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Original Article

Practices and Outcomes of the Emergency Remote Teaching of Biology at Brazilian Military Schools

Práticas e efeitos do ensino remoto emergencial de biologia no Sistema Colégio Militar do Brasil

Prácticas y Efectos de la Enseñanza Remota de Emergencia de Biología en el Sistema Colegio Militar de Brasil

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Abstract

The development of pedagogical activities during the covid-19 pandemic was a fertile field for experiences carried out by teachers themselves. This work investigated how the emergency remote experience affected the teaching of Biology at Brazilian Military Schools. We opted for exploratory, qualitative research, in a case study. We interviewed teachers and verified that, for the most part, they did not have adequate training on the use of digital technologies for teaching. Besides, their pedagogical conceptions, still very much linked to the centrality of the teacher, led to the predominance of lectures. However, with the return to face-to-face teaching, teachers are able to diversify their learning strategies with technologies, giving greater protagonism to students.

Keywords: emergency remote learning; biology teaching; Military Schools; high school; blended learning.

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Resumo

O desenvolvimento das atividades pedagógicas durante a pandemia de covid-19 foi campo fértil de experiências por iniciativa dos professores. Este trabalho investigou como a experiência do ensino remoto emergencial afetou o ensino de Biologia no Sistema Colégio Militar do Brasil. Para tal, optamos por uma pesquisa exploratória, qualitativa, enquadrada em um estudo de caso. Assim, entrevistamos professores, verificando que, em sua maioria, não apresentavam formação adequada no uso das tecnologias digitais para o ensino. Além disso, suas concepções pedagógicas, ainda muito atreladas à visão da centralidade do professor, levaram ao predomínio da aula expositiva. Com o retorno ao ensino presencial, porém, os docentes mostram diversificar mais suas estratégias com tecnologias, dando maior protagonismo aos alunos.

Palavras-chave: ensino remoto emergencial, ensino de Biologia, Colégios Militares, ensino médio, ensino híbrido.

Resumen

El desarrollo de actividades pedagógicas durante la pandemia de covid-19 fue un campo fértil para experiencias por iniciativa de los propios docentes. Este trabajo investigó cómo la experiencia de la enseñanza remota de emergencia afectó la enseñanza de Biología en los Colegios Militares de Brasil. Para ello se optó por una investigación exploratoria, cualitativa, enmarcada en un estudio de caso. Entrevistamos a los docentes y comprobamos que, en su mayoría, no contaban con una formación adecuada sobre el uso de las tecnologías digitales para la enseñanza. Además, sus concepciones pedagógicas, todavía muy ligadas a la centralidad del docente, llevaron al predominio de la clase expositiva. Sin embargo, con el regreso a la enseñanza presencial, los docentes logran diversificar sus estrategias de aprendizaje con las tecnologías, dando mayor protagonismo a los estudiantes.

Palabras clave: enseñanza remota de emergencia; enseñanza de la biología; Colegios Militares; enseñanza secundaria; enseñanza híbrida.

1. Introduction

The global education sector experienced an unprecedented scenario starting from the beginning of 2020, due to the occurrence of the COVID-19 pandemic. By April 30, 2020, 167 countries had closed their schools due to the spread of the disease (United Nations Educational, Scientific and Cultural Organization - UNESCO, 2020), including most of Europe and South America. This affected almost 90% of the world's students, in an unprecedented situation in terms of global monitoring and dissemination. The closure of Brazilian schools resulted in the interruption of face-to-face teaching activities and, in many education systems, led to the adaptation of the curriculum to digital solutions in order to ensure, to some extent, the continuity of pedagogical actions. As stated by Moreira, Henriques, and Barros (2020, p. 352), "no one, not even teachers who already adopted online environments in their practices, imagined that such a rapid and emergency change would be necessary, almost mandatory, due to the spread of COVID-19."

The speed, quality, and characteristics that emerged from this curriculum adaptation varied among schools according to various factors in the domains of infrastructure, personnel, and school management, obviously limited by the available financial resources. According to Arruda (2020, p. 259):

> More than an educational issue, the blockade of access to school has reconfigured society, as schedules and movements were disrupted, families began to harmonize the responsibilities of work and students' lives in extended times and in contexts of either the need to maintain employment and income, or in the context of confinement in reasonably reduced spaces, so that isolation is daily compared to wartime situations.

In this scenario, the research problem presented here arises, namely: How did the experience of emergency remote teaching affect the teaching of Biology in the Brazilian Military School System (SCMB)?

Based on the previous considerations and in order to operationalize

the study, the problem was unfolded into the following research questions:

- What strategies were used to migrate from a face-to-face curriculum to a remote setting in the Biology discipline?

- What challenges did Biology teachers encounter during the implementation of emergency remote teaching?

- After the return to face-to-face classes, what perceptions do teachers have about teaching Biology in SCMB?

- Which pedagogical practices initiated or strengthened during emergency remote teaching can be maintained to enhance the use of technology in face-to-face teaching?

Therefore, the objective of this study was to investigate how the experience of emergency remote teaching affected the teaching of Biology in the Brazilian Military School System.

It is worth noting that this article stems from the master's dissertation in Education and Digital Technologies at the University of Lisbon, defended by the first author of this study.

2. Theoretical Framework

The development of pedagogical activities during the COVID-19 pandemic became a field for a profusion of experiences mainly driven by teachers' initiatives. If, in the field of didactics, we witnessed multiple methodological approaches, this was partly due to the terminological ambiguity of the type of teaching intended for the period. Will et al. (2021) precisely discuss the terminological profusion of pedagogical practices in Basic Education during the COVID-19 pandemic and note that new terms emerged without adequate conceptual or legal definitions, such as Remote Teaching and non-face-to-face pedagogical activities. The same authors emphasize:

> The creation of new terms, without the concern to conceptualize them, allows us to infer that the new can encompass anything, including the individual responsibility of the teacher for the development of the entire

> teaching and learning process, such as technology management (Will *et al.*, 2021, p. 15).

In this scenario, some resorted to the nomenclature of Distance Education (DE), which has one possible definition as "a mode of education in which teachers and students are separated, planned by institutions, and which uses various communication technologies" (Maia; Mattar, 2007, p. 6). Two points stand out in this definition: the physical separation between teachers and students, and its planning by institutions to better address the peculiarities generated by the aforementioned separation.

Tori (2022), however, relativizes the physical distance between teacher and student and questions the lack of presence in distance learning classes, stating that "we can be remote and, at the same time, as present as – or even more than – in local activities" (Tori, 2022, p. 54).

The legal definition of Distance Education (DE) in Brazil can be found in Decree No. 9,057, dated May 25, 2017, which adds further details to the previously mentioned definition, including qualified personnel, appropriate monitoring, and evaluation.

> Article 1. For the purposes of this Decree, distance education is considered an educational modality in which the didactic-pedagogical mediation in teaching and learning processes occurs through the use of information and communication means and technologies, with qualified personnel, access policies, monitoring, and evaluation compatible, among others, and develops educational activities for students and education professionals who are in different places and times (Brazil, 2017).

In the specific case of basic education, the National Education Guidelines and Bases Law (LDBEN) No. 9,394, dated December 20, 1996, provides that for elementary education (Article 32), Distance Education (DE) can be used as a complement to learning or in emergency situations. Regarding high school, the focus of this study, LDBEN, in its Article 36, allows for the recognition of competencies and the establishment of

agreements with DE institutions for the purpose of meeting the curricular requirements of this segment (Brazil, 1996).

In this context, during the COVID-19 pandemic, Law No. 14,040 was enacted on August 18, 2020, to establish educational norms to be adopted on an exceptional basis during the state of public calamity (Brazil, 2020). Regarding non-face-to-face pedagogical activities, the aforementioned Law provides in its Article 2:

> § 4. At the discretion of the educational systems, in the academic year affected by the state of public calamity referred to in Article 1 of this Law, non-face-to-face pedagogical activities may be developed
>
> [...]
>
> II - in elementary and high school, linked to the curricular content of each stage and modality, including through the use of information and communication technologies, the computation of which, for the purpose of integrating the minimum annual workload, shall be subject to objective criteria established by the National Education Council (CNE).
>
> § 5. Educational systems that choose to adopt non-face-to-face pedagogical activities as part of the fulfillment of the annual workload shall ensure in their regulations that students and teachers have access to the necessary means to carry out these activities (Brazil, 2020).

Using the term Distance Education for what was done during the covid-19 pandemic would make sense due to its legal provision. However, what was done initially did not involve qualified personnel for Distance Education nor did it have compatible monitoring and evaluation processes. This ended up strengthening the use of the term remote teaching, which, according to Tori (2022, p. 57), "is still a form of distance education, not necessarily the distance education regulated by law."

Thus, there was a widespread use of the term Emergency Remote Teaching (ERT), which, according to Hodges et al. (2020), refers to a

temporary pedagogical model in response to crises that require the interruption of originally face-to-face or hybrid courses. In ERT, however, there is no expectation that it will provide the robustness required by courses originally designed under the distance education (DE) model, since we are dealing with curricula intended for face-to-face teaching. While in DE, we have multidisciplinary teams previously trained to offer didactic content and pedagogical activities permanently, in ERT we have an adaptation of face-to-face classes into remote pedagogical practices, essentially mediated by Digital Information and Communication Technologies (DICT) (Araújo; Voltolini, 2021).

Thus, in the context of ERT, teachers and students were forced to migrate to the online reality, transferring and transposing methodologies and pedagogical practices typical of physical learning environments. However, in most cases, these technologies were used "from an instrumental perspective, reducing methodologies and pedagogical practices to purely transmissive teaching" (Moreira; Henriques; Barros, 2020, p. 352), with little interactivity and insufficient feedback (Vieira; Silva, 2020).

With the advancement of vaccination and the increasing relaxation of health restrictions in 2021, we saw a gradual resumption of face-to-face pedagogical activities around the world, often with the adoption of student scheduling to avoid gatherings and respect safety protocols. In this scenario, Hybrid Learning gained momentum, which, despite being presented under various definitions in the literature, has as its central idea the convergence between the face-to-face learning model and the online model, based on Information and Communication Technologies (ICT) (Bacich; Tanzi; Trevisani, 2015). Thus, we witnessed initiatives such as the so-called sliced hybrid teaching and simultaneous hybrid teaching. Tori (2021, p. 91) defines sliced hybrid as "a slicing of courses or subjects between parts offered online and others physically present." The same author defines simultaneous hybrid teaching as a scenario in which "students can participate in the same activity both remotely and locally" (Tori, 2021, p. 92). The SCMB, the subject of this case study, also went through periods of ERT and Hybrid Learning, both in sliced and simultaneous formats.

The SCMB comprises fifteen school units located throughout the national territory and maintained by the Brazilian Army, namely, and in order of creation: Military College of Rio de Janeiro; Military College of Porto Alegre; Military College of Fortaleza; Military College of Belo Horizonte; Military College of Salvador; Military College of Curitiba; Military College of Recife; Military College of Manaus; Military College of Brasília; Military College of Campo Grande; Military College of Juiz de Fora; Military College of Santa Maria; Military College of Belém; Military College of São Paulo; and Military College of Vila Militar.

The SCMB is intended to offer Middle School (6th to 9th grade) and High School education, targeting primarily the dependents of career military personnel from the Army, and to a lesser extent, students who have entered through public competitive exams (Brazilian Army, 2022). Its teaching staff consists of both military personnel (mostly Army officers) and civilian staff, who are either hired through competitive exams or on a contractual basis (Brazilian Army, 2021).

The curriculum is standardized across the entire system, and although all Military Schools already had their Virtual Learning Environments (VLE) in operation even before the imposition of Remote Learning, there were no curricular guidelines, regarding the teaching of Biology, for the effective use of VLEs as a complement to face-to-face teaching. As a result, VLEs were generally mere repositories of digital content for students to consult.

Despite the LDBEN, in its article 83, granting autonomy to military education to be governed by specific legislation, the SCMB follows the regulations issued by the Ministry of Education to ensure the equivalence of studies and the validity of its diplomas. Thus, in the context of the covid-19 pandemic, the SCMB followed the guidelines of the Ministry of Education, the National Council of Education, and municipal/state sanitary decrees and measures. Consequently, although all Military Schools went through some period of remote learning, their start and end depended on local peculiarities and policies, which varied greatly due to Brazil's continental dimensions and the unequal progress of epidemiological situations in different parts of the country.

3. Methodology

This exploratory investigation was guided by the phenomenological--interpretative or naturalistic paradigm, characterized by presenting an inductive/descriptive logic, with the involvement of the researchers, and whose central point "is the understanding of the intentions and meanings - beliefs, opinions, perceptions, representations, perspectives, conceptions, etc. - that human beings place in their own actions, in relation to others and to the contexts in which they interact" (Amado, 2014, p. 40-41).

The problem of this investigation aligns with a qualitative methodology, and the chosen technical procedure was the intrinsic case study, which, according to Stake (1995), is one in which the researcher is interested not only because studying it teaches us about other cases or about some problem in general, but because we need to learn about this particular case. The research took place between March and September 2022, duly ratified by an opinion from the Ethics Committee of the Institute of Education of the University of Lisbon and with authorization from the Brazilian Army.

To obtain the necessary answers to our research questions and achieve the proposed objective, it would make sense to directly engage with Biology teachers from the Military Schools integrated into the SCMB. Thus, five teachers were chosen, one from each geographical region of Brazil (South, Southeast, Midwest, Northeast, and North), who taught Biology classes in high school during the years 2020 and/or 2021. This choice is justified by the attempt to obtain diverse viewpoints, reflecting the experiences and characteristics of each geographical region, providing an overall picture of pedagogical practices in the SCMB. All interviewees signed the Informed Consent Form (ICF).

As Taherdoost (2016) notes, qualitative research, particularly case studies, are associated with non-probabilistic sampling, as there is no intention to conduct statistical analyses since they are not representative of the population as a whole. In this study, purposive sampling was also used, where participants are chosen based on particular characteristics that qualify them to provide important and relevant information for

the study. Cohen, Manion, and Morrison (2007) further emphasize that in studies like this, there is little benefit in using random sampling, as most participants may not be able to provide information of interest to the researcher.

Thus, the five participants were chosen by the researcher, taking into account their roles as teachers in their respective Military Schools.

Data collection consisted of semi-structured interview surveys, which addressed the following themes: Training and professional experience; Curriculum; Challenges during remote teaching; Assessment of learning after remote teaching; Suggestions and opportunities for pedagogical improvements. The choice of themes in the interview guide directly reflects what is expected in the research questions, in line with Cohen, Manion, and Morrison (2007), who state that the questions in a guide should reflect what the researcher wants to discover. Each interview lasted, on average, 57 minutes, with a total time of 4 hours and 47 minutes used, and all took place during the first semester of 2022. Subsequently, each interview was transcribed into a text file, with the assistance of the online tool Transkriptor (available at www.transkriptor.com).

The technique used to analyze the data obtained from the interviews was thematic categorical content analysis, which "involves the use of existing categories or the creation of specific categories" (Esteves, 2006, p. 111) so that the researcher can make inferences based on the interpretation of the collected data. The entire content analysis was conducted within the text editor used for transcribing the interviews.

In this study, as is often the case in research involving interviews, we considered each of the interviews as a unit of context (UC), since by definition, a UC is what, in its entirety, "allows us to understand the meaning of each of the units of record that have been excerpted and that are intended to be coded" (Esteves, 2006, p. 115). The units of record (UR), on the other hand, correspond to units of meaning, which will be the subject of the categorization to be performed (Esteves, 2006). According to Amado (2014, p. 315), URs correspond to the smallest "part of the communication with its own meaning, depending on the objectives of the work and, consequently, also the material to be analyzed." URs arise from the segmentation of UCs and require a great deal of interpretation

and extraction of meaning, especially when working with semantic or thematic units, as was the case in this investigation.

The segmentation of UCs and the consequent constitution of URs were initially carried out based on the blocks of the interview guide. This process resulted in the elaboration of the analysis system matrix, composed of five dimensions, their categories, and subcategories. The dimensions defined for the analysis system matrix were: Teacher's Profile; Curricular migration to remote teaching; Challenges during remote teaching; Assessment of learning after remote teaching; and Suggestions and opportunities for pedagogical improvements in the use of ICT.

4. Presentation and Discussion of Results

4.1. General reading of the results

The Table 1 represents the analysis system matrix, already including the frequencies (Fr) of citations in the URs included in each dimension, category, and subcategory. Out of a total of 208 URs, we observe that 36.5% refer to the dimension Curricular migration to remote teaching, indicating a greater importance given to this set by the interviewees.

Among the subcategories of our matrix, the Use of digital tools in the implementation of the curriculum in remote teaching was the most referenced, corresponding to 12% of the total URs. These mentions corroborate the important role of digital tools in remote teaching, as expected. It is interesting to note that all interviewees had, to some extent, some previous experience in using digital tools. However, we noticed that teachers considered the main challenge related to themselves precisely the use of these digital tools in remote teaching.

The dimension with the lowest number of mentions was Suggestions and opportunities for pedagogical improvements in the use of ICT, accounting for only 6.3% of the total URs. Several hypotheses can be raised for this result, such as the lack of reflection by the interviewees on their experiences during remote teaching or an unconscious desire to return to the comfort zone of predominant traditional pedagogical practices before the onset of remote teaching in 2020.

Regarding the profile of the interviewees, all were between 35 and 40 years old and completed their initial education in the first decade of the 2000s, with varying amounts of experience in basic education ranging from five to fourteen years at the time of the interview. Only one of the interviewees reported having previously worked effectively in the distance learning modality.

All interviewees had prior experience using virtual environments as a complement to face-to-face teaching. Only two interviewees mentioned initiatives by the schools to train teachers at the onset of remote teaching, and all mentioned the self-directed learning of teachers in response to the challenges that arose during that time.

As Stake (1995) asserts, the focus of a case study is on particularization rather than generalization. Therefore, it's essential to thoroughly understand the case being studied, focusing on its uniqueness, although comparing it with other similar cases is also important.

Table 1 - General analysis of the occurrences of categories in the interviewees' discourses

Dimension	Categories	Subcategories	Fr	%
Profile of the teacher	Professional background	Academic trajectory	13	6,3
		Professional experience	13	6,3
	Familiarity with the use of ICT	Specific training for remote teaching	11	5,3
		Previous experiences with digital tools	14	6,7
		Partial total	*51*	*24,5*
Curricular migration to remote teaching	Planning	Centralization by the school	3	1,4
		At the teachers' discretion	6	2,9
	Implementation	Curriculum compliance	11	5,3
		Use of digital tools	14	6,7
		Learning strategies	13	6,3
		Class organization	6	2,9
		Motivational aspects	2	1,0
	Assessment	For formative purposes	3	1,4
		For summative purposes	9	4,3
		Partial total	*76*	*36,5*

Challenges during remote teaching	Related to themselves	In the use of digital tools by teachers	6	2,9
		In aspects of personal life	3	1,4
		Lack of motivation to seek new learning strategies	1	0,5
		Due to difficulties faced by other teachers on the team	1	0,5
		Due to teachers' workload	2	1,0
		Lack of face-to-face contact with students	3	1,4
	Related to students	In organizing for more autonomous study at home	5	2,4
		Psychosocial issues	4	1,9
		In student assessment	4	1,9
		In the amount of required tasks	2	1,0
		Difficulty in conducting practical classes	3	1,4
		In motivating students to participate in pedagogical activities	11	5,3
		Partial total	*51*	*24,5*
Assessment of learning after remote teaching	Impact on learning	Positive impact	2	1,0
		Negative impact	12	5,8
	Pedagogical practice	Favored	9	4,3
		Partial total	*23*	*11,1*
Suggestions and opportunities for pedagogical improvements in the use of ICT	In-person	For teacher use	1	0,5
		For student use	5	2,4
	Remote	In providing study material	4	1,9
		In remedial and reinforcement activities	3	1,4
		Partial total	*13*	*6,3*
		Overall total:	**208**	**100,0**

Source: Author's own elaboration.

4.2. Reflection on the results obtained and possible answers to the research questions

In the following sections, we aim to address the research questions defined initially and, to the extent possible, draw parallels between our case study and other studies on remote biology teaching.

4.2.1. What strategies were used to migrate from a face-to-face curriculum to a remote setting in the subject of Biology?

The curricular migration to remote teaching was considered from the perspectives of planning, implementation, and assessment of learning.

4.2.1.1 PLANNING

In this context, we perceive, through the accounts of three interviewees, that there was little or no centralization of planning by the schools, leaving decisions about the content to be covered and learning strategies in the hands of the teachers. The other two interviewees mentioned some guidelines provided by the schools, but these were essentially recommendations for teachers to record video lessons and provide study materials on the Virtual Learning Environment. It is worth noting that although there is a well-defined curriculum for the Military Schools, it was entirely designed for face-to-face teaching, which would require analysis and planning for its use in remote teaching. However, with the abrupt migration reported by all interviewees, there was not even enough time for efficient planning.

4.2.1.2 IMPLEMENTATION

Starting from the assumption that there was little planning for the curricular migration to remote teaching, let's see how this migration was effectively implemented. All interviewees considered that the curriculum was fully covered during the period of remote teaching. However, to reach this conclusion, they relied on the availability of video lessons covering the programmatic content. This reflects the centrality of the figure of the teacher in the perception of the interviewees. It is worth noting that this perception is not exclusive to remote teaching, meaning it is merely the transposition of a face-to-face teaching approach centered on the teacher to the online context. On the other hand, this notion of curriculum is not exclusive to teachers, as both school managers and students and their families demand that all the planned content be orally delivered by the teachers.

Regarding the digital tools used during remote teaching, it is worth

mentioning that the Military Schools already had their LMS (Moodle platform) in operation before the pandemic, supporting face-to-face teaching. Thus, these environments were obviously utilized during remote teaching, remaining largely as content repositories. The main synchronous tool used was Google Meet, mentioned by all interviewees. Two teachers also mentioned the use of podcasts, but only with the provision of pre-existing material to students, without the proposal of content creation by the learners. Indeed, we noticed that the recording or live streaming of video lessons was widely used during remote teaching, as presented in the works of Barbosa, Ferreira, and Kato (2020), Abe and Quijada (2021), Santos et al. (2021), and Soares, R. et al. (2021).

When it came to the most commonly used learning strategies during remote teaching, there was unanimity in mentioning the dialogic lecture, which is not surprising, as this type of lesson facilitates the fulfillment of the aforementioned curriculum requirements. The predominance of lecture-based teaching was also cited by Santos et al. (2021). Soares, R. et al. (2021) go further by stating that the predominantly expositional nature of video lessons, besides being unstimulating, inadequately replaces concepts and fundamentals that are more solidified through experimental lessons. According to the interviewees' reports, there was unanimity in mentioning the limited participation of students during these lessons, making them much more expositional than dialogic. Four of the interviewees also mentioned attempts to conduct practical lessons, even remotely, and in all of these initiatives, there was student involvement in conducting the experiments.

Regarding the organization of teaching activities, initially, schools did not have fixed schedules for synchronous meetings with students, and teachers were only required to make content available on their respective Learning Management Systems. However, at a later stage, there was a systematization of synchronous meeting schedules, similar to those of in-person classes. Students then had daily live session schedules, which, as mentioned above, were predominantly focused on dialogic lecture-style lessons, but with little student interaction. In this regard, two interviewees mentioned their role in motivating students to study.

4.2.1.3 EVALUATION

All interviewees reported that the assessment of learning during remote teaching was focused on procedures with clearly summative purposes, with a predominance of tests or quizzes administered on Moodle or through Google Forms. These assessments, often with automatic grading, have the advantage of practicality for teachers but reflect very little of what students have actually learned. One of the interviewees mentioned the use of differentiated assessment instruments, such as small tasks developed on Moodle, but also noted the amount of work required to correct, tabulate, and provide feedback to each student. Soares, M. et al. (2021, p. 646) echo the perceptions obtained in this study by stating that "The method of assessing the student has become more complex, highlighting that the practice of assessing through single means, such as exams, is an outdated method." Indeed, assessing learning is not an easy task, and there is a tendency for both teachers and students to associate assessment solely with the assignment of grades or, conversely, to disregard evaluative procedures that do not contribute to summative school approval.

4.2.2. What were the challenges encountered by biology teachers during the implementation of emergency remote teaching?

The greatest challenge faced by Biology teachers at SCMB during remote teaching was the lack of student motivation to participate in pedagogical activities. This was mentioned by four out of the five interviewees, totaling eleven citations due to repetitions found in each individual's discourse. According to the analysis of the reports, student participation, both in synchronous and asynchronous activities, was generally below desired levels. It is important to consider, however, that the learning strategies chosen by teachers, focusing on expository lectures, may have contributed to this lack of student motivation.

Vitor, Silva, and Lopes (2020) also identified the lack of interest and participation from students as a challenge of remote teaching. Meanwhile, Bandeira and Mota (2021) suggest that active methodologies could lead to greater motivation and engagement from students in synchronous or asynchronous settings. This lack of student motivation results from

various factors, such as difficulties in organizing study at home, either due to a lack of suitable environment or technical challenges (devices and connections). Other authors also mention the lack of internet services and limited access to computers by students, including Barbosa, Ferreira, and Kato (2020), Borba et al. (2020), Vitor, Silva, and Lopes (2020), Bandeira and Mota (2021), and Conrad, Ceschini, and Cunha (2022).

The challenge of using digital tools due to a lack of training in this field was also prominently highlighted by four out of the five interviewees, totaling six citations due to repetitions found in each discourse. Several other authors also cite this as a challenge of remote teaching, such as Barbosa, Ferreira, and Kato (2020), Borba et al. (2020), Vitor, Silva, and Lopes (2020), Bandeira and Mota (2021), Soares, M. et al. (2021), and Soares, R. et al. (2021). This lack of training contributes to other challenges identified by the interviewees, such as having to deal with the difficulties of other teachers on the team and an increased workload, as they not only had to handle pedagogical activities but also had to learn how to use digital tools. Other authors also cite workload overload as a challenge of remote teaching: Borba et al. (2020), Soares, M. et al. (2021), and Soares, R. et al. (2021).

Furthermore, regarding teachers' routines, another challenge identified by three out of the five interviewees was the difficulty of balancing aspects of personal and professional life, as work was brought into the home environment. This point was also mentioned by Barbosa, Ferreira, and Kato (2020), Borba et al. (2020), and Soares, M. et al. (2021). The lack of face-to-face contact between students and teachers was also considered a challenge by two interviewees, as it made it more difficult for teachers to perceive whether students were learning or not, something also mentioned by Conrad, Ceschini, and Cunha (2022).

School assessment is always a complex issue, and in the context of remote learning, it also became a challenge, especially when the assessment tools used are essentially a transposition of non-consultative exams from face-to-face teaching. According to the accounts of three interviewees, this assessment model ended up favoring the copying of answers from the internet and sharing among students, as there were no efficient means to monitor this, causing distortions between the grades obtained and the

actual learning achieved.

Another challenge, particularly specific to the field of Natural Sciences, which includes Biology, was the difficulty in conducting practical classes, mentioned by one of the interviewees. This is also supported by Soares, R. et al. (2021), who state that video lessons do not adequately replace concepts solidified in experimental laboratory classes.

4.2.3. After returning to face-to-face classes, what are the teachers' perceptions of teaching biology at the SCMB?

Regarding student performance, all interviewees considered that there were negative impacts, evidenced by difficulties in writing and gaps in the Biology content that students should have learned during the remote learning period. One interviewee also mentioned positive impacts, noting the students' efforts to catch up on learning upon the return to in-person classes.

On the other hand, concerning their pedagogical practices, all interviewees considered that their experiences in remote teaching benefited their teaching activities, as they generated significant learning with results applicable even in face-to-face teaching. This perception aligns with what Soares, M. et al. (2021, p. 649) state: "Many educators see the use of information and communication technologies as a challenge, while others see it as an opportunity to reinvent themselves and improve teaching methods."

4.2.4. What pedagogical practices started or strengthened during emergency remote teaching can be maintained to increase the use of technologies in face-to-face teaching?

As we mentioned in section 4.1 of this study, the dimension of the analysis system matrix with the lowest number of citations by the interviewees was Suggestions and opportunities for pedagogical improvements in the use of ICT, which hindered the response regarding the increase in the use of technology in face-to-face teaching.

Based on the interviewees' reports, the increase in the use of technologies can occur during face-to-face classes or in a non-face-to-face context, but in support of activities carried out at school. The latter scenario is closer to the widely spread definition of hybrid learning, where we have a convergence between the face-to-face learning model and the online model (Bacich; Tanzi; Trevisani, 2015). Specifically for use in face-to-face activities, teachers mentioned interactive activities, using tools such as Kahoot (three interviewees), Padlet (two interviewees), and Plickers (one interviewee), which presuppose active student participation in their learning. For non-face-to-face use, expertise in AVA can be used, in addition to simple distribution of educational material (mentioned by four out of five interviewees), for the development of reinforcement or recovery classes that would otherwise be held in person during off-hours. This ends up being an advantage so that students are not required to remain at school outside regular class hours.

5. Final considerations

The experience of teaching during the COVID-19 pandemic undoubtedly becomes a temporal landmark for all the educators who lived through it. Thus, by studying the perceptions of a group of teachers about this experience, particularly shortly after they have gone through it, we contribute to composing a historical account of this sensitive yet significant moment for global education. We acknowledge that, probably, if this research were conducted later, the teachers' accounts would not be as vivid and rich.

Therefore, we consider that this research has direct implications for rethinking pedagogical practices in the Biology discipline, based on experiences of remote teaching and the optimal utilization of ICT. This should be reflected in school curricula and other methodological guidance documents. Ultimately, incorporating ICT into Biology education, or indeed any discipline, is a way to contextualize learning, as the use of these technologies is an inseparable part of the daily lives of the vast majority of students in Basic Education.

We also understand that present-day teachers need to master digital

competencies, and for this, it is essential that initial training curricula and continuing education programs pay due attention to the topic.

As we conclude this work, returning to our research problem, we can finally conclude that Biology education was affected by remote teaching primarily due to the lack of preparedness of teachers to operate in this scenario, but also by the challenges of adapting students to this situation. The very definition of remote teaching inherently entails a series of obstacles when it involves transposing in-person practices into an online context.

On the other hand, revisiting the research questions, we also perceive that despite everything, there are indeed positive outcomes to be gleaned from this experience, particularly in the increased integration of technologies into learning (virtual learning environments, interactive tools like Kahoot), the diversification of pedagogical strategies, and the full awareness of the need for continuous updating of educational practices, primarily through the promotion of ongoing training for teaching professionals.

After all, the "new normal" that was so often discussed during the pandemic also seems to have become a permanent fixture in Education.

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