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Teaching Chemistry: Teachers' Challenges in the Period of the Covid-19 Pandemic in the City of the Abaetetuba-Pa Amazon Region

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ABSTRACT

Chemistry is a complex discipline and difficult to pass on to students since its essence is practice and despite the theory predominating in the classroom, practical classes also occur. However, with the Covid-19 pandemic, discipline practices became unfeasible as teaching became remote. Therefore, teachers had to create new online teaching methodologies. Thus, in this context, work will be carried out to portray the challenges of chemistry teachers in the municipality of Abaetetuba-PA.

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INTRODUCTION

Chemistry is a science in the area of Exact and Natural Sciences, considered difficult to access knowledge due to the need for experimentation to demonstrate the development of phenomena, however, there are a small number of such practices in Brazilian schools and consequently, theoretical classes are predominant.

Especially at the moment experienced with the Covid-19 pandemic, the experimental activities of the discipline became unfeasible, since the teaching needed to be reformulated, and the remote methodology was adopted. Such method, according to Barbosa; Ferreira, and Kato (2020), remote teaching can be described as pedagogical activities in a virtual environment to enable a strategy of emergency minimization of problems related to student learning, since the school year cannot remain static, as months are passing and it is necessary to adapt activities to this "new normal" that is being lived.

In this way, teachers had to create new teaching methodologies in an online format. Based on this bias, this work aims to verify the challenges of teachers when teaching Chemistry in the municipality of Abaetetuba-PA during the pandemic period. The municipality of Abaetetuba-PA is located in the northeast of Pará, with approximately 159,080 inhabitants and nearly 20 high schools (IBGE, 2017). Of these 20 schools, 4 are private and 16 are public. Private schools are well structured in terms of the presence of laboratories for practical classes and some public schools also have structure, however, they have limitations regarding glassware and laboratory equipment.

In this way, it is necessary to give visibility to the obstacles faced by teachers in the pandemic period, as this scenario has provided significant changes in teaching, showing the facets of a new normal that was abruptly established in society, thus providing structural changes in education, thus seeking to improve the students' cognitive development indexes.

1.1 THEORETICAL FRAMEWORK

According to Neves and Farias (2008), since the beginning, humanity has tried to understand how nature works, and for many centuries man has tried to study chemical phenomena. Chemistry as a science came to the fore at the beginning of the 17th century, in a practical way,

with mining and purification of metals, creation of jewelry, ceramics, and firearms; medical chemistry, with the use of herbs and various preparations made from them and mystical beliefs, such as the search for the philosopher's stone/universal elixir (GREENBERG, 2010).

However, it was only after the work of the Frenchman Antoine Laurent de Lavoisier (1743-1794) that Chemistry began to be analyzed systematically, that is, studied formally on school benches and provided its development (MAAR, 2008).

In Brazil, the first traces of chemistry were observed in the indigenous people, through the dyes they used to paint their bodies and the teas they made. The material for these processes was extracted from nature (ALMEIDA & PINTO, 2011). This occurred with the arrival of the Jesuits, which even started the Brazilian school system.

According to Carneiro (2006), in 17th century Brazil there was no possibility of having adequate spaces for the development of regular scientific careers, because, in that period, the teaching of chemistry was theoretical, associated with mineralogical studies, and placing chemistry as an appendicular portion of Physics.

Still, in the 17th century, the Viceroy Marquês of Lavradio installed the Scientific Academy in Rio de Janeiro, which focused on the study of science, with a section dedicated to Chemistry among the various other sections of this institution (FILGUEIRAS, 1988).

One of the biggest supporters of Brazilian scientific progress was Emperor D. Pedro II**.** He was dedicated to the studies of Chemistry and even in his house, there was a Chemistry laboratory in which he carried out experiments (FILGUEIRAS, 1988). So much so that School Pedro II was created in 1837 to be a model for other educational establishments and to structure Brazilian secondary education and, therefore, the implemented curriculum contained scientific subjects (ROSA & TOSTA, 2005).

Although D. Pedro II showed great interest in chemistry, the first Brazilian school aimed at training professionals for the chemical industry, created in the republican period, was the Institute of Chemistry of Rio de Janeiro, at the beginning of the 20th century, in 1918 (LIMA, 2012a).

In Brazilian Secondary Education, Chemistry began to be taught as a regular subject from 1931 onwards and its objectives were to direct the student to specific knowledge, encourage interest in science and demonstrate the relationship of this knowledge with everyday life (MACEDO &LOPES, 2002).

In 1990, there was a reform in Brazilian Secondary Education, which culminated in the LDB nº 9.394 of 1996. About Chemistry Teaching and the knowledge involved in them, the PCNEM proposes that the multidimensionality, dynamism, and epistemological character of its contents be made explicit (BRASIL, 1999). For a significant Secondary Education, Chemistry must assume its true cultural value, as a fundamental instrument in a quality human education, constituting itself in a supporting way in the knowledge of the universe, in the interpretation of the world, and in the active responsibility of the reality in which one lives (LIMA, 2012b).

However, it is clear that in the Teaching of Chemistry in Brazilian elementary schools there is a lack of interest of many students in the contents of this discipline, even considering it not to be part of their daily life (PORTO & KRUGER, 2013). Rocha and Vasconcelos (2016) contribute to this idea by stating that the teaching of chemistry continues to reflect a feeling of discomfort for students due to learning difficulties in the learning process. This is because many contents of this discipline require a more practical approach and not just a theoretical one for the best teaching and learning of the student since Chemistry is constituted as an essentially experimental science (LIMA, 2012b).

However, due to the Covid-19 pandemic caused by the coronavirus called SARS-CoV-2 and its aggravation around the world, the World Health Organization (WHO) declared that the epidemic was a matter of emergency of International Public Health on the 11th. March 2020 (OLIVEIRA et al., 2020).

About Education, according to the United Nations Educational, Scientific and Cultural Organization (Unesco), the crisis caused by Covid-19 has led to the suspension of classes in educational institutes, affecting 90% of students worldwide. (DAYS & PINTO, 2020). From this perspective, as a way of continuing school work, educational spaces started remote classes.

METHODOLOGY

Initially, a systematic literature review was performed, which is a synthesis of the research related to a specific issue (GALVÃO; SAWADA; TREVIZAN, 2004). This research was about the History of Chemistry, challenges in teaching chemistry, and challenges in teaching chemistry during the pandemic period using works from the main scientific platforms such as Google Scholar, Scielo, Science, Capes, and PubMed.

After that, a questionnaire was made on Google Forms and made available to chemistry teachers who teach high school classes in schools in the city of Abaetetuba-PA (Brazil). The questionnaire was shared with the teachers via WhatsApp through the link: https://forms.gle/fFqyp4Z4A37wENmw8, the questionnaire was composed of 8 questions, 4 objectives, and 4 subjective, and 14 teachers participated in the research. It is worth mentioning that the identity of the collaborators will be preserved since it will not be necessary to identify themselves.

The Municipality of Abaetetuba, belonging to the northeastern mesoregion of Pará, is located at the geographical coordinates of 01º43'24" South latitude and 48º52'54" West longitude, 124 km away from the capital Belém by the highway, also having access by the rivers, since it is located in the Amazon Region (IBGE 2017).

The research is of the qualitative type since the data collection was done from the filling of the questionnaire by the teachers, containing subjective, personal questions, related to the teachers' view on the subject in question (GODOY, 1995).

RESULTS AND DISCUSSIONS

14 teachers answered the questionnaire, about the first question (Figure 01), about which school the teacher works in, if it is public or private, 71.4% answered that it is in a public school, 28.6% answered that it is in public and private school and 0% work only in private schools.

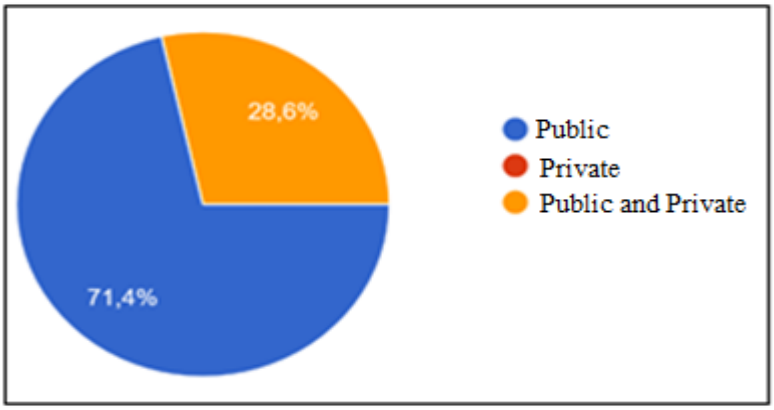

Figure 01- Answer to question 1, in which the question is asked, do you work at school:

Regarding the second question (Figure 02), about what were the biggest challenges that the teacher perceived when teaching chemistry during the pandemic, 57.1% answered that the biggest difficulty was the student's precarious internet, 7.1% believe that the greatest challenge is that students do not have access to the internet because they do not have financial conditions, 7.1% believe that the biggest challenge is that the internet service is poor in general and that there is a lack of interest from students from both public and private schools, 7.1% responded that the biggest challenge is the impossible practical classes and the difficulty to make students carry out their activities in an integral way, 0% that the biggest challenge would be the difficulty in remote teaching platforms, precarious internet of the teacher and practical classes impossible and 21.4% answered that the biggest challenge would be all the options mentioned.

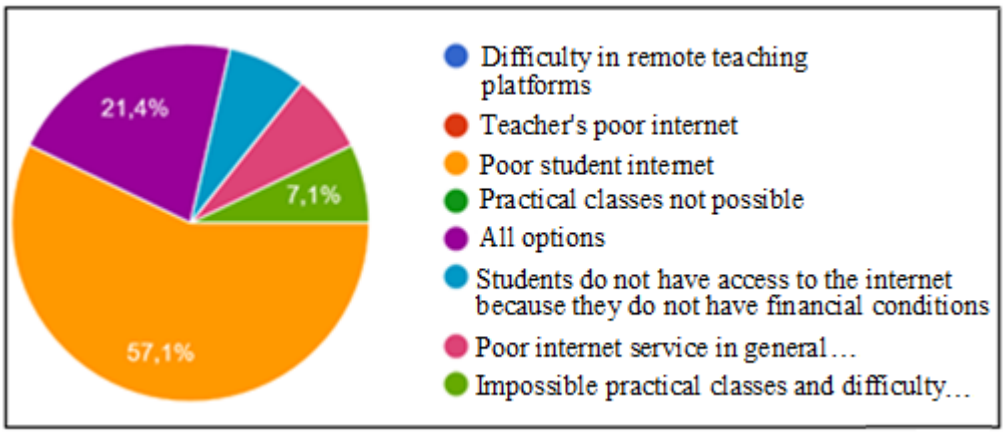

Figure 02- Answer to question 2, in which the question is asked, what are the biggest challenges you have noticed when teaching chemistry during the pandemic:

Regarding the third question (Figure 03), if the teacher had already taught a remote class before the pandemic, 85.7% answered no and only 14.3% answered yes.

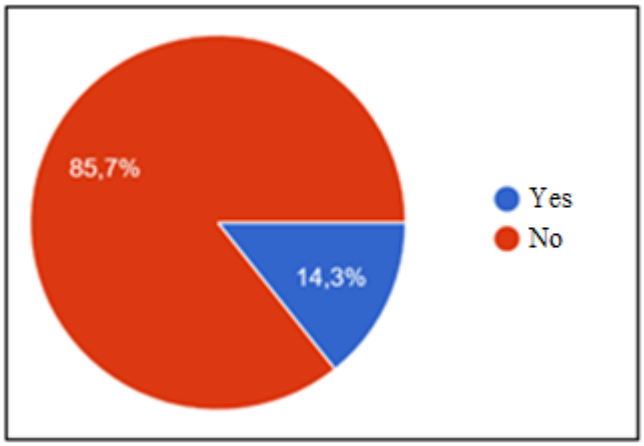

Figure 03- Answer to question 3, in which the question is asked if the teacher had already taught a remote class before the pandemic.

Regarding the fourth question (Figure o4), which was whether at any time during remote teaching the teacher felt any difficulty related to the use of platforms/programs (examples: Google Classroom, Zoom, Skype, Meet etc.) online, 42.9% answered yes, 35.7% answered no and 21.4% answered that the difficulty was relative.

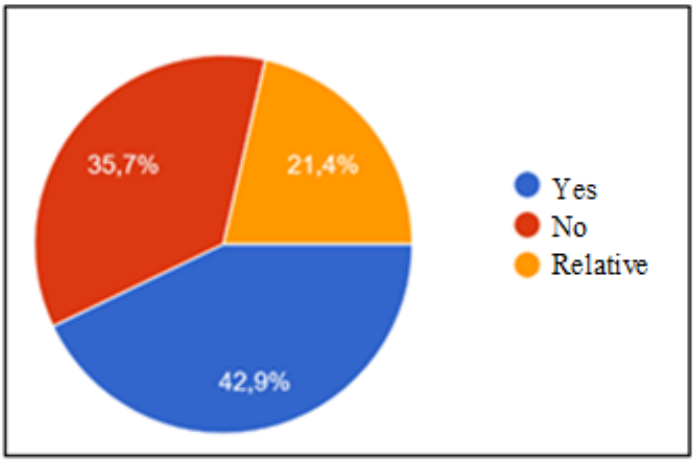

Figure 04- Answer to question 4. in which the question is asked, if at any time during remote teaching, you felt any difficulty related to the use of platforms/programs (examples: Google Classroom, Zoom, Skype, Meet, etc.).

The fifth question, which is subjective, was about what strategies the teacher used to overcome the challenges of remote teaching. The answers were very diverse (Chart 01).

Chart 01- Answer to question 5: in which the question is asked, what strategies did you use to overcome the challenges?

Answer Numbering	Answer
1	"In the region of the islands, internet use is very precarious, most students do not have access, so the most I could do was create Whatsapp groups for those who had access and record short videos to help students"
2	"The use of textbooks and videos helped a lot"
3	"I studied a lot about the platforms used"
4	"Watching tutorials, help from friends"
5	"Class planning and content organization"
6	"Use of other technological mechanisms of access and communication with students and methodological innovations for a better understanding of the discipline"
7	"I did a lot of research and training on online teaching tools to get around the difficulties"
8	"I tried my best to teach live classes, seeking the active participation of students, even if remotely"
9	"I looked for videos that could help me to know more about these difficulties and found some online courses, provided by the Department of Education"
10	"I researched the resources and how I could have a more interactive class, using digital resources"
11	"Research about doubts that could arise regarding the use of platforms and programs, so that I could teach the best remote class I could"
12	"I sought to learn to work with tools that I did not know of, through online courses and help from colleagues"
13	"Challenges were minimized using more accessible resources such as the

	formulation of handout material, conversations in messaging applications most used by students, application of activities through Google Forms, recording of videos to answer questions and indication of some videos on YouTube"
14	"I used many strategies with the help of many resources such as classes recorded on the board, Whatsapp and telegram to send material and communication with students, compendium, class recordings with screen-captured software, classes through meet and zoom (using teaching material in doc, ppt, pdf...and graphics tablet), Google room, Google form, Youtube channel, etc. For each student's reality, a strategy was designed"

Regarding the sixth question (Chart 02), which is also subjective, what was the contribution of the school, in the sense of mitigating the problems caused by the pandemic? The answers were also very diverse.

Chart 02- Answer to question 6, in which the question is asked, what is the school's contribution, in the sense of mitigating the problems caused by the pandemic?

Answer Numbering	**Answer**
1	"The school did what it could, producing printed textbooks, always taking into account the reality experienced by the Modular Teaching System"
2	"The contribution was little because the rural area suffered a lot due to the lack of Internet signal"
3	"They did everything they could, but when it comes to public education, everything is more difficult"
4	"The school gave all the necessary support, given the difficulties encountered, we also had the options of compendium printing, individual visits with parents and students"
5	"The school has the role of providing all the technical and emotional support to the student"
6	"Contribution with technological tools, internet and continuous guidance for

	work progression. In addition to the constant search for the advancement of student inclusion"
7	"The school was very flexible and gave all possible guidance to teachers and students to minimize the difficulties of both parties"
8	"Providing courses for teacher training to use the platforms"
9	"The courses provided by the school/Secretary of Education were of paramount importance. They help us a lot to reduce doubts and difficulties"
10	"None"
11	"It offered training to teachers in the use of digital tools, and there was always someone from the coordination available to help if there was a problem"
12	"The school contributed through training and support from the pedagogical team"
13	"The school has been contributing positively to this learning process during the pandemic. Even with all the challenges of public education, it has been seeking to support students and teachers in their difficulties"
14	"The minimum and this was not even by omission, but for not having the resources and knowledge to equip the teachers at the time"

Regarding the seventh question (Chart 03), which would be a complement to the sixth question, the professor was asked what his evaluation would be of the result of the strategy carried out.

Chart 03- Answer to question 7, in which the question is asked, what is your assessment about the result of the strategy carried out?

Answer Numbering	**Answer**
1	"The use of printed compendia was the best choice to reach the clientele served by us since most of them do not have access to the internet, so using platforms/programs would not fit our audience"
2	"I evaluate it as a less harmful action to the student, as they had no support for remote classes (since the students are from rural areas), although it was not ideal"
3	"Relatively good"

4	“Significant”
5	“A positive review”
6	“Taking into account the difficulties encountered in terms of the precariousness of structure, especially in public schools and in the current scenario, it was very satisfactory”
7	“I find it satisfactory. It was possible to achieve the desired goals of the students”
8	“Satisfactory rating”
9	“Good and important for us to prove that it is possible to work online with pedagogical methodologies. However, it is necessary to expand the provision of public and free networks for students”
10	“It was satisfying”
11	“For students who had access to classes and referrals, if they paid attention and committed, they had a satisfactory learning experience. Unfortunately, most of them did not have adequate access”
12	“The result was satisfactory”
13	“I assess that the strategies used are having positive results, despite the great difficulty we face (students and teachers). There is a great effort so that learning can happen and there are not so many losses or delays in the school year”
14	“I think it was excellent from the point of view of mobilization in the search for knowledge to overcome the challenges posed by the pandemic. However, from the point of view of educational performance, we still don't know, since many students lack honesty in the development of activities, lack responsibility, discipline, and organization that remote teaching needs and in many cases financial resources to enable an internet and cell phone and/or computer to accompany remote teaching”

The eighth question (Chart 04), is also subjective, it is the same idea as questions six and seven, but focuses on what would be the ideal strategy to overcome the challenges of teaching chemistry during the pandemic? The main responses were aimed at the use of technology and greater support from government officials.

Chart 04- Answer to question 8: in which the question is asked, what would be the ideal strategy to overcome the challenges of teaching chemistry during the pandemic?

Answer Numbering	Answer
1	"Video lessons, games, WhatsApp groups"
2	"Internet support for all rural students so that they could have access to digital teaching platforms where there are many simulators that could be used in classes"
3	"It would be giving unlimited internet access to all students, something unrealistic for our case"
4	"It was a very arduous process for the teachers, but through the mobilization of teamwork, we can consider that several new strategies emerged and we had the opportunity to work even with "Problem-based Learning" in the face of this pandemic scenario experienced in the world "
5	"There is no ideal strategy to overcome challenges! Each teacher has their methodology.
6	"Use of diversified technological tools and evolution in the creativity of teaching methodologies and practices to facilitate the understanding of student knowledge"
7	"Increased government support for schools, teachers, and students about? availability of materials necessary for conducting online classes, such as telephone chips, internet, etc."
8	"I think that the way I used, teaching live classes, with a camera, blackboard, brush, and teaching as if I were in the classroom, was the way I found to get around the situation caused by the pandemic and it was the way that was best. accepted by my students according to them"
9	"I don't believe in an ideal strategy. But yes, in the various strategies that exist and those within our reach. Together and by varying the existing strategies, they allow us to lead the educational process"
10	"Suitable materials for each student, as we have a limited number of pages to send on each subject"
11	"The state provides the internet as an essential service, like electricity, so that

	students can have access. In addition, the number of pages of apostille material for those without access should not be limited to such a small number of copies, as it is not possible to teach the intended subject properly"
12	"Offering courses for teachers and quality internet for students"
13	"The ideal strategy would be to reformulate the way to apply the contents and activities proposed to the students so that they become more accessible to their understanding. Also, propose simple experiments to do at home so that they do not lose the ability to relate chemistry to everyday life"
14	"There is no ideal strategy, it happens. The ideal strategy is the one that manages to make Chemistry reach the students, that is, according to the reality of our students, we need to create means and move resources so that the teaching of Chemistry takes place"

CONCLUSIONS

It can be seen that in the pandemic period, the teaching of chemistry presented many challenges to teachers, especially due to remote classes. Teachers tried strategies to mitigate some obstacles, but teaching was harmed.

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