Municipal Education Council, opted for distance learning mediated by technology. For students who did not have access to internet or technological tools, printed study materials were delivery for those responsible in person at the school. Mediation with teachers was suppressed, in the same way that such activities in distance learning were proposed with the sole objective of maintaining the bond of the student and his family with the school, without any relationship with validation of workload. Mathematics activities have been available since the platform was implemented. Under the framework of the class of ninth grade of elementary school, the last stage offered by schools in the public municipal school system of Petropolis, this work intends to answer the research question: ‘Mathematics activities, made available to the class of ninth grade of elementary school through the virtual platform, without any teaching mediation, were sufficient to maintain the student's bond with his school, despite this student being in the last stage of elementary school?’ In order to answer the research question, the general objective of this study was to evaluate the concept of distance learning established by the public municipal school system of Petropolis in view of the pedagogical proposal offered to students. As specific objective, it was verified the adherence of the pedagogical proposal with the students of the

ninth grade of elementary school in the discipline of Mathematics. Due to the number of students enrolled in the public municipal school system of Petropolis, we opted for a case study at a school in that system. The chosen school is located in a rural area, with limited internet access. It was intended, based on this choice for the case study, to identify specificities of the school unit unable to be perceived by macro governmental actions and brings to the reflection the theme of the real inequalities existing in Brazil, which became even more evident at the time of COVID-19 Pandemic.

2. Technology-mediated classes: understanding the dynamics of internet access

Until the beginning of 2020, public schools, both the public state school system of Rio de Janeiro and the public municipal school system in Petropolis, did not reflect concern about students' access to the internet in their physical facilities. According to Carius [7], the use of a mobile cell phone is a reality for high school students in the public federal school system. The author defends the use of this devices in mathematics pedagogical activities for these students. This finding reflects the results of the 2019 Brazilian Census of Basic Education. According to this data base, considering the 12 schools in the public state school system of Rio de Janeiro, located in Petropolis, only 9 provided internet access to their students. Among the 168 schools in the public municipal school system of Petropolis, 54 of them offered internet access to students. Although student access to the internet is available to a significant number of schools on both school systems, this does not mean that such access occurs for students' personal devices. Figure 1 shows the comparison between the number of schools that provided internet access for students' personal devices, both in the public municipal school system of Petropolis and in the public state school system of Rio de Janeiro, in schools located in the municipality under analysis.

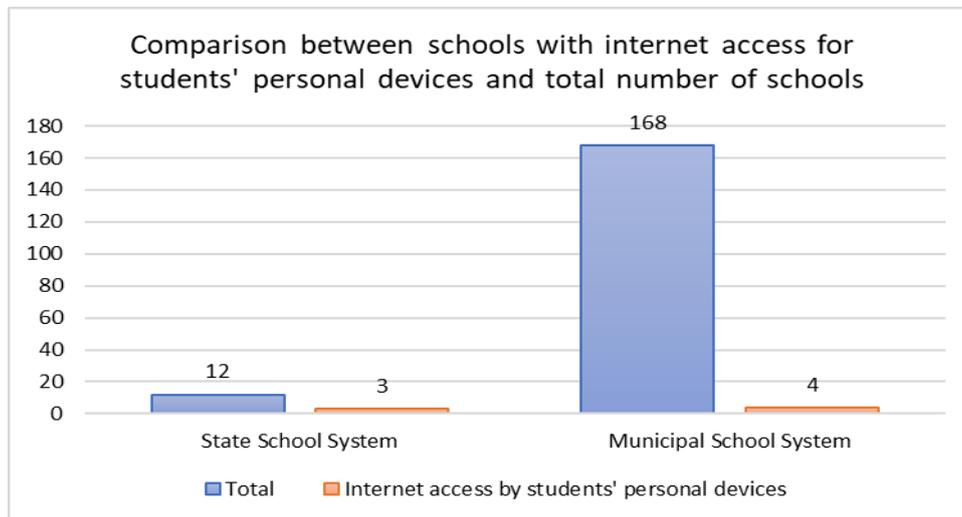


Figure 1: Comparison between internet access by students' personal devices in the school's physical facilities and the total number of schools in state school system of Rio de Janeiro and in municipal school system of Petropolis located in Petropolis, RJ.

Considering the data in Figure 1, it is observed that 25% of school in state system provide internet access for students' personal devices, while 2.38% of schools in municipal system do so. The negligible amount of schools

in municipal system that allow access to the internet for students' personal devices reflects the systematization of an educational process in which learning experiences with the use of technology, especially with the inclusion of the students' own smartphones, are not encouraged. One of the hypotheses that comes up for the non-inclusion of technological tools with access to the internet in pedagogical practices in schools of the public municipal school system of Petropolis refers to lack of student-owned equipment for internet access. In this sense, the continuous NHSS (National Household Sample Survey), from the fourth quarter of 2018, conducted by BIGS (Brazilian Institute of Geography and Statistics) presents data on the type of equipment used for internet access by students aged 10 or over in Brazil. Figure 2 describes the percentage of students, aged 10 or over, and the respective equipment that these students use to access the internet.

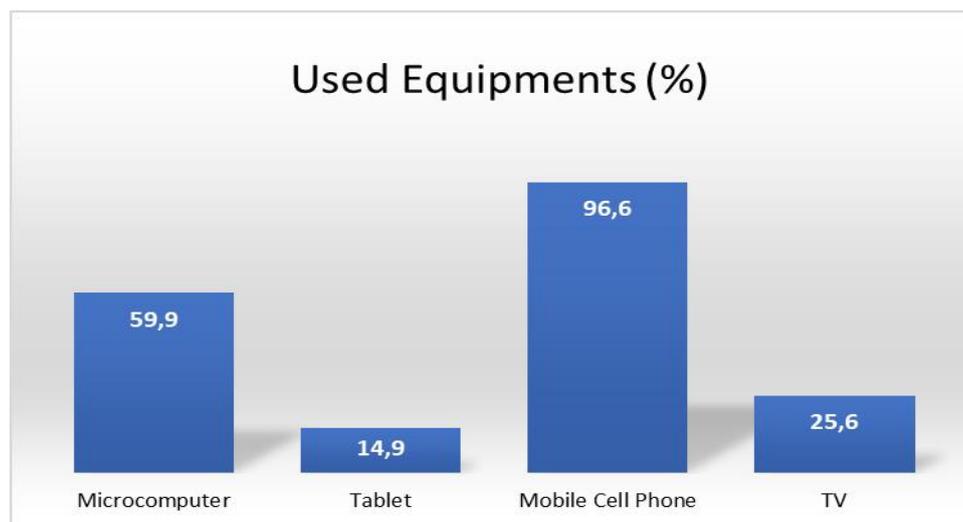


Figure 2: Equipment used by students, aged 10 or over, to access the internet.

It is observed, based on the BIGS data, that students access the internet mainly through the mobile cell phone. However, the survey does not inform whether the equipment used by the student is his own or that of third parties. Therefore, there is a first weakness regarding the internet access of Brazilian students: the non-guarantee of availability of equipment for internet access for a period of time in order to carry out the home activities offered by the public municipal school system under analysis. It is not possible, from this set of macrodata, to deduce that there are, in fact, electronic equipment with internet access in the students' homes, especially for the students enrolled in public municipal school system of Petropolis. The second question that arises in the problem of students' access to the internet refers to the type of access available to them. Also according to the NHSS, linked in the fourth quarter of 2018, it was found that 99.8% of students aged 10 or over, have broadband internet access in the country, whether fixed or mobile. Of this group, 84.2% have access to fixed broadband internet, 80.4% have access to mobile broadband internet and 64.8% have access to both forms of broadband internet simultaneously. Therefore, broadband internet access, whether fixed or mobile, occurs for almost all students. However, by restricting the scope of this research to the municipal school located in a rural area in the municipality of Petropolis, the picture is quite different: at the school itself there is no signal of mobile broadband internet by any of the operators operating in the region and as for the fixed broadband internet, this is only offered in part of the houses in the region, by a single company. It is important to note that, regardless of

the financial conditions of several families in the region, the internet is not offered, either by fixed or mobile broadband. The school in question has internet access via satellite, funded by the Brazilian Ministry of Education, only for administrative purposes. Considering the precarious situation of the institution with respect to internet access, the school's management team organized itself so that distance learning, would have a dynamic independent of internet access. The printing of activities, with shifts at the school unit by the management team and continuous invitations to families for this exchange of activities, was the most successful path in this atypical dynamic for all actors.

3. Methodology

According to Gil [8], an exploratory research 'has as its main purpose to develop, clarify and modify concepts and ideas, with a view to formulating more precise problems or searchable hypotheses for further studies.' The purpose of exploratory research is to provide an overview, of an approximate type, about a given fact. Still according to Gil [8], exploratory research is used when the chosen theme is little explored and it is still premature to formulate hypotheses about it. Due to the unprecedented nature of the closure of schools for such a long period of time and the use of distance learning as a strategy to maintain the link between the school, students and their families, it was found that exploratory research was an appropriate instrument for the present analysis. For the research design, it was decided to work in the perspective of a single school, located in a rural area of Petropolis' town, due to the peculiar dynamics of internet access by this school and the local community. In this sense, the case study is properly. For Gil [8], among the purposes that we can list for a case study, the following stand out: possibility of exploring real life situations whose limits are not clearly defined and describing the situation of the context in which a given investigation is being carried out. From a technical point of view, for data collection, two research techniques were chosen: document analysis, considering public consultation to the website '*Educa em casa*', made available by the Municipal Education Department of Petropolis, for the mathematical activities offered for the ninth grade of elementary school of the public municipal school system of Petropolis and semi-structured interviews, carried out with the school management team. All participants did so by free consent under the Free and Informed Consent Form (FICF).

4. Asynchrony between generalizer activities in distance education and the specifics of the students in the chosen school

The rural school is, in itself, full of specificities, regardless of the pandemic context. The *João e Maria* Municipal School (fictitious name) is no different. The school unit receives two very different student audiences: a group from community and around it and another from a poor community located 4 kilometers away from the school. Due to this issue, cultural conflicts generated by the attempt to interact between the two groups naturally exist in the school environment. The group of students from farming families, in general, has little financial difficulty. The region's farmers sell vegetables and flowers in the markets and fairs of the municipality itself and neighboring municipalities, achieving a relatively comfortable life, despite being away from the urban center. These students also attend the *João e Maria* Municipal School because of the distance to their homes, since they work in the fields after the classes, in addition to going to the fairs or markets on the weekends to sell the products grown in agricultural areas. The transportation of these students is done by their

own family members or by the school bus, intended for access to areas far from the urban center. The group of students from the poor community, near the *João e Maria* Municipal School, describes itself in another way: in general, the students are children of workers as informal or formal with low pay in the urban area, and there are several situations of lack of financial resources of families being observed. In this sense, the school has a social importance, including for food. These students have access to the school through the only bus line that arrives there, with the time for classes, meals, entry and exit for students regulated by this transport, which is different from the group's transport for farmers. The *João e Maria* Municipal School is located next to a Catholic church and in front of a Basic Health Unit and a sports court, with small shops in the surroundings. Therefore, the school is inserted in an area of greater access for the community for various services. As previously mentioned, despite the partial isolation of the *João e Maria* Municipal School, internet access to the location is precarious: there is no access to any mobile broadband internet provider and only one company offers a precarious fixed broadband internet plan. Therefore, the access of the *João e Maria* Municipal School to the internet is done via satellite through resources from the Brazilian Ministry of Education, only used for administrative purposes by the management team and the school secretary. The Rural Products Association of the region has access to fixed broadband internet and distributes, via wi-fi, internet access to the school, church, health clinic and nearby businesses. Students who have a mobile cell phone with internet access usually use this network on a daily basis to access the internet via their mobile devices when they are in the school unit, as well as teachers. However, not all rooms in school have access to this network. As for classes, the school attends Early Childhood Education classes, not offering the daycare service, classes in the early and final years of elementary school. The ninth-grade class of elementary school in 2020 has 23 students, 4 boys and 19 girls. In this class there are two students with special needs: a student with cerebral palsy, having mobility difficulties and another with bipolarity. As for access, the classroom of the class was located on the ground floor, making it possible for students with mobility difficulties to access autonomously. For the student with bipolarity, an intern was made available for full monitoring during school activities. Having described the target audience of this case study, the first question to be asked in this research refers to the work that was developed in the mathematics discipline for the class of ninth grade of elementary school in 2020. Considering the planning of the discipline's teacher, provided by the pedagogical advisor, the teacher contemplated the NCCB (National Common Curricular Base), a request from the municipal education system of Petropolis. The teacher considered knowledge of Algebra, Arithmetic, Trigonometry and Statistics, including some discussions involving Financial Education. In addition, the class of ninth grade would participate in the project developed by the research group responsible for this study, in the area of Media and Social Networks, at the university that houses this research group. However, due to the COVID-19 Pandemic, the group did not participate in any meeting. From the planning, unfortunately not materialized, there is a concern, both from the management and from the teacher, with regard to the social role of mathematics for the lives of students, represented in such a peculiar group, in the Ethnomathematics perspective of Ubiratan D'Ambrósio [9]. The paper of Almeida and Antunes [10] presents a consistent reflection on the articulation between Education in the Field and Ethnomathematics, a fact that the *João e Maria* Municipal School conceived, for years, as a major objective for the discipline of mathematics, in order to return their activities to the target audience of the school unit. The second question to be asked refers to the participation, from the class of ninth grade of elementary school, in the research project related to Media and Social Networks, it also aimed at reflecting on the lack of internet access and the need for digital literacy of

these students. This approach aims at technological empowerment of these students for use in agricultural businesses to which some are inserted, in the same way that it would provide opportunities for the group from the poor community, to use technology to solve problems in the neighborhood itself, for example. With the pandemic caused by COVID-19, the qualitative study of distance learning also begins. The discipline of mathematics was chosen for this study because the math teacher who worked with the class of ninth grade of elementary school *João e Maria* Municipal School was dismissed on March 13, 2020 because of the pandemic. In this sense, the management team cannot dispose on this math teacher to mediate the distance learning for the class of ninth grade students. Considering the EEC Resolution of the Council State Education Department of Rio de Janeiro No. 376, of March 23, 2020, the Municipal Education Department of Petropolis opted to make available, after anticipation of July 2020 vacations, asynchronous home activities, available on the '*Educa em Casa*' platform (public access via the Petropolis City Hall website). At first only they made available activities for Portuguese and Mathematics and, with the increase in the period of activities at home, interdisciplinary activities in two areas: **Language** (Portuguese, English, History and Geography) and **Mathematics and Sciences** were made available. The activities of Mathematics, interdisciplinary with Sciences, were made available to all schools in the public municipal school system of Petropolis. There is a concern with the playful nature of these activities, respecting the guidelines of the National Common Curricular Base (NCCB), being sent weekly to students in the ninth grade of elementary school. However, these activities do not address the specificities of the *João e Maria* Municipal School. There is no activity (among the 70 activities available) that presents problems related to the rural dynamics of students, just as there are no Financial Education activities, aimed at the collective interest of this group of students and one of the perspectives that were developed in the mathematics activities of the ninth grade of elementary education in face-to-face classes. In this sense, the asynchrony between the generalizer activities offered by the Municipal Education Department of Petropolis and the real needs of the students, in their specificities, which were met in the face-to-face classroom regime, represents, from the perspective of this research, a huge setback. The lack of meaning of these activities for students, without teaching mediation, places the school in a secondary role in their lives, discouraging the group from continuing their studies or participating in the activities. Therefore, the criticism that this work makes to the precariousness of the proposal for distance learning in the public municipal school system of Petropolis is connected with two motivations: the absence of a mediating teacher, relating remotely with students and the autonomy of this teacher to create and develop motivating and suitable activities and for their students.

5. The interview with the management team of the *João e Maria* Municipal School

The last stage of this study presents an interview with the management team of the *João e Maria* Municipal School regarding the participation of the ninth grade of elementary school in distance learning. The institution's general director and pedagogical advisor were interviewed. The first question that was asked to the management team was about the delivery of math activities by students in the ninth grade of elementary school. It should be noted that adherence to distance learning was voluntary, with the aim of maintaining the link between school and students and their families. According to the interviewees, the ninth grade of elementary school is the worst in terms of commitment and delivery of activities by students. The pedagogical advisor emphasizes: 'The impression I have is that they anticipated the end of the school year and, consequently, their stay at school. Few present the activities or are interested in accompanying the material made available by the Department of

Education'. At the beginning of the distance learning, a student from the ninth grade of elementary school opened a Whatsapp group to organize the delivery of activities and help students with difficulties accessing the internet or without technological equipment. However, over time, this student became discouraged and gave up helping others. For the management team, such behavior reflects the lack of validation of activities under distance learning by the Municipal Education Department. As activities in distance learning are not considered legitimate, students do not get involved in the process just to maintain a link with the institution, mainly because it is the last year of these students at *João e Maria* Municipal School. The only students who did not access the activities remotely and asked for their printing were the two students with special needs. The participation of students' responsible were relative. For the pedagogical advisor: 'Parents believe that the oldest child already has responsibility for their own activities and, therefore, do not collaborate or charge them. As a result, we see that students do not have the necessary discipline at this time for remote activities and end up participating much less in the proposed activities than younger students.'

6. Conclusion

Considering the research question to which this study sought to answer: 'Math activities, made available to the ninth grade of elementary school in *Educa em Casa* Platform, from the public municipal system system of Petropolis, without any teaching mediation, were sufficient to maintain the student's bond with your school unit, even though this student is in the last stage of elementary school?', it was observed, from the case study carried out, that the pedagogical practices in mathematics developed through the Municipal Education Department of Petropolis, mediated by technology, were not sufficient to maintain the students' link with their school unit. Based on this observation, we sought to suggest possible causes for non-adherence, by students in the ninth grade at *João e Maria* Municipal School, to mathematics activities sent by the Municipal Education Department of Petropolis. It was listed, then, as factors that interfered for the non-participation: difficulty of access to the internet by the community and lack of adequate technological equipment for remote access to activities; the non-validation, as teaching hours, of remote activities by the Municipal Education Department of Petropolis and the absence of a mediating mathematics teacher for the activities. Upon doubts about the topics addressed in the activities and without academic conditions, on the part of those responsible to solve them, the students found themselves alone in completing their tasks. It is noteworthy that the Municipal Education Department of Petropolis did not offer material through digital media to guide students, such as videos, podcasts, slides, among others. It is concluded, therefore, that the public municipal school system of Petropolis is not prepared to offer school activities remotely or even in a hybrid way, given the difficulties of access to the internet by the students and the supply of material not adequate to the specificities of students, as well as the absence of a teacher for guidance from these students. Based on this case study, it is intended to raise hypotheses about similar situations in different regions of Brazil and the urgent need for internet access infrastructure by the population (including Basic Education schools), as well as continuing education for teachers for this teaching modality, in order to ensure effective learning by students when they are mediated by technologies. Brazilian Basic Education is not prepared for distance learning. Continued training for teachers, investment in internet access infrastructure and appropriate technological devices are required. In addition, new pedagogical practices, suitable for distance learning, must become a reality in Brazilian schools. Otherwise, the result of the improvisation in force will put the training of children and young people at risk.

7. Recommendations

As this is a case study, the results were based on the attendance record of students in the ninth grade of elementary school at *João e Maria* Municipal School and on the reports of the management team regarding the participation and fulfillment of activities in the area of mathematics by students. In addition, the 70 math activities sent to these students by the end of this study were analyzed, with regard to the adequacy of these activities to the rural context of the participating community. In fact, it is not possible to generalize the scenario found at *João e Maria* Municipal School in all Brazilian schools. And it is a study limitation. However, it is possible to raise hypotheses about the real situation of distance learning and how pedagogical practices in mathematics are occurring in other regions of the country.

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