EDUCAÇÃO EM FOCO
PROGRAMA DE PÓS-GRADUAÇÃO EM EDUCAÇÃO | UNIVERSIDADE DO ESTADO DE MINAS GERAIS

Práticas e modelos pedagógicos digitais educomunicativos de ensino no PIBID de química: uma análise de experiência formativa

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Resumo
O Programa Institucional de Bolsas de Iniciação à Docência (PIBID) em química na UFAM vivenciou uma imersão imbricada em dilemas, possibilidades e experiências na multimodalidade digital de práticas pedagógicas durante a pandemia. Destacamos e avaliamos dois momentos na forma de minicurso pelo uso das Tecnologias Digitais da Informação e Comunicação (TDIC) com produção de material didático e paradidático para a Educação Básica. O percurso metodológico utilizado na pesquisa e análise foi a abordagem qualitativa como relato de experiência de caráter exploratório, observação participante, na coleta de dados no *chat* durante as atividades e interações realizadas nos minicursos formativos. Os resultados apontam o potencial e as múltiplas possibilidades dos recursos digitais no ensino-aprendizagem nas práticas pedagógicas, bem como suas limitações.

Palavras-chave: Multimodalidade Digital. Pandemia. PIBID Química. TDIC.

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Educommunicative digital pedagogical practices and models for teaching in chemistry PIBID: an analysis of training experience

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Abstract
The Institutional Teaching Initiation Scholarship Program (PIBID) in chemistry at UFAM experienced an intertwined immersion in dilemmas, possibilities and experiences in the digital multimodality of pedagogical practices during the pandemic. We highlight and evaluate two moments in the form of a short course using Digital Information and Communication Technologies (DIT) with the production of teaching and para-teaching material for Basic Education. The methodological path used in the research and analysis was a qualitative approach as an exploratory experience report, participant observation, in the collection of data in chat during the activities and interactions carried out in the training short courses. The results point to the potential and multiple possibilities of digital resources in teaching-learning in pedagogical practices, as well as their limitations.

Keywords: Digital Multimodality. Pandemic. Chemical PIBID. DICT

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Prácticas y modelos de enseñanza educativa digital en el PIBID de química: un análisis de la experiencia de formación

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Resumen
El Programa Institucional de Iniciativa de Enseñanza (PIBID) en química de la UFAM vivió una inmersión envuelta en dilemas, posibilidades y experiencias la multimodalidad digital de las prácticas pedagógicas durante la pandemia. Destacamos y evaluamos dos momentos en forma de minicurso mediante el uso de Tecnologías Digitales de la Información y la Comunicación (TDIC) la producción de material didáctico y paradidáctico a educación básica. El enfoque metodológico utilizado en la investigación y análisis fue el enfoque cualitativo como relato de experiencia exploratoria, observación participante, la recolección de datos del chat durante las actividades e interacciones realizadas los minicursos de capacitación. Los resultados apuntan al potencial y las múltiples posibilidades de los recursos digitales en la enseñanza-aprendizaje en sus prácticas pedagógicas, así como en sus limitaciones.

Palabras clave: Multimodalidad Digital. PIBID Química. Pandemia. TDIC.

Introduction

EDUCATIONAL DIGITAL TECHNOLOGIES IN REMOTE TEACHING

The COVID-19 pandemic, declared by the World Health Organization (WHO) in March 2020, forced us into social isolation and transitioned from in-person teaching to Emergency Remote Teaching (ERT) in the virtual learning environment, using Digital Information and Communication Technologies (DICT) and their multiliteracies as resources to connect students and teachers (SARTORI, 2021; UDOMRATN et al., 2022; BRASIL, 2020). Thus, an additional challenge to teaching practice in an increasingly information-saturated digital ecosystem emerged, filled with media applications and communication trends of the "TikTok generation," where thousands of viewers are entertained by short video messages that do not exceed sixty seconds. Consequently, reading has become a tedious trend, and critical-reflective thinking an act of boldness and sophistication.

Digital technologies and their media entertainments have advanced unprecedentedly in a voraciously consuming society, as a global market strategy, counter to a reality lacking critical literacy for the common citizen. As educators in the field of science, digital literacy must necessarily encompass critical literacy through scientific literacy for future teachers, enabling them to critically analyze the implicit discourses in visual and multimodal texts related to socio-environmental, cultural, and political issues. This approach prepares individuals to understand socio-environmental and global contexts and to actively participate in changes benefiting their communities (CORRÊA et al., 2021; MARQUES et al., 2021).

The "Achilles' heel" of transitioning from in-person to virtual teaching is also tied to digital competencies and the digital maturity index of internet users in the country. Despite Brazil being the fourth-largest online population on the planet, it is limited in basic and unsophisticated digital activities. For instance, the use of e-learning and the creation and development of online content are confined to a group of users with differentiated levels of digital competencies in Educational (EE), Communication (EC), and Learning (EA) ecosystems while addressing Multimodality in Education (ME) (SILVA *et al*, 2021, 2022).

These ecosystems share a common project and vision: to provide education within the context of digital culture, extending beyond the boundaries of traditional in-person teaching, guided

by the principles of dialogicity and network action. They represent an effective educommunication ecosystem, integrating semiotic resources in teaching, whether oral or written, digital or printed, and striving to convey understanding through the chosen language (CORRÊA et al., 2021; SARTORI, 2021).

Amid the pandemic challenges faced by the Institutional Program of Teaching Initiation Scholarship (PIBID) across the country, the Chemistry PIBID at the Federal University of Amazonas (UFAM) sought to implement many solutions for the training of its scholarship holders and supervising teachers from the involved schools through the Emergency Remote Education (ERE) modality and multimodalities in digital teaching (BRASIL, 2013, 2010, 2018).

Among these solutions were various online activities involving the use and training of DICT through courses/workshops/mini-courses/lectures/symposia, socialization meetings, and cultural knowledge exchanges conducted in partnership with universities, Federal Institutes of Education, and teachers from other educational institutions across the country. These efforts were inspired by the call for help and cooperation from the sub-area coordinator for the UFAM-ICET Chemistry project from the Double Degree Program in Chemistry and Biology Education in Itacoatiara-AM.

This research work, as a report of experience and reflection, was driven by the following investigative question: Would the digital pedagogical strategies, models, and practices adopted throughout the PIBID activities promote satisfactory learning for the training of PIBID participants and ongoing professional development of the supervising teachers from the schools involved in the project?

To answer this question, the study aimed to analyze the experience provided by PIBID through two mini-courses on the use of educommunication digital systems via DICT. Selecting these mini-courses for discussion was not easy without being unfair to other activities excluded from the scope of this article, identifying the challenges of the teaching-learning process in the ERE modality, and ensuring satisfactory training for its participants.

The methodological approach is qualitative and exploratory, utilizing primary data collection through participant observation and textual testimony from both teachers and PIBID participants, as described in each section of the article (LEITE; MÓL; SCHNEIDER et al., 2017; GÜNTHER, 2006). The textual contributions from the narratives of the two teachers involved in the mini-courses were collaboratively reviewed until consensus was reached among the peers.

Therefore, "including the introduction presented here," with a brief theoretical background for understanding the article, this experience report, as a case study, is divided into four sections or phases, presenting the practices and results of digital education in its multimodalities and multiliteracies. The fourth and final section presents the concluding reflections on the experience provided throughout the activities during the pandemic.

EXPERIENCE REPORT: MULTIMODALITY AND MULTILITERACY IN CHEMISTRY EDUCATION

Digital multiliteracy and virtual environments in Emergency Remote Education (ERE) through digital technologies contributed to facilitating the democratization of education and improving educational quality in certain aspects during the pandemic. However, the period of social isolation revealed that the country is far from leading educational initiatives with effective partnerships between education and technology (CORRÊA et al., 2021; MARQUES et al., 2021).

A backward mentality still prevails among many school administrations, viewing the use of educational technologies as a fleeting trend, despite students being increasingly "plugged in" and integrated with these technologies in their daily lives. In this context, we agree with Corrêa et al. (2016) that educational institutions must adapt to this contemporary, increasingly multimodal reality, where communication and expression occur through multisemiotic texts (printed or digital) in a variety of languages that convey meaning (verbal oral language, signs or writing, videos, graphs, or photos).

All PIBID participants in the project were from the year 2000 generation, meaning they were born into an era of technological advancements and unprecedented access to a myriad of social and digital networks compared to the project coordinators, who experienced the era of floppy disks.

The pandemic prompted us to consider this audience more thoughtfully. Chemistry classes needed to be directed towards pedagogical practices that were digitally literate and multimodal, contextualized. Therefore, beyond traditional content related to chemical concepts, formulations, and symbolism, it was crucial to adopt a more engaging, collaborative, and dynamic approach. The search for solutions during the pandemic to reintegrate public university students into the teaching-learning context made remote teaching a mandatory modality in the courses, compelling us to step out of our comfort zones and seek digital communication methodologies that could meet this demand and social requirement

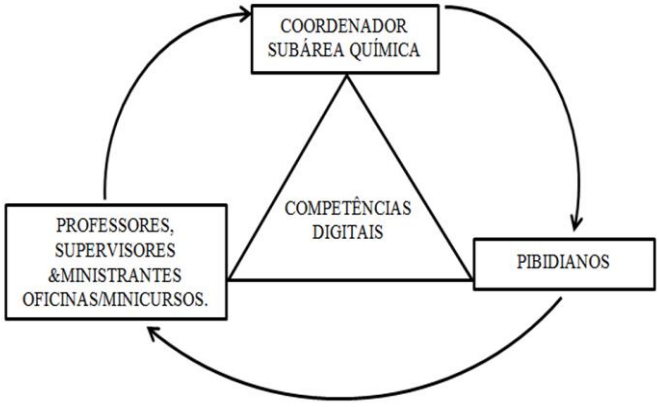
(RIBEIRO, 2020; SOARES *et al*, 2020).

The online platform Google Meet, among other interaction and collaboration tools, was part of the educational ecosystem for classes during Emergency Remote Education (ERE). The same was true for PIBID. It is important to highlight that as a strategy of action, before each PIBID chemistry activity in the Double Degree Program in Chemistry and Biology at UFAM-ICET was implemented, meetings between the sub-area coordinator, supervising teachers, and mini-course instructors were held. These meetings were facilitated through the creation of groups on the messaging app WhatsApp, both for the teachers and the PIBID participants, aiming at future evaluations of activities and information sharing.

When communication issues arose between PIBID participants and their respective supervising teachers and mini-course instructors, the coordinator of the sub-area was contacted to address doubts and minimize conflicts of ideas during the outlined process.

The groups created an educommunicative learning environment that fostered the development of several digital competencies as PIBID carried out its activities. Among these competencies, we highlight: network engagement, content production, organization and planning, cooperation in virtual learning environments, and teamwork in networked settings. This approach facilitated greater coordination and speed in continuous interactions among students, teachers, and sub-area coordinators, as a triangular strategy to enhance communication and assess the progress of activities in PIBID, as illustrated in Figure 1.

Figure 1- Diagram of Communication and Monitoring Flow in Online Activities of the PIBID Chemistry Program Fostering Digital Competencies in ERE Mode



Source: Author's figure

With this idea in mind, an online mini-course of 40 hours, divided into 50-minute sessions across eight meetings, was proposed. The course aimed to train PIBID participants in the following skills: researching articles in databases (2 hours), guiding and producing scientific scripts after reading scientific articles (10 hours), guiding, producing, and editing Vodcasts and Comics (10 hours), group support (10 hours), and presenting and discussing work with the collective, divided into groups with 2 hours each, weekly, totaling (8 hours).

From the start of the meetings, a transversal pedagogical action was established in teaching and learning, aligned with the theme of the mini-courses, which included reading scientific articles and subsequent textual production and analysis. This academic-scientific literacy practice facilitated discussion and guidance in the textual construction of scientific concepts in chemistry. This textual production involved creating summaries, reviews, and script outlines as micro-activities, leading to the development of Vodcasts and Comics, with greater time investment as indicated by the PIBID participants identified by the initials PB.

To start, the PIBID participants were instructed on how to research articles using databases from the CAPES & CAFe Portal, SciELO, Edubase, Educ@, and Google Scholar.

The free video editors used for Vodcast production were mobile apps such as CapCut and InShot, while the platform Make Beliefs Comix (https://makebeliefscomix.com/Comix/) was used for creating comic strips. This online comic production platform, among others tested by students under the guidance of the course instructor, was chosen by them for its wide range of creative possibilities and ease of use. The PIBID participants also created step-by-step manuals and explanatory videos for the three aforementioned apps, using more accessible and summarized language. These resources were intended to be made available to supervising teachers at their schools, allowing them to replicate similar activities in their classroom pedagogy, analogous to those conducted in the Chemistry PIBID program.

The activities developed by each group of students, coordinated by their respective supervising teacher, were shared and discussed in meetings via Google Meet, with presentations both oral and written in PowerPoint or other graphic creation/editing programs chosen by the groups.

The chosen evaluation criterion for the activities was the leadership and joint participation of the PIBID participants. This pedagogical strategy aimed at fostering interaction in the remote environment, given that turning off microphones and personal cameras is a common practice in the digital teaching ecosystem, thereby preventing it from becoming a "land of the mute."

Some scholarship holders (identified as PB 1, 2, 3...) reported in the Google Meet chat as part of their experience with the activities that:

PB1: "*...this way of working allowed us more freedom to create and study chemistry. We read more articles to create comic stories in chemical science and link them with other themes...".*

PB7: "*...promoting science and combating fake news by creating Vodcasts was an exciting activity... It required reading a lot of articles, summarizing, writing scripts, and trying to incorporate all of that creatively into a short video. The activity proved to be feasible and even encouraged us to do something similar with students in schools*

According to some scholarship holders (PB1 and PB7), we focused on guiding the work through a dynamic approach using activities that could stimulate student cognition creatively, making them architects of their own knowledge, overcoming challenges, and solving problems through dialogue with their team, which was understood as an active teaching methodology.

Another aspect highlighted as an experimental environment, according to some scholarship holders (PB2, PB3, and PB6), was the motivation provided by topics related to chemistry and its connection with teaching and scientific literacy. This motivation was facilitated by the selection of topics within the WhatsApp group, which enhanced interest in the activities.

These topics addressed interdisciplinary issues with contextualized socio-environmental realities, including: micro and nanoplastics in the environment, the chemistry of leachates in landfills and their impact on groundwater, pesticides, acid rain and its ecological impacts on the Amazon rainforest, the chemistry of processed and non-processed foods, medicinal plants of the Amazon and their therapeutic chemical substances in the context of the ethnopharmacobotany of caboclos, riverside communities, and indigenous peoples, the history and importance of vaccines in epidemic and pandemic contexts, and racial and gender issues in everyday life and in the world of science (Percy Lavon Julian, Katherine Johnson, Alan Turing, Anita Canavarro, among other notable figures).

According to some scholarship holders (PB2, PB3, PB6) regarding how the mini-course stimulated their understanding of certain chemistry concepts and the development of their textual production skills and creativity in creating comics and podcasts, we highlight:

PB2: "...i was able to read, discuss, and write summaries of ideas from scientific articles on various topics related to chemistry with my colleagues to create the comics. Some were more dedicated than others, which is normal, even in in-person teaching. But those who took advantage of

it did benefit, right? It requires time, but it's exciting because it helps us develop our writing skills and understand chemistry within the context of the Amazon. It was very rewarding".

PB3: "...writing isn't that easy; summarizing the ideas from articles and creating comics demands a lot from us. Putting the idea on paper and drafting the script makes us think more. It's not easy, but in the end, it turned out really well. We covered a lot about the chemistry of pesticides and learned more about this chemistry. My neighbors use them a lot, and it's concerning....".

PB6: "...Using podcasts in the form of vodcasts to create videos was very gratifying. Using new and free apps made a difference in the activity, allowing us to be free to create and understand more about chemistry. It was even more meaningful to discuss vaccines at a time when people are disregarding them, denying science in the name of a politics that has already killed many people.".

We emphasize that the topics covered in these activities are part of the guidelines of the New High School (Novo Ensino Médio) as outlined by the BNCC (Base Nacional Comum Curricular). Therefore, they are related to the practice of teaching chemistry in schools, where teachers can utilize these media resources to make the subject more engaging, meaningful, and connected to the local cultural reality by considering the context in which the student is situated.

Many of the works mentioned here, along with other important activities such as the educational material on Brazilian Sign Language (Libras) in chemistry, are available on the online social network Instagram, on the virtual site "@pibidquimicaicet," created and developed by students under the guidance of the project's teachers as part of their evaluative activities and teacher training.

PARADIDACTIC PRODUCTION IN LIBRAS FOR TEACHING CHEMISTRY

In the digital context of bilingual education in Brazilian Sign Language (LIBRAS), new media and digital technologies, by incorporating semiotic resources into this teaching, represent a valuable tool against the exclusion of deaf individuals. Digital Information and Communication Technologies (DICT) can also support the training of pre-service teachers by providing the basic knowledge necessary to work in Basic Education schools, as guaranteed by CEB Resolution No. 2 (2001) of September 11, 2001, which establishes the National Guidelines for Special Education in Basic Education (BRASIL, 2001; DA SILVA *et al*, 2013; DOS SANTOS *et al*, 2020; MIRANDA, 2019; TEIXEIRA *et al*, 2020).

Despite inclusive education being mandated by law, many barriers hinder its successful implementation in schools, including the lack of teacher training and deficiencies in the physical and material infrastructure of the school environment. The absence of signs in certain areas of knowledge can directly influence the access and retention of deaf individuals in any educational institution (DOS SANTOS *et al*, 2020).

Currently, the Double Degree Program in Chemistry and Biology at the Institute of Science and Technology (ICET), UFAM, Itacoatiara campus, includes LIBRAS (Brazilian Sign Language) as a mandatory course in its fourth semester, with a total workload of 60 hours. However, this course only provides students with basic terminologies for initial communication in sign language within basic education schools.

Until 2021, with the change in the Political-Pedagogical Project of the Course (PPC), the LIBRAS course was placed in the final semester alongside the Final Paper (TCC), demonstrating that the limited understanding of the members of the Teaching Core (NDE) relegated LIBRAS to a status of low importance, and thus, without prerequisites for the Stage I and II courses in biology and chemistry in schools.

This weak vision of teaching and teacher training is unfortunately characteristic of the country's reality in undergraduate programs in Mathematics, Chemistry, Physics, and Biology, which rarely present specific terminologies in LIBRAS for their respective fields. When entering the job market and encountering deaf students in schools, teachers inevitably face the reality shock of struggling to convey the specific knowledge of their discipline (GONÇALVES et al, 2019; TEIXEIRA *et al*, 2020).

Given this context, receiving the invitation from the coordinator of the Chemistry PIBID program to teach a minicourse on LIBRAS and its terminologies in chemistry was both gratifying and challenging. Initially, we considered a 20-hour course for the PIBID participants, but since all of them were part of the previous curriculum, we decided to extend it to 60 hours for the minicourse titled "Inclusive Education of LIBRAS in Chemistry Degree Program at PIBID".

An even greater challenge was figuring out how to structure the minicourse in the most efficient and dynamic way possible with both synchronous and asynchronous classes via Google Meet. We aimed to propose motivating tasks for students and supervising teachers throughout the training, with a political-critical-reflective approach to issues of inclusion and accessibility in the role of LIBRAS in educational environments. Additionally, we sought to promote basic communicative

skills training and produce supplementary materials for schools with specific terminologies in chemistry as part of PIBID activities. Given the scarcity of signs for many chemical concepts and vocabularies in the field of chemistry, and the lack of standardization for these signs, we can even find more than one type of sign representing the same chemical term or object (GONÇALVES *et al*, 2019; SANTOS *et al*, 2019).

When it comes to the subject of chemistry, which is filled with formulas, symbols, equations, and specific jargon, it becomes a barrier to the learning of deaf students. This is compounded by the fact that there is a limited number of specific terminologies in LIBRAS, even for basic words in the field, causing a series of difficulties for the teacher and interpreter during instruction (ARAGÃO; COSTA, 2017). Gonçalves et al. (2019) point out that the lack of specific signs in LIBRAS for chemistry, for example, corresponds to the non-existence of correlates for all the specific concepts and vocabularies in this scientific area, as well as cases where signs in the sign language have correlates in Portuguese but differ in meaning from the scientific concept.

Based on this, we devised a didactic teaching-learning strategy divided into five synchronous classes/meetings, each lasting 60 minutes, once a week. After these five meetings, we developed asynchronous activities such as creating supplementary materials in the form of pamphlets and videos. During these activities, we also had some synchronous meetings with each work team, so that the PIBID participants and supervising teachers could resolve their doubts during the completion of the assigned tasks.

In the first two synchronous classes, we discussed the main laws, guidelines, and resolutions that ensure accessibility for the deaf community, situating students in issues related to affirmative public policies and educational inclusion in the fight for equity in the right to citizenship for deaf children and adolescents in schools, as well as ethics in education and/or inclusive society; problematizing actions to promote inclusive practices in schools; correct terminology to avoid pejorative connotations; the importance of family participation and support in the development of deaf individuals; pedagogical methodologies and approaches focused on deaf education, such as digital multiliteracy and other resources; and concluding with a review of the main points raised and a discussion period.

At the end of each of the five classes, a scientific article from an indexed journal on LIBRAS was made available to the students and supervising teachers via a WhatsApp group. This allowed them to read, discuss, and produce a review as a written assignment with their respective

groups. In the subsequent class, they would highlight the most prominent points and questions, as well as address any doubts about the proposed topics through discussions.

he articles discussed topics related to inclusive education and special education within the school context, advancements and political-educational issues in Brazil, terminology in finger-spelling, and pedagogical methodologies for teaching and learning for deaf students. The purpose of reading these articles, some of which are referenced throughout this text, was to lead students to a greater awareness of the topic, its advancements, its challenges, and the process of implementing Inclusive Education in Brazil.

In the initial phase of our activity, we observed in the Google Meet chat how students (PB9, PB10) recognized the importance of the topic, expressing that:

PB9: *"It is evident that there is a shortage of education professionals trained for the inclusion of deaf students in the school environment. In this sense, it highlighted the importance of understanding the difficulties and reality of teachers who are unprepared for including deaf students in their classes, especially in chemistry*."

PB10: "*This minicourse session was important and a great surprise as it addressed various issues related to inclusive education and how there is a significant difficulty, especially in the subject of chemistry."*.

As highlighted by Mourão (2013), even though the rights of deaf students are guaranteed by the constitution, they face many socio-educational challenges, whether related to the physical adaptation of school spaces, teaching methodologies, or the initial and ongoing training of teachers. Therefore, it is emphasized that it is not enough for education professionals to merely learn LIBRAS; they must also learn how to develop teaching and learning practices that address the needs of deaf learners in their training programs.

All the information provided in this first meeting was crucial for raising awareness and reflection among students and future professionals. The LIBRAS course, as required in the curricula of exact sciences teacher education programs, might fail to instruct with appropriate pedagogical approaches and educational practices that facilitate the understanding of scientific concepts for deaf students.

In the second meeting, we began with the presentation of the LIBRAS manual alphabet, known as dactylology, a resource of sign language that aids in initial communication. Each letter of the alphabet is represented by a specific hand configuration. At this stage, we engaged in hands-on

practice of basic signs from the LIBRAS alphabet, where students and teachers were encouraged to repeat the signs for each letter. This allowed everyone to participate in a relaxed manner, helping each other with the correct use of this communication method.

To better assist students and teachers in their studies and activities, especially with the correct movements of signs, we decided to produce and share an audiovisual material in the WhatsApp group. This material includes chemical terminologies studied, as well as each letter of the alphabet in LIBRAS. This content was later shared on the PIBID Chemistry Instagram platform, which can be accessed at the following link: https://www.instagram.com/pibidquimicaicet/.

At the end of the class, we also presented how to use visual resources to enhance understanding of the content for deaf students. This included discussing the time required between explanations, correcting activities, writing on the board, the number of exercises applied, and the importance of respecting LIBRAS grammar.

In the third and fourth meetings, we continued with practicing basic signs related to the school environment. These included signs for materials in the school bag, areas of the school, signs identifying the teacher, the student, greetings and salutations, verbs, among other signs. This practice contributed to expanding the vocabulary in LIBRAS and also provided a foundation for initiating conversations in a future classroom.

These signs facilitate building a relationship between deaf students and the school community, aiding in initial dialogue and developing basic communicative skills in LIBRAS between individuals. This helps to reduce the gap between students and teachers. Figure 2 illustrates some of these learning moments in the remote class.

Figure 2- Activities from the Online LIBRAS Workshop in the PIBID Chemistry Program Accessible on the Website: @pibidquimicaicet.

Source: https://www.instagram.com/pibidquimicaicet

The fourth and fifth meetings were the most anticipated by the PIBID participants. The terminologies and their respective signs in chemistry were presented and practiced with the group's participation. The over 70 signs covered included laboratory glassware, electrical and thermoelectric equipment, physical and chemical reaction processes, chemical elements from the periodic table, the atom and its constituent particles, some chemical formulas, and other terms used in the field.

Knowledge of these signs will assist future hearing educators in their pedagogical practices, with the essential support of Portuguese Sign Language Interpreters (TILS) in the classroom during the teaching and learning process for deaf students in both experimental and theoretical chemistry lessons. Additionally, it will aid in the development of lesson plans that can equitably address the needs of these students in school. The collaboration between science teachers and TILS is crucial for supporting the scientific literacy of deaf students and, ideally, for working together to create new LIBRAS signs for scientific terminologies in chemistry and other sciences where specific signs are currently absent.

As we can see from the statements obtained from some PIBID participants (PB5, PB8, and PB10) in the Google Meet chat, the minicourse achieved its objective according to their satisfaction and understanding of the importance of the topic covered:

PB5: "*The LIBRAS minicourse was essential for the scholarship holders; it opened our eyes to the issue of accessibility in education... we cannot think about education and teacher training without considering equity.*"

PB8: *"The minicourse was extremely relevant... it will serve as a resource for communication within educational environments, with tools and activities that can be applied in chemistry classes... this language is fundamental for teachers, as they work with diverse student profiles, and therefore need to understand all the students' needs in the classroom."*

PB10: *"...one of the most impactful experiences throughout PIBID for our teacher training was the LIBRAS minicourse/workshop. I was able to enhance my knowledge and practices... the current reality, not only in schools in my region but also in the entire public education network, increasingly demands a focus on 'Inclusive Education'... the minicourse was invaluable for my professional development and enriching from a human and social perspective."*

After the completion of the fifth class, three activities were proposed to the group. The first and second activities were, respectively, creating a video of no more than five minutes representing metallic, metalloid, and non-metal elements from the Periodic Table (PT) in LIBRAS and producing chemical terminology involving laboratory glassware and equipment.

Each of the groups from the three schools involved in PIBID was tasked with presenting a specific number of chemical elements from the PT, as well as other chemical terminologies, thus equally dividing the involvement in the task.

The third activity involved creating a booklet for each school, containing signs and chemical terminologies through images with easy-to-understand textual descriptions for users. The practices were completed one month after the final workshop class and presented by the groups in a final meeting on Google Meet. Each team posted their work on their respective schools' official websites, providing additional feedback to the PIBID Chemistry community and encouraging the ongoing professional development of the supervising teachers. The videos and booklets produced are available at the Instagram link of PIBID Chemistry UFAM-ICET: https://www.instagram.com/pibidquimicaicet.

Final consideratios

Despite the absence of formative practices in-person at schools and universities, PIBID was conducted through Emergency Remote Education (ERE). The innovation of incorporating new learning methods through Digital Education (DE) and Information and Communication Technologies (ICT) introduced various challenges, successes, and limitations to teaching that must be highlighted reflectively.

Among these, the limited access to quality internet that could fully meet the basic needs of this education, and provide students with support in the learning process through ICT by removing barriers, time-space constraints in communication, and offering flexibility in learning and development of digital skills, searching and sharing information, and interacting and relating.

It is also essential, as a *sine qua non* condition, to renew teaching practices with methodologies that encompass skills and attitudes linked to Digital Education (DE) and not merely the use of Information and Communication Technologies (ICT) as a final answer to the demand of an increasingly networked society for the development of digital competencies. This could, in turn, help future educators more effectively acquire an academic profile with digital competence, enabling them to better manage their time for studies and seek greater autonomy in their education.

Therefore, during the activities of the two workshops, which we use here as a benchmark against the many other activities carried out over the two years of the PIBID Chemistry program (2020-2022), we carefully positioned the PIBID participants as the protagonists in each pedagogical action developed, fostering their creativity and reflexivity in their teacher training and dialogue. This care was taken both by the supervising teachers and the instructors of the activities, aiming to prioritize the selection of chemistry topics, the mediation of choosing scientific articles, and the development and textual production of Vodcats, Comics, and audiovisual materials, among other activities contextualized to the citizen formation of the individual.

Beyond merely transmitting scientific knowledge effectively, it is crucial to question the processes and methods we use in the formation of our future teachers. This motivated us to better understand the teaching practice through a self-critical lens, leading to a more authentic and legitimate reflection on the work performed, acknowledging both successes and errors. We recognized this challenge as educators and coordinators of the PIBID Chemistry program, where the academic epistemology of its predominant technical rationality tends to value theoretical knowledge for its

scholarly nature, overshadowing pedagogical aspects in teacher education. This limitation often results in a less critical-reflective stance on teaching practice, citizenship, and politics.

PIBID sought to stimulate in teacher candidates a break from the technical nature of knowledge imposed within the university and around the chemistry teacher training course. The program encouraged students to develop their training as a "teacher-chemist" and to value teaching research alongside applied chemistry research.

Overcoming this historical-academic complexity within its traditional teaching structure requires the integration of a new way of thinking, a new paradigm, in this new knowledge society with its digital multimodalities. The experience of the PIBID Chemistry program throughout the pandemic demonstrated the viability and necessity of integrating digital multimodality into teaching practice and the ongoing professional development of teachers and teacher candidates in digital competence.

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Recebido em: 06/11/2022
Aprovado em: 05/09/2023