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# Approach, Methods and Teacher Work Profile for Teaching Molecular Biology in Basic Education: Teachers' Reports in an Online Continuing Education Course

Ranlig Carvalho de Medeiros[1], Benjamin Carvalho Teixeira Pinto[2] e Daniel Fábio Salvador[3]

## Abstract

This work aims to present a view of teachers, of basic education, about the approaches, methods, difficulties and challenges for teaching Molecular Biology in Distance Learning Courses. The research was carried out through qualitative analysis of the conceptions, reflections in the speeches produced in thematic forums, during the moments of interaction and collaboration of 36 course participants / teachers, in an online course of continuing education for teachers, offered by the Foundation CECIERJ. It was found that during the moments of interaction and collaboration, significant discussions and reflections were promoted among the professors participating in the forum, which reflected in changes in approaches to teaching Biology, as well as changes in attitude and conceptual changes. The reflections of teachers, promoted throughout the forums, reveal a positive direction regarding the use of History of Science as an alternative to teaching Biology, as well as its

1 Universidade Federal Rural do Rio de Janeiro. BR-465, Km 7 Seropédica – RJ – Brazil. ranligcarvalho@gmail.com

2 Universidade Federal Rural do Rio de Janeiro. BR-465, Km 7 Seropédica – RJ – Brazil.

3 Fundação CECIERJ. Central do Brasil Building. Cristiano Ottoni Square, S/N – 6th floor, Centro – Rio de Janeiro – Brazil.

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combined use with ICTs. This analysis also allowed the construction of a teaching work profile where it was possible to identify four work profiles, with regard to the use of technological resources (Digital or Analog) and the communicative approaches (Expositive or Dialogic), used in the classroom.

**Keywords**: Biology teaching, teacher training, interaction, collaboration, online teaching.

# 1. Introduction

Studies and research point to new educational technologies, the computer and the internet as possibilities to favor teaching-learning, especially in the context of access to information and in the communication process (LÉVY, 1999; LEMOS, 2008; DEMO, 2009; PRIMO, 2011; KENSKI, 2012). From the innovation of the means of information and communication and studies with proposals for their application in the educational process, documents appear in Brazil that seek to guide and provide guidelines for the use of new educational technologies. The Brazilian Educational Laws and Guidelines (LDB) - Law No. 9394/96 - already points to the element of interaction, which can be promoted by the new Information and Communications Technologies (ICTs), as well as the importance of developing appropriate methodologies for its use. Furthermore, the National Curriculum Parameters (PCNs) (BRASIL, 1998) guide the use of educational technologies as a support for teaching work, in order to make learning environments more attractive, stimulating research and experimentation with students. The PCNs (1998) also highlight the importance of the constant updating of the education professional for the new teaching trends in relation to information, encouraging and guiding the teacher to seek new approaches.

In addition, on the surface of the possibilities and challenges of using new educational technologies as a means of obtaining information and communication, the National Common Curricular Base (BNCC) (BRASIL, 2018) also brings ICTs as an inherent part of the development of competences in different areas of knowledge. However, care must be taken with the educational proposals found in documents such as the

BNCC for the use of ICTs in the educational process, especially when the objective is to massify and commercialize the educational system, causing the impoverishment of the quality of teaching and learning. Resolution No. 2, 2015, in its Art. 5, Paragraph VI, points out that, for the initial training of teachers, the competent use of ICTs is necessary, for the improvement of the pedagogical practice of teachers and students (BRASIL, 2015). This resolution also defines, in Art. 8, Paragraph V, that teachers must have mastery of ICTs for the development of learning (BRASIL, 2015). Therefore, there is an increasing incorporation of ICTs in the educational system as a means to promote the teaching--learning process, especially in the current scenario of social isolation, caused by the new coronavirus, SARS-COV-2, responsible for the pandemic and post-pandemic. Covid-19, where remote education is the main alternative for the educational process.

In view of the change in the configuration of educational processes, courses for updating teachers offer, online, through the Virtual Learning Environment (VLE), activities, discussions, reflections and alternatives to traditional teaching, filling in the gaps left by initial training courses, both in face-to-face and distance courses. Thus, distance education courses have stood out, for the most part, for allowing a large number of people, from different regions, to have access and participate in new discussions, as well as to have access to textual materials and interaction and collaboration devices for moments of collective knowledge construction. According to Salvador *et al.* (2017), currently, there are several interaction networks and virtual communities created in cyberspace, some of which are intended for collaborative learning.

## Continuing Teacher Education in the Context of Online Education

The search for continuing education courses on the part of Biology teachers is often related to the difficulty found by these education professionals to teach certain contents that present a high degree of abstraction, such as the contents that involve theoretical models. This difficulty is the result of a deficient initial training, both in terms of specific content and, mainly, in relation to the pedagogical disciplines that influence the way the content is approached and how knowledge is constructed (CACHAPUZ; PRAIA; JORGE, 2004; TEODORO; CAMPOS, 2016).

> […] the teacher must be well prepared, have initial and continuous training of quality and solid knowledge of the specific content and the pedagogical content, he must also show his students that knowledge is built and that they are part of this process, trying to integrate them in the search for knowledge, preparing them to face and solve problems and analyze the social consequences of science and technology in modern society (TEODORO; CAMPOS, 2016, p. 5390).

In view of these difficulties, reflecting on the initial training of teachers and updating them is convenient, especially in the Natural Sciences, in which the production of knowledge is fast and constant. The authors emphasize a concern with the continuing education of teachers, and these researches have been identifying teaching-learning problems and proposing actions for quality education, both with regard to the knowledge of the content to be taught and the pedagogical approach. For Cunha and Krasilchik (2000) and Bonzanini and Bastos (2007), the teacher needs to know the content he will teach, but he must constantly update himself, since science is not static and changes constantly. Bonzanini and Bastos, (2007) also emphasize that continuing education should provide educators with the opportunity to update themselves to better develop their pedagogical actions, but that the vast majority of these courses are considered inefficient. One of the causes of this inefficiency is attributed by Cunha and Krasilchik (2000) to the non-integration between the University and the Basic Education schools and between theoretical studies and teaching practice.

> It is important to bring practicing teachers to the university, to discuss common problems, to learn new content and to permanently update, since it was found that the lack of knowledge on the part of the teacher influences the approach of the content, the methodology that uses , and the cognitive advancement of students (BONZANINI; BASTOS, 2007, p. 10).

This lack of dialogue between researchers who propose new projects and teachers, who work as mere consumers of this product, makes it

impossible to work together, adapting new proposals and the methodology. In this context, Diniz *et al*. (2005) highlight that continuing education cannot have the teacher as a spectator, but as an active subject in the construction process and that must be established in the school routine. Several continuing education initiatives have been placing the teacher as an active subject, allowing for a better analysis of his difficulties and facilities, and establishing proposals, especially in relation to the teaching of specific contents (BONZANINI; BASTOS, 2007; ROLANDO et al., 2014). In studies developed by Diniz, Campos and Kulh (2004), Diniz et al. (2005); Santos *et al*. (2013) show that many courses are already adopting discussion actions on the combination of specific content, pedagogical content and the reality of the classroom.

Within the scope of distance education, these actions are materialized in several courses that are offered for the continuous training of teachers and other education professionals. The offer of these courses allows a large number of professionals to have access to an environment of information, interaction and collaboration without displacement. In addition to the new educational space, which avoids displacement to a face-to-face teaching unit (most of the time, concentrated in large centers), there is also the question of temporal flexibility. The interaction mediated in these environments allows the student to build knowledge collaboratively, in different spaces and at different times, making learning more affective and meaningful.

According to Tractenberg (2011), collaborative teaching (EC), as well as online collaborative teaching (ECO), are ways of teacher collaboration that present positive results for professional development and the culture of collaboration.

> Continuous collaborative teacher training would be any activity of professional teacher development in which there are specific plans to stimulate and enable shared learning and support between at least two fellow teachers, in a sustained manner" (DAY, 1999 apud CORDINGLEY et al., 2005b, p. 2).

In order to provide a more meaningful learning to the theoretical classes, the incentives for the use of VLEs point to the importance of exploring the students' view of the problem to be investigated. In other words, it seeks to promote a reflective process that allows interaction, dialogue and problematization. For Preto (2006), information technology has a great educational potential, not only of a technological nature, but fundamental in the teaching-learning process. In fact, the use of VLEs can be a path towards learning that breaks physical and temporal barriers, and has an affective and learning process. According to Silva and Schirlo (2014), there are three requirements for learning: 1) existence of previous knowledge; 2) offering new knowledge exposed in a logical manner; 3) explicit attitude of learning and connecting the new knowledge to the previous one.

Thus, the methodology used in a continuing education course, carried out in the context of online education, must explore the requirements highlighted above. As in continuing education, the public is composed of teachers who seek updating and improvement, due to difficulties in their daily teaching practice, the teaching-learning process of specific and pedagogical contents can be developed looking for the potential of the different interaction interfaces found in the VLEs. Such interfaces allow teachers to work together, discussing issues related to teaching and their daily practice. In this context, the possibilities and challenges of interaction interfaces in LMSs are diverse. Forums are the most frequent interaction interfaces in continuing teacher education courses, since they are a space for Collaborative Education (CE), since the forum combines interaction and collaboration of participants in the construction of knowledge. About EC, Tractenberg (2011, p. 149) highlights:

> It is a modality of work where teachers have common teaching-learning objectives about the same group of students, in the context of a course, discipline or educational program, they act in a coordinated and interdependent manner in pedagogical planning, in the development of didactic resources, in conducting teaching-learning activities and / or evaluating these activities.

The same author points out that qualitative studies indicate that co-teaching can be a promising model for teacher training, as it favors mutual learning and the improvement of teaching strategies, through collaboration. Thus, these practices can be the solution to remedy the deficiencies found in teacher training courses. Cunha and Krasilchik (2000) highlight the flaws and gaps in the knowledge of teachers, left by undergraduate courses, as well as the great advance that this knowledge has been suffering in the last decades. In this way, the monitoring of discussions and activities, within the scope of continuing education courses for EaD teachers, allows to identify certain gaps left by the initial training courses in relation to the issues of didactic-pedagogical approach, epistemology of specific biological knowledge and the technical and methodological knowledge.

The didactic-pedagogical approach is configured in the process of didactic transposition (CHEVALLARD, 1991), but specifically that which involves the transposition of scientific and academic knowledge to school knowledge. This process occurs within formal and non-formal basic education institutions, in which the teacher has a fundamental role. According to Carvalho and Gil-Pérez (2006) and Pimenta (2008), for the didactic transposition to occur within the school context, the teacher needs to have teaching knowledge divided into three axes: experience; specific knowledge; pedagogical knowledge. Thus, aspects such as the initial and continuing education of the teacher are highlighted by the authors as essential to carry out the transformation of the selected scientific knowledge and, now, present in the school curriculum, into school knowledge.

According to Santos (1992), training courses prioritize a dissociative view with regard to theory and practice. For Candau and Lelis (1999), this dissociation generated by the emphasis on theory makes it impossible to modify or intervene in educational practice. This may be indicative of the difficulty that teachers encounter in transforming the so-called scientific knowledge into school knowledge. This difficulty is reflected in the teachers' search for continuing education courses with the aim of looking for new alternatives when doing pedagogical and to improve their daily practice. According to Chevallard (1991), the knowledge

produced in the scientific context undergoes transformations, that is, "a didactic garment", so that it can be taught and, in this way, it reaches the classroom in a different way. In order for this didactic outfit to be possible, the teacher has several resources that are also inserted in the context of didactic transposition.

> A content of knowledge that has been defined as knowing how to teach suffers, from then on, a set of adaptive transformations that will make it able to occupy a place in teaching objects. The work that makes an object of knowing how to teach, an object of teaching, is called didactic transposition (CHEVALLARD, 1991, p. 39).

The domain of specific knowledge of Biology is another challenge that the teacher encounters in his daily practice and is linked, mainly, to the difficulty of teaching and bringing together scientific knowledge (scientific knowledge), derived from theoretical models, in school knowledge (school knowledge or knowledge taught) (CARVALHO, 2009). This knowledge has different characteristics, since the first is academic and produced by research institutions, by higher education institutes, and the second is built in the school environment. The scientific knowledge produced must relate to that produced in the school environment, so that there is a balance between the two sides, avoiding a certain distance, since there is a mismatch between them.

Technical-methodological knowledge is linked to technological knowledge and its forms of application, by the teacher, as an alternative to traditional teaching. The use of new methodological approaches by the teacher in a perspective of Science, Technology and Society (CTS) contributes to the construction of scientific knowledge in a contextualized and critical way, being fundamental for a better understanding of these contents worked in the school space.

In EaD courses, VLEs today represent an essential technological resource for mediation of the numerous proposed activities, and their interfaces allow for dialogue and collaboration, thus representing an important part in the didactic transposition processes in this teaching modality. As in the classroom teaching model, which has the classroom

as the main space for discussion and dialogue, the teacher / tutor / mediator, through the LMS, needs to carry out didactic transposition processes of academic knowledge, to be taught in the form of school knowledge, which would be the knowledge taught (TRAVASSOS; GUERRA, 2013). In LMSs, the forum represents the closest interface to a discussion environment for pedagogical interactions to take place, such as the face-to-face classrooms, providing moments of problematization, interaction, interactivity and intervention of the teacher / tutor throughout the process of building the desired knowledge (MEDEIROS; PINTO; SALVADOR, 2020). The entire structure of the course, such as textual and audiovisual materials, as well as the didactic model of the LMS and the teaching methodology employed, are important for the didactic transposition to occur..

This work aims to analyze the conceptions and discourses of teachers of basic education, enrolled in an online teacher update course, offered by the CECIERJ Foundation, about the approaches and methods, the difficulties and challenges in the teaching of Molecular biology.

## 2. Methodology

This research represents a study of the interactions of discursive activities in an online course of continuing education for teachers. Data collection was carried out through non-participant observation, within a VLE, with the objective of evaluating the interactions of 72 Basic Education students / teachers, in the discussion forums (thematic forums), the main interface used during the mediations. Qualitative monitoring of the textual productions was made at each post of the participant, and of his interactions with the other course participants, observing the relevance of the subject discussed, based on what was proposed by the course, in addition to checking if these subjects would allow developments for future discussions. It is important to highlight that the observation and analysis were carried out without interference from the researcher during the discussions promoted during the activities. Thus, only the textual constructions of the course participants / teachers and tutors were collected.

This research was developed with Science and Biology professors, both public and private, who seek professional and continuous updating and who were enrolled in the updating course, Transmission of Life, offered by the extension department of the CECIERJ Foundation. The course lasted 12 weeks, with a total workload of 30 hours. Being completely online, they use an LMS-Moodle platform as an interface for carrying out the various activities. The Transmissões da Vida (Transmission of Life) course is divided into five units, which cover the contents of the school curriculum and which are taught by teachers to students in the first year of high school. In the present work, we carry out the analysis of the discursive activities of teachers in the thematic forums of Units 1 and 2 (Chart 1).

**Chart 1 - Contents covered in the continuing education course Transmissões da Vida (Transmission of Life) in Units 1 and 2**

| | |
|---|---|
| **Unit 1** | Base text: DNA *a molécula da Vida (DNA the molecule of Life)*<br>Complementary material: *A descoberta da Estrutura do DNA* e *História da Ciência e Ensino: onde terminam os paralelos possíveis? (The discovery of the DNA Structure and History of Science and Teaching: where do the possible parallels end?)*<br>Action script 1 – Quem é o DNA? (Who is the DNA?)<br>Action script 2 – Por dentro das células: cromossomo, DNA e gene (Inside the cells: chromosome, DNA and gene); |
| **Unit 2** | Base text: *Os desafios ao ensinarmos síntese proteica (The challenges when teaching protein synthesis.)*.<br>Action script 3 – Acadêmicos dos unidos da proteína (Protein united academics). |

Source: Prepared by the authors.

At the Thematic Forum I, a total of 130 posts were registered, the vast majority of which were carried out by course participants (116 posts out of the total) and a smaller number carried out by the tutor (14 posts out of the total). In the Thematic Forum II, a total of 129 posts were registered, 114 of which were for course participants and 15 by the tutor (Table 1).

**Table 1 - Summary of interaction and collaboration activities promoted in forums 1 and 2**

| Units | Worked issues | Number of posts |
|---|---|---|
| **Unit 1- Thematic Forum I** | What is your position regarding the use of the History of Science in learning? Do you agree that this is a good strategy? Are there any limits, or criteria, that should be taken into account when recommending this strategy? Use your experience as a teacher and criticize how this strategy has been used (positive and negative aspects). | 130 |
| **Unit 2 – Thematic Forum II** | How could you develop the theme: "protein synthesis" in the context of a 1st year high school classroom? | 129 |

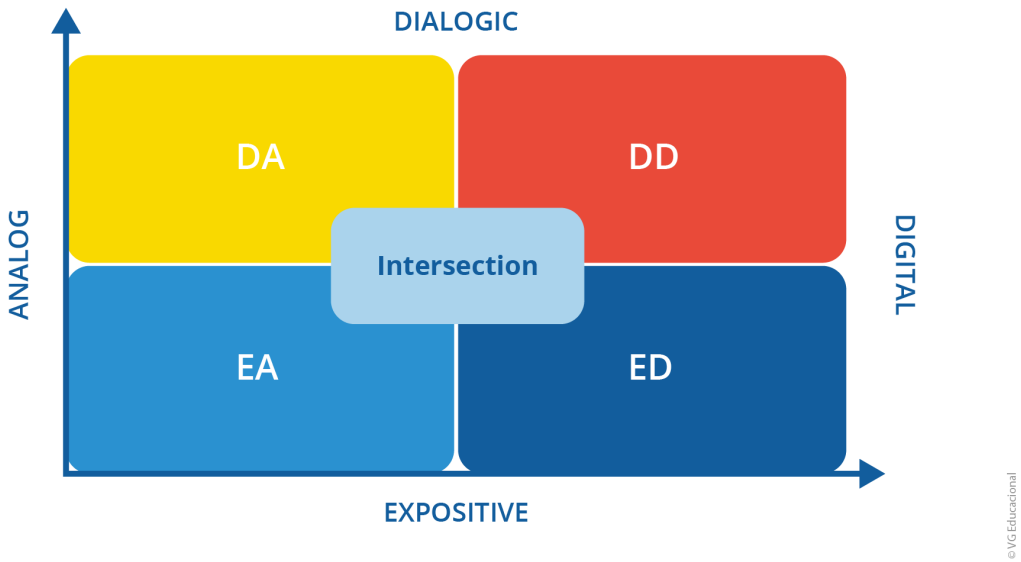
Source: Adapted from Medeiros, Pinto and Salvador (2020).

The forums chosen for the analysis lasted 13 days and had an average participation of 36 of the 72 professors enrolled in the course. The procedure for analyzing the data obtained through the postings was carried out using qualitative methodology. To find common characteristics, the content analysis process was followed, in which the data were identified, named and coded (FRAENKEL; WALLEN, 2008). For coding and categorizing the data obtained, Silva (2010) interactivity indicators were used as a base. For the construction of categories and

analysis of the type of technology and communicative approach used by teachers in their classes, four categories were defined to identify the profile of teaching work. Technological dimension: 1- analog; 2- digital. Communicative approach: 3- expository; 4- dialogical (Figure 1; Table 2). The profile only contemplates the technological dimension and the communicative approach.

After the definitions of the categories, all posts in forums 1 and 2 were systematically analyzed; the categories were quantified, identifying the methods / procedures, the technological resources used and the advantages and disadvantages.

**Figure 1 - Representation of the technological dimension (analog or digital) and of a communicative approach (Expositive and Dialogic) to determine the teaching work profile**




Source: Prepared by the authors.

In the scheme (Figure 1), the two upper quadrants (DA and DD) represent a dialogical communicative approach, therefore, a teaching work profile focused on interactivity. According to Silva (2010), interactivity can occur regardless of the use of digital information and communication technologies, and the teacher can use different resources in order to promote interactive teaching.

> After all, interactivity is not a prerogative of information technology and the internet, but a concept in communication theory. In the "infopoor" classroom, you can invest in a multitude of connections and connections using texts, fragments of TV programs, complete films or fragments, recordings, diaries, songs, chat, presentations, etc. (SILVA, 2010. p. 257).

Within the upper right quadrant (DD), it is possible to observe the digital culture profile. With the interactivity indicators already highlighted, it is possible to verify if the teacher explores the potential of a virtual classroom working in a multidirectional dynamics of information, to ensure the collective construction of knowledge. However, as previously highlighted by Silva (2010), interactivity occurs regardless of the use of digital technologies; thus, the presence of teachers in any of the two upper quadrants represents a work profile based on dialogue and that promotes interactive teaching.

There is also a teaching work profile that is centralized. This central region highlights a highly versatile profile of teachers regarding the use of technologies and communicative approaches during classes (Figure 1). In Chart 2, it is possible to observe the description of the teaching work profiles, considering the technological dimension and the communicative approach.

**Chart 2 - Profiles of teaching work:** technological dimension and communicative approach

| | |
|---|---|
| **Expository and Analog = EA** | Expository classes, with the use of non-digital resources, such as white or black board, printed teaching material and ready-made models. The way of working follows a unidirectional logic of knowledge (teacher → student). |
| **Expository and Digital = ED** | Expository classes, with the use of digital resources, such as a projector, films and animations obtained on the Web (YouTube, streaming). The way of working follows a unidirectional logic of knowledge (teacher → student). |
| **Dialogic and Analog = DA** | Dialogic classes, with the use of non-digital resources, such as whiteboards, physical didactic material, modeling, construction of conceptual maps. The way of working follows a multidirectional logic of knowledge (teacher student) and (student ← → student) |
| **Dialogic and Digital = DD** | Dialogic classes, with the use of digital resources, such as computational modeling, construction of conceptual maps with the help of software, Wiki tools, AVA, social networks, forum, chat. The way of working follows a multidirectional logic of knowledge (teacher← → student) and (student ← → student). |

Source: Prepared by the authors.

# 3. Results And Discussion

**Thematic Forum I**

The reflections and discussions carried out by the student teachers throughout Forum 1 revealed agreement about the use of the History of Science in the teaching of Molecular Biology. The statements revealed that different subjects can emerge or can be worked on by the teacher when using the History of Science. As for concerns about the procedures and resources to be used in the classroom, many posts demonstrate the need to contextualize the content, an interdisciplinary practice and the use of appropriate methodologies and technologies.

The use of the history of science in the educational context is recommended by many authors, including Bizzo (1992) and Matthews (1995). For Matthews (1995), the use of History and Philosophy of Science, in Science and Biology classes, allows the connection of historical events of the production of scientific knowledge of contents in an integrated way and the development of critical-reflective thinking.

In Bizzo's (1992) perspective, curricular and didactic planning can benefit from bringing Science and Biology content closer to the historical process of Science. The author's text was one of the materials made available and used in Forum 1 as a basis for reflection and discussion.

With regard to science teaching, Krasilchik and Trivelato (1995), Marandino, Selles and Ferreira (2009) and Cachapuz, Praia and Jorge (2004) explain the need to understand about "what", "for what" and "How to teach" Sciences, in addition to how these decisions have a direct relationship with issues of utilitarian nature for the individual. Thus, decisions related to the content to be addressed and the methods used are of paramount importance in the context of a continuing education course. Chart 3 represents a synthesis of the main positive and negative aspects, of the reservations or limits identified in the posts of course participants throughout Forum I, regarding the use of the History of Science in the teaching of Molecular Biology.

**Chart 3 - Positive and negative aspects highlighted by course participants for the teaching of Biology through the History of Science**

| Positive aspects | Negative aspects (caveat) |
|---|---|
| - Allows dialogic and interactive classes.<br>- It allows the understanding of science as something unfinished and the result of a constant construction.<br>- Critical Sense Development.<br>- It allows the realization of activities aimed at research, stimulating participation.<br>- Contextualization of the content history.<br>- Allows the understanding of current scientific knowledge.<br>- Construction of knowledge beyond the transmission of content. | - Makes the classes dull and not very dialogical.<br>- Science can be presented as something discontinued.<br>- Theoretical classes with little context.<br>- Need for the use of technological resources, such as videos, documentaries, etc.<br>- Adequacy to the short time available in the room.<br>- Need for diversification of teaching approaches. |

Source: Prepared by the authors.

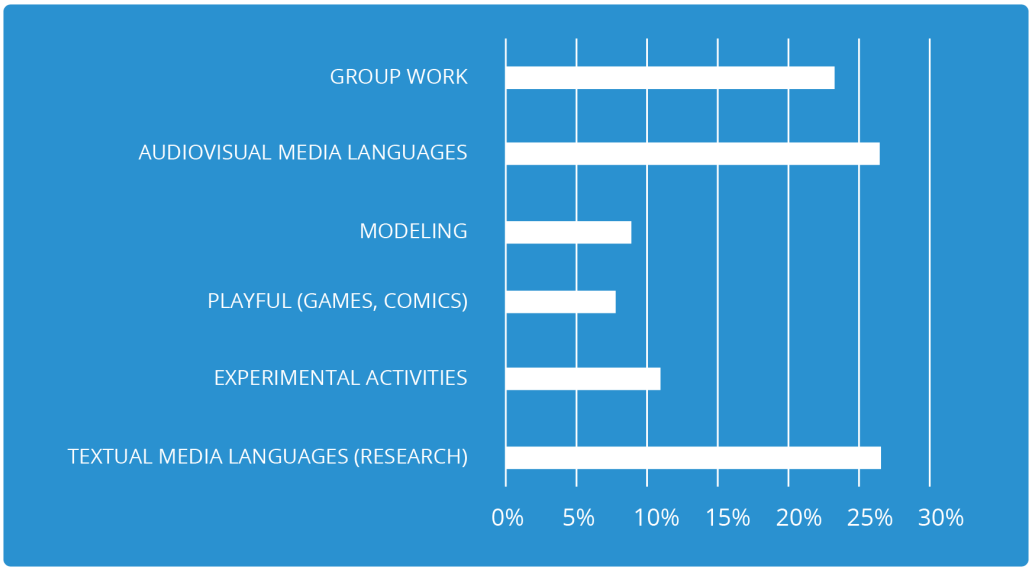
For Bizzo (1992), simplification in itself does not allow a real understanding of how and in which historical-social context knowledge was produced. Thus, "These possible distortions in the development of scientific knowledge can have a severe impact on the context of teaching, especially when educators make use of the reconstructions of theories of the past offered by scientists of the present" (BIZZO, 1992. p. 31). The History and Philosophy of Science contribute to teaching-learning in a historical-social, critical and integrative context, in a reflexive way.

In this context, the didactic transposition, a term originally coined by Chevallard (1991), has as its starting point the idea of organizing the knowledge produced in the academic environment for a knowledge that needs to be taught in the school context. These modifications or reorganizations depend on didactic procedures that involve methodological approaches and the use of resources by teachers and, therefore,

are relevant within the context of a continuing teacher education course. In the discussion forums, these points are the most highlighted by course participants.

As for the approaches and resources used in the teaching practices in the classroom, the teachers pointed out the media language, both through texts and through audiovisual instruments as the most used resources (Figure 2).

**Figure 2 - Approach and resources highlighted by course participants for teaching Biology through the History of Science (Thematic Forum I)**




Source: Prepared by the authors.

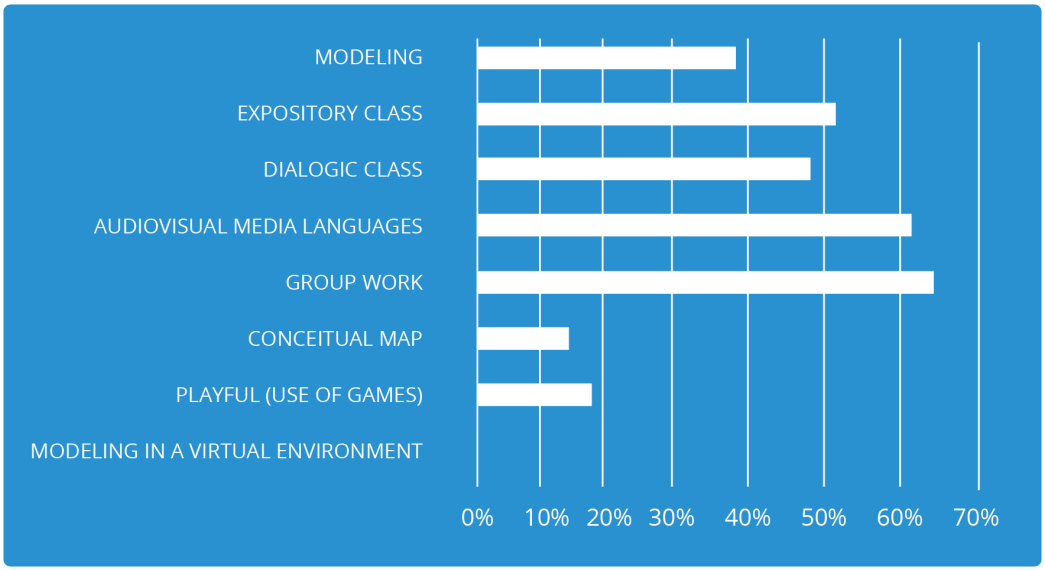
## Thematic Forum II

In Unit 2, The Challenges in Teaching Protein Synthesis, from the Transmission of Life course, we sought to identify teachers' difficulties in teaching content of an abstract nature in Biology, such as the genetic code and protein synthesis. We also tried to identify which approaches, methods and / or resources were used to make the content more meaningful in the teaching-learning process. Interestingly, none of the students mentioned the use of History of Science as a method for teaching protein synthesis.

In addition to the reports on the different ways of working on protein synthesis, there was an emphasis on the need to work on content exploring the visual aspect, either through virtual resources or physical models made with different materials. Many reports reveal creativity in the construction of models and the use of playful resources such as games, although many course participants have declared using videos and animations. There was also a preference for the use of non-digital manipulable resources (modeling), with few students who declared using any manipulable virtual model or games in a virtual environment.

Figure 3 represents the approaches, methods and / or resources mentioned by course participants during their participation in the Thematic Forum II. There is a preference for group work, followed by approaches with resources of audiovisual media languages and expository class. It is possible to notice that there is a great involvement of the students collaborating with ideas, experiences and exchange of experiences.

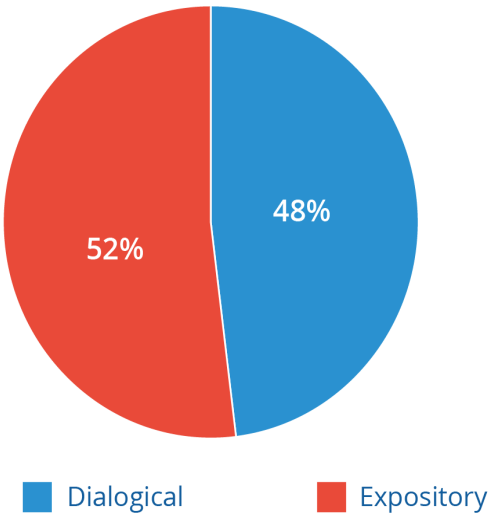
**Figure 3 - Approaches and resources highlighted by course participants with regard to the teaching of protein synthesis (Thematic Forum II)**




Source: Prepared by the authors.

The reports and discussions also reveal concerns and insecurity about the procedures and resources to be used in the classroom. Many students prefer to work on the content in an expository way, initially, while others opt for dialogical work to search for the student's prior knowledge. The number of course participants who declared to use expository classes is relatively high. According to the reports on the forum, course participants prefer to start activities in the classroom (starting point) using expository means to work on the theoretical contents, but they diversify using other approaches. Thus, the "starting point" for many is a moment of explaining the content in a more unidirectional way (teacher → student), later transforming into a more dialogical work of construction and authorship (teacher ← → student) ( Figure 4). This data reveals the difficulty that the teacher has in changing the paradigm of traditional teaching by dialogic, as highlighted by Krasilchik and Trivelato (1995) and Cachapuz, Praia and Jorge (2004).

**Figure 4 - Communicative approach used by course participants at the beginning of their classes when working on protein synthesis (Thematic Forum II)**

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Source: Prepared by the authors.

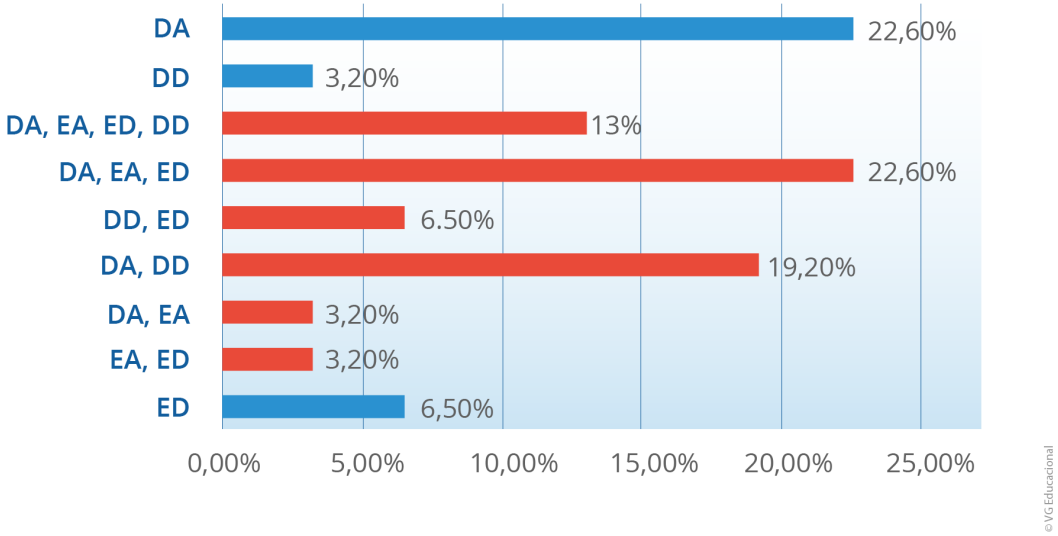
Although teaching science through "History of Science" was widely discussed in forum 1, as a didactic-pedagogical proposal for a contextualized approach, there were no reports or any discussions on the use of the History of Science during the forum 2. Teachers, in Forum 2, did not pursue this approach, and discussions were centered on the diversification of methods/resources and the combined use of technologies. However, it was possible to observe that, although the presence of Analog (non-digital) is evident, there is a great inclination of the students regarding the use of digital technologies in their classes, replacing analog technologies.

It was observed that students also prefer the use of modeling (use of ready-made models or building models collectively). "Group work" is another point that deserves to be highlighted, as it was discussed a lot in the reports and reflections of the course participants. This approach is in line with the course proposal, which encourages dialogue, interaction and collaboration for the collective construction of knowledge. There were no reports of group activities using a VLE through any interface.

As highlighted earlier, in Figure 1 and Chart 1, the course participants' reports allowed the identification of four work profiles, taking into account the technological resources and the communicative approach used. The reports show that course participants diversify their practices, and many occupy different positions in these quadrants.

In Figure 5, it is observed that the course participants have a versatility in the way of working with the contents related to Molecular Biology. The adoption of different approaches and technologies creates intersections between the quadrants (Figure 1), which makes the teacher not only a single teacher work profile. When looking at Figure 5, it can be highlighted that 68% of teachers are in more than one teaching work profile (bars in red) and that 74% make use at some point of some digital resource.

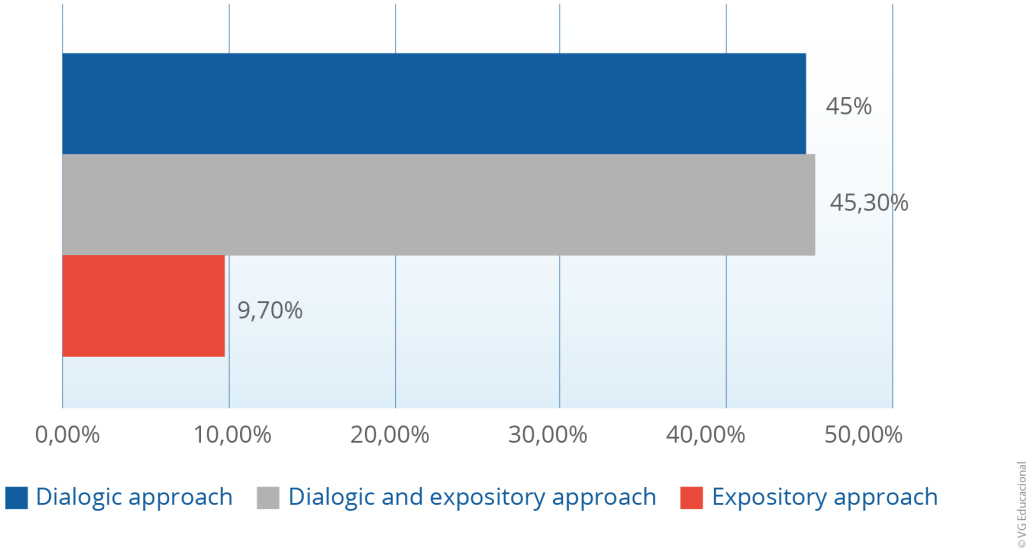
**Figure 5 - Proportion of course participants in the different teaching work profiles:** ED = Expositive and Digital, EA = Expositive and Analog, DA = Dialogic and Analog and DD = Dialogic and Digital




Source: Prepared by the authors.

The analysis of the teaching work profile can provide more detailed information regarding the dynamics used by the teacher during his classes, especially with regard to the communicative approach (Figure 5). Teachers tend to use more expository approaches at the beginning of their classes, but seek to transition from an expository approach to a more dialogical approach (Figure 6).

**Figure 6 - Proportion of teachers in their communicative approaches**

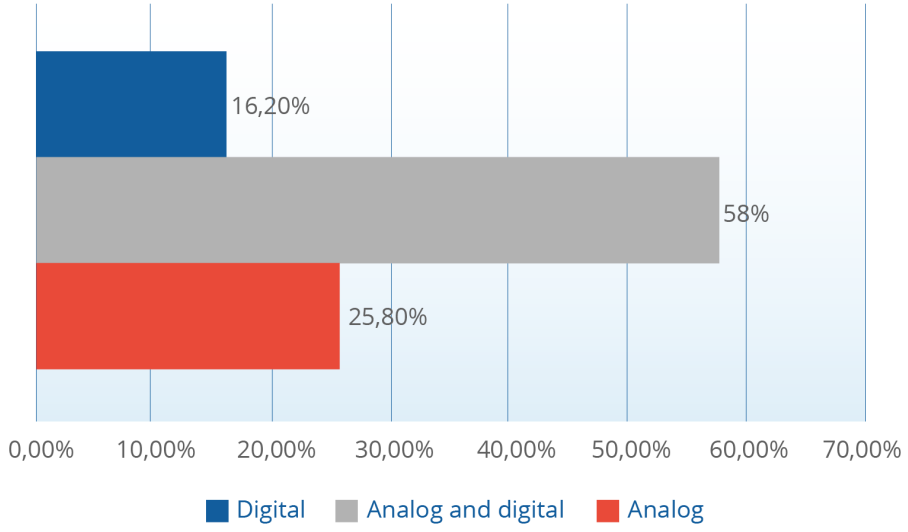



Source: Prepared by the authors.

It is possible to observe that 45.3% of the teachers work with both the dialogical and the expository approach; 45% of teachers start with the dialogical communicative approach; only 9.7% of teachers represent the expository form. As explained by Silva (2010), any form of work, with or without the use of digital technologies, presupposes a form of work with a focus on interactivity. Therefore, teachers who occupy the upper part of Figure 1 are inclined to practice interactive teaching, being represented here by teachers who use a dialogical approach and those who move between the expository and the dialogical (blue and gray bars, respectively, of Figure 6).

Regarding the technological dimension, this versatility between the use of digital and analog technologies is also evident (Figure 7). The percentage of 16.2% of teachers uses exclusively digital resources, 25.8% uses analogue resources and 58% transitions between the use of digital and analog technological resources. This versatility between analogue and digital implies that teachers are looking for alternative forms and varied resources to break with the difficulties of working with content of an abstract nature of Molecular Biology.

**Figure 7 - Proportion of teachers using digital and/or analog technology resources**




Source: Prepared by the authors.

# 4. Final Considerations

The discussions promoted in the two thematic forums represented the center of the processes of exchange and construction of meanings by teachers, which are extremely important in online courses, since they allow for the approximation between the interlocutors. Through reflections and the construction of meanings, materialized in the reports and speeches, resulting from the teachers' conversations, it was possible to analyze the concerns about the procedures and resources to be used in the classroom, for the teaching of Molecular Biology. The use of the History of Science was presented and discussed at Thematic Forum I as an alternative to teaching Science and Biology; he aroused interest, but divided opinions. The discussions carried out indicate that, although the History of Science may allow a historical contextualization for a better understanding of how knowledge is produced, aspects such as approach, methods and technological resources were the elements most used and highlighted by teachers.

At the thematic Forum II, which aimed to discuss the challenges of teaching protein synthesis, discussions were also centered on the approaches, methods and / or technological resources used to make the content more meaningful to the teaching-learning process. The resources pointed out by the teachers in the two forums were divided into digital and analogue (non-digital), in the two forums; reports on different approaches and technological resources indicate the use of both digital and analog resources, but with an inclination to use digital technologies. Audiovisual media languages, group work and play, such as the use of games, were the resources most highlighted by teachers in the two forums. In addition to the resources, the communicative approach, being divided into dialogic or expository, was also very present in the two forums.

According to the reports, course participants prefer to start activities in the classroom using expository means to work on the theoretical contents, since for many it is a moment of explaining the content in a more unidirectional way (teacher → student), transforming themselves, later, in a more dialogical work of construction and authorship (teacher ← → student).

Through the analysis of reports and reflections on approaches, methods and technological resources, it was possible to create four categories of methodological / procedural profile (teacher work profile), contemplating only the technological dimension and the communicative approach used by teachers. It was observed that the analysis of the teaching work profile can provide more detailed information regarding the dynamics used by the teacher during his classes, both with regard to the communicative approach and the technological dimension. Our analysis allowed us to identify that teachers tend to use more expository approaches in the initial moments of their classes, but a large proportion seeks to transition between an expository approach and a more dialogical approach.

Regarding the technological dimension, this versatility between the use of digital and analog technologies is also evident. The adoption of communicative approaches and different technologies allows the teacher to present more than one teaching work profile. The vast majority

of teachers are in more than one teaching work profile and make use, at some point, of a digital resource. This versatility of approaches and methods for teaching Molecular Biology suggests an inclination towards an interactive teaching practice, with or without the use of digital technological resources.

Although the nature of the content to be taught has a high level of abstraction, being considered complex and difficult to understand in the teaching of Science and Biology, the teacher can explore alternative ways of teaching, which can promote the learning of new meanings. In this context, online continuing education courses, such as extension courses offered by the CECIERJ Foundation, are extremely important, as they allow the discussion of new approaches and methods, placing the teacher at the center of the process.

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