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# The Didactic-Pedagogical Model of the Chemistry Teacher: A look at the skills and competencies established in the Common National Base For Teachers' Initial Education

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**ABSTRACT**

Considering the High School Education reform from the perspective of the National Common Curriculum Base (BNCC), we present the developments of a study on the competencies and skills found in Resolution CNE/CP No. 2/2019 that establishes the National Common Base for Initial Teachers' Education for Basic Education (BNC-Education), from the perspective of the Teacher's Didactic-Pedagogical Model (DPM) for the Teaching Degree in Chemistry, emphasizing the understandings made possible from an analytical movement based on Content Analysis. In this sense, the aspects established for teachers' initial education from the DPM perspective were highlighted and by the implementation of the BNC-Education. As a result, concerns were pointed out regarding the neo-technicist view of a restrictive and instrumentalist nature that underpins the analyzed document. Finally, the importance of building training spaces that support the development of didactic-pedagogical models based on the teaching practice complexity was highlighted beyond the pragmatist and reductionist points identified in the document.

**KEYWORDS**: Initial Education. Chemistry graduation. Teachers Model. BNC-Education.

## 1 INTRODUCTION

Our choice to address the Professor's Didactic-Pedagogical Model (DPM) is based on the concerns of professors working on teaching courses and also those resulting from the guidance proposed by the provisions of Resolution CNE/CP nº 2, of 20th December 2019. Such resolution "defines the National Curricular Guidelines for the initial education of basic education teachers and sets the National Common Base for the initial education of basic education teachers (BNC-Education)" (BRASIL, 2019, p. 1).

The said document provides, via normative act, the competencies and skills that must be developed throughout the teachers' initial education. Such a document is an attempt to subsidize the practice of future teachers by means of aligning the norm to the principles of basic education regarding the National Common Curriculum Base (BNCC - *Base Nacional Comum Curricular*). Therefore, the following question arises: What are the competencies, skills and knowledge required during teachers' initial education? Which DPM emerges from the formative profile set in the BNC-Education?

To provide some answers to these questions, we aimed at clarifying what the competencies and skills set as the formative core of the BNC-Education are. In addition, we sought to understand the possible approaches to DPM as pointed out by García-Pérez (2000), in the perspective of initial education in Chemistry teaching.

## 2 THEORETICAL BACKGROUND

### 2.1 The National Common Base for the Initial Education of Basic Education Teachers (BNC-Education)

Chemistry undergraduate courses, both bachelor and teaching degrees, are mainly regulated by Resolution CNE/CES nº 8/2002 (BRASIL, 2002) and Opinion CNE/CES nº 1303/2001 (BRASIL, 2001). These documents set the National Curricular Guidelines for the Chemistry Courses (DCNCQ) and establish the minimum characteristics regarding general structure, curricular content, and students' profile. According to Lima and Leite (2018, p. 155), the DCNCQ set the "[...] profile of students in the Chemistry bachelor and teaching degrees and, therefore, are the first attempt to separate these courses [...]", since they list the competencies and skills to be developed by students in each of the different modalities.

This article focuses on the initial education of Chemistry teachers in undergraduate courses, since this is considered the main academic phase destined to provide chemical conceptual knowledge and to qualify future teachers to work with this subject in basic education. Over the historical trajectory of Brazilian education reforms, different socio-historical and political contexts were experienced in the country, which influenced and determined the way teacher qualification courses have been structured. In several contexts, the education in undergraduate teaching courses was structured based on technical rationality privileging theoretical knowledge and a simplistic view of teaching as transmissive, technical, inflexible and rigorous control of the pedagogical activity (CARVALHO;

GIL-PÉREZ, 2011; MOURÃO; GHEDIN, 2019; FADIGAS, 2019; SILVA; CARNEIRO, 2020).

Although the DCNCQ signaled a relevant change in the conception of chemistry teachers' education in relation to those aiming at a bachelor's degree, Gatti (2010, p. 1357) points out that,

> we entered the 21st century in a condition of educating teachers in different subject areas in which even with the most integrative guidance regarding the "disciplinary education/education for teaching", in practice we still see the prevalence of the model consecrated in the early 20th century in these teaching courses [...].

In the last few decades, some movements at the normative level have promoted a rupture with that model. The main improvements occurred in Chemistry teaching courses include changes aiming at articulating theory and practice throughout the whole education process and the implementation of an identity that proposed the effective separation of bachelor's and teaching degrees (SANTOS; LIMA; GIROTTO JUNIOR, 2020; LIMA; LEITE, 2018).

Such principles were initially emphasized in Resolution CNE/CP nº 2/2002, which instructed full graduation teaching courses, providing higher education to qualify teachers for basic education. Next, the same movement was observed in Resolution CNE/CP nº 2/2015, which instituted the National Curricular Guidelines for Basic Education teachers at a higher level (DCNC-Teaching courses). According to Santos, Lima and Girotto Junior (2020, p. 979) the DCNC-Teaching courses "[...] in general, kept the essence of the previous guidelines, just changing the workload, its distribution, and systematizing other two types of initial education courses for teachers in basic education".

However, despite the advancements announced by the DCNC-Teaching courses, the scenery of political crises and instability occurred from 2015 onwards limited the implementation of this important document. In such context, Resolution CNE/CP nº 2/2019 appeared and defined new National Curricular Guidelines for the initial education of teachers for basic education, by means of the National Common Base for the Initial Education of Teachers (BNC-Education). The new document is presented as an arena of great debates about the ongoing educational trajectory and the intention to point out a "new" education model aligned with the High School Phase reform and the implementation of the National Common Curriculum Base (BNCC) in Basic Education (BRASIL, 2017).

For Giareta, Zilani and Silva (2022, p. 12), the teachers' education policy, ruled by Resolution CNE/CP nº 2/2019 is based on the hegemonic rationality and "[...] emerges as the specific expression of a broader agenda of curricular reform conducted by the State in a disciplined way and obeying hegemonic relationships in the country [...]". As regards the education structure at the national level, the BNC-Education sets ten general competencies and twelve specific competencies equally distributed in dimensions as follows: Professional knowledge, Professional Practice, and Professional Engagement (RODRIGUES; PEREIRA; MOHOR, 2021; BRASIL, 2019).

The curriculum based on competencies, created in the early 1990s for basic education and in the 2000s for higher education, appears in the initial education of teachers by means of focusing on the specific qualification for professional

teaching. According to Rezer (2020, p. 8), the "Pedagogy of Competencies does not deny content or knowledge, but moves it into an adaptive, utilitarian, and application logic [...]".

In Chemistry teaching courses, according to Martins Júnior and Vidal (2021, p. 42), such qualification cannot be limited to the teaching operational activities such as devising tasks and evaluations, but rather broadened and conceived as a "[...] work activity based on specific knowledge, which reinforces a professional identity, with growing social appreciation". For Gollo Júnior and Campos (2021, p. 224) the BNC-Education represents a return "[...] to teacher's education focusing on pragmatism and the development of competencies [...]", thus revealing

> [...] a return to the guidance of neoliberal agencies and the reintroduction of the epistemology of competencies in teachers' education courses and in basic education. The epistemology that, among disputes for different projects, has never been totally abandoned.

Such concerns result in contradictions in the initial education of chemistry teachers, where the expectancy is that the graduates' profile should comprise the desirable characteristics for this professional practice considering both knowledge of chemistry and the ethical, political, and technical dimensions of the teaching job aligned with the sociocultural, economic and contemporary reality.

### 2.2 Teacher's Didactic-Pedagogical Model

Knowing the epistemological bases that support teachers' praxis is a way to cater for initial education that is effectively based on intentional pedagogical interaction. This should enable the future teacher to understand their role in the school universe and regarding scientific knowledge.

Therefore, the understanding of the formative dynamics and how the DPM of future teachers appears is a type of knowledge of teachers' expressions within the teaching-learning process (GARCÍA-PÉREZ, 2000; RIVERO-GARCÍA; PORLÁN-ARIZA, 2000) which, impact significantly the teaching quality and the learning relationships in the school dynamics.

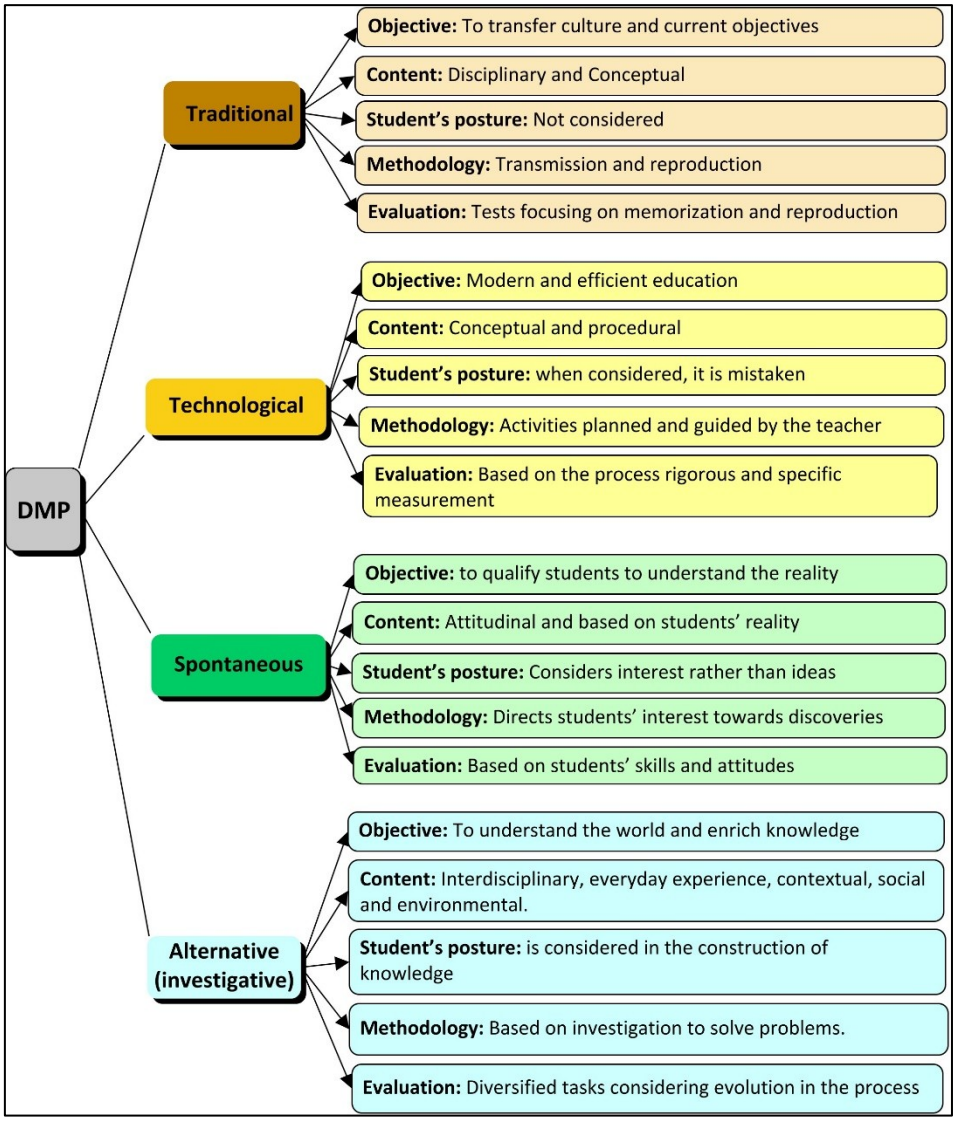
The DPM proposition is an attempt to represent the mediating scheme between the pedagogical practice and the internal conceptions acquired throughout their education and professional exercise (GARCÍA-PÉREZ, 2000). Therefore, we understand that in the DPM constitution, each teacher gathers different types of knowledge and formative practices in different steps of appropriation, which are intertwined in academic and personal experiences and in their professional practice.

García-Pérez (2000) describes DPM considering the traditional and the constructivist trends. As a result, the DPM might be as follows: Traditional, Technological, Spontaneous and Alternative or Investigative. That author uses the characteristics of each DPM as marks of the teaching process in five dimensions, namely, objective, content, students' posture, methodology and evaluation (AYRES-PEREIRA *et al.*, 2019) (Figure 1).

In Chemistry teaching, the **Traditional DPM** is based on a teacher-centered transmission of contents and concepts. The predominance of aN expository methodology is observed with high appreciation of laws and mathematical

formalism, in addition to the evaluation of students' memorization and reproduction of such content (GARCÍA-PÉREZ, 2000; RIVERO-GARCÍA *et al.*, 2017; AYRES-PEREIRA *et al.*, 2019).

Figure 1 – Teacher's Didactic-Pedagogical Model and its characteristics in the teaching




Note: Information organized by the authors.

Source: García-Pérez (2000)

As a way of modernizing this approach, the **Technological DPM** also focuses on the teacher as the knowledge carrier. However, this model includes some opening to students' participation in the education process aiming at the exploration of updated scientific knowledge applicable to their reality (professionalization). The development of the study program is directed and methodic, aiming at the identification of conceptual mistakes in the acquisition of chemical skills and competencies that must be corrected for the scientific confirmation of certain phenomena. The evaluation process is based on the results of competition and ranking, by means of specific instruments and procedures (GARCÍA-PÉREZ, 2000; RIVERO-GARCÍA *et al.*, 2017; AYRES-PEREIRA *et al.*, 2019).

Turning our look towards Chemistry Teaching, teachers' postures and practices are identified depending on content and emphasizing the theoretical-mathematical representation of chemical phenomena and the orthodox view in the curriculum organization. Regarding the **Technological DPM,** it is mainly focused on training and development of chemical skills needed in the development of procedures and processes that require such knowledge (GARCÍA-PÉREZ, 2000).

As regards the models found in the Constructivist trend, its main advancement seems to be the students' perspective as the anchoring point of the education process, in addition to the appreciation of context and the environment where they are inserted in the use of such methodology. The **Spontaneous DPM** considers students' ideas and their immediate reality, while these aspects guide the content explored by means of teaching strategies that employ spontaneous discovery coordinated by the teacher. This DPM might be seen as a kind of transition from the traditional and technicist currents towards more constructivist conceptions (RIVERO-GARCÍA *et al.*, 2017; AYRES-PEREIRA *et al.*, 2019).

The **Alternative (Investigative) DPM** employs the knowledge integration view and its socio-environmental and daily relationships beyond the classroom. The methodology uses investigation and students' continuous evaluation by means of knowledge evolution verification (GARCÍA-PÉREZ, 2000; RIVERO-GARCÍA *et al.*, 2017; AYRES-PEREIRA *et al.*, 2019).

According to Rodrigues Junior *et al*. (2019), conceptions of teaching and learning processes tend to be different before and after a formative process. Initially, undergraduates use their personal experience as students as their starting point and the gradual and progressive restructuring occurs when professional and pedagogical knowledge is appropriated by the individual during their initial education and later in their professional activity. The basis of this process is conceptual, methodological, reflective, and attitudinal.

Therefore, teachers' knowledge and the different types of knowledge are elements that must be catered for in the initial education. Such knowledge must be mastered by the teacher as a subject in their pedagogical practice, which, as a consequence, echoes in the DPM of these professionals in different intensities and priorities, leading to different conceptions of the teaching dimensions and DPM variations.

When considering DPM as a continuous construction, which is mainly supported by formative and personal experiences throughout an individual's education from the basic level to the graduation, discussing the types of DPM presented to undergraduates is necessary. Such discussion, in a contemporary scenery, is emphatically linked to the formative model described in the document BNC-Education.

## 3 METHODOLOGY

The main objective of this research was to seek the understanding allowed by the BNC-Education competencies and skills regarding the DPM Chemistry students in teaching undergraduate courses should be familiarized with throughout their initial education. The research corpus was based on the Resolution CNE/CP nº 2/2019, which instituted BNC-Education (BRASIL, 2019). We analyzed specifically the general competencies in the qualification of teachers for basic education,

specific competencies and skills according to the professional knowledge dimensions, professional practice, and professional engagement found in the BNC-Education appendix, which are all part of the corpus of analysis.

As regards the methodology employed, this research is qualitative in relation to the approach, exploratory in relation to its purpose, and documentary regarding the technical procedure. The data analysis methodology used Content Analysis (BARDIN, 2021). A document pre-analysis was carried out, followed by its thorough exploration, aiming to understand and describe all the information found in the corpus, according to the research aims. We sought to relate the competencies and skills set as formative guidelines in the BNC-education to DPM, and finally, the treatment of results and interpretations.

After reading attentively the competencies and skills, we carried out the deconstruction of excerpts (register units, UnR) which consisted of highlighted utterances such as sentences, paragraphs, or larger parts of the texts, and the structuring of initial categories (Ci). Such categories were set later, based on the emergence of different knowledge dimensions identified in the register units that are required from teachers in their choice of teaching and learning strategies and mediation of content in their education area.

Next, the Ci were grouped into five intermediate categories (Ct) which included the teaching dimensions, according to García-Pérez (2000). The following Ct were listed: Ct1. What is the teaching objective?, Ct2. What has to be taught?, Ct3. What is the relevance of students' ideas and interests?, Ct4. How can I teach? and Ct5. What is the evaluation like? (Figure 1). Finally, the final category (Cf) was proposed including the teacher's DPM that we thought would be able to address the formative conceptions presented by the BNC-Education in the perspective of Chemistry teachers' initial education.

## 4 RESULTS AND DISCUSSION

### 4.1 Pre-analysis and exploration of competencies and skills in BNC-Education

Chart 1 shows examples of UnR and the initial categories (Ci), organized from the fragmentation and deconstruction of the corpus. Ninety-one UnR emerged from the reading and impregnation with the BNC-Education competencies and skills (corpus of analysis). The selection was based on the knowledge to be addressed in the initial education of teachers. Those UnR were grouped into initial Categories (Ci) set later according to the excerpts' connection and proximity (Ci1=16, Ci2=11, Ci3=5, Ci4=6, Ci5=8, Ci6=9, Ci7=11, Ci8=15 and Ci9=9) (Chart 1).

After this first movement of unitarization and fragmentation, the initial categories (Ci) were grouped into five intermediate categories (Ct1=16; Ct2=11; Ct3=11; Ct4=43 and Ct5=9) considering the similarity and articulation of excerpts based on the dimensions that guide the pedagogical practice and purpose (GARCÍA-PÉREZ, 2000) (Chart 2).

Chart 1 – Corpus Unitarization and Categorization

(To be continued)

| Examples of Register Units (UnR) | Initial Categories (Ci) |
|---|---|
| **UnR.Sg01.Cg** "Understanding and using knowledge historically built to be able to teach the reality engaged with students' and their own learning [...] (BRASIL, 2019, p. 13).<br>**UnR.Sg05.Cg** "Valuing and incentivizing diverse artistic and cultural manifestations, both local and global, and students' participation in diversified practices of artistic-cultural production so that the students can broaden their cultural repertoire" (BRASIL, 2019, p. 13).<br>**UnR.Sg13.Cg** "[...]understanding themselves in the human diversity, recognizing their own and others' emotions, with self-criticism and ability to deal with them, thus developing students' self-knowledge and self-care" (BRASIL, 2019, p. 13).<br>**UnR.Sg14.Cg** "[...] respecting and promoting human rights, socio-environmental awareness, responsible consumption at the local level, with ethical positioning in relation to their self-care, care for others and the planet" (BRASIL, 2019, p. 13).<br>**UnR.Sg43.Hb** "Understanding knowledge objects that articulate with students' sociocultural contexts to provide meaningful learning and favor the development of general skills" (BRASIL, 2019, p. 16). | **Ci1**. Specific knowledge in the area, historical-social, cultural and ethical. |
| **UnR.Sg10.Cg** "appreciating permanent education for the professional practice, seeking updating in their area and other related areas, appropriating new knowledge and experiences that result in professional improvement" (BRASIL, 2019, p. 13).<br>**UnR.Sg18.Ce** "Mastering knowledge objects and knowing how to teach them" (BRASIL, 2019, p. 13).<br>**UnR.Sg21.Ce** "Showing knowledge of their students and how they learn" (BRASIL, 2019, p. 14).<br>**UnR.Sg30.Hb** "Showing knowledge about the processes through which individuals learn, thus adopting teaching strategies and resources anchored in education sciences [...]" (BRASIL, 2019, p. 115).<br>**UnR.Sg34.Hb** "Mastering the Content Pedagogical Knowledge (CPC) taking the competencies and skills planned for each year or phase as a reference" (BRASIL, 2019, p. 15).<br>**UnR.Sg50.Hb** "Sequencing curriculum content, learning strategies and activities aiming at stimulating students' ability to learn with proficiency" (BRASIL, 2019, p. 17). | **Ci2**. Pedagogical and Curricular knowledge |
| **UnR.Sg07.Cg** "[...] sharing information, experiences, ideas and feelings in different contexts, thus producing feelings that lead to mutual understanding" (BRASIL, 2019, p. 13).<br>**UnR.Sg02.Cg** "[...] collaborating with the construction of free, fair, democratic and inclusive society" (BRASIL, 2019, p. 13).<br>**UnR.Sg24.Ce** "Recognizing contexts" (BRASIL, 2019, p. 14).<br>**UnR.Sg84.Hb** "Building a learning environment that motivates learners to solve problems, make decisions, learn throughout life, and collaborate with a constantly changing society" (BRASIL, 2019, p. 19).<br>**UnR.Sg32.Hb** "Recognizing current scientific evidence originated in the different knowledge areas, which favor the teaching and learning process, as well as the students' development" (BRASIL, 2019, p. 15). | **Ci3**. Attitudinal, interpersonal and relational knowledge |
| **UnR.Sg20.Ce** "Committing with their own professional development" (BRASIL, 2019, p. 13).<br>**UnR.Sg72.Hb** "Devising a professional plan using different resources, [...] to achieve their own objectives and reaching their own fulfilment as an education professional" (BRASIL, 2019, p. 19). | **Ci4**. Knowledge of practice and professional engagement |

(Continued)

| Examples of Register Units (UnR) | Initial Categories (Ci) |
|---|---|
| **UnR.Sg73.Hb** "Engaging in practices and processes to develop personal, interpersonal, and intrapersonal competencies [...]" (BRASIL, 2019, p. 19).<br>**UnR.Sg74.Hb** "Taking responsibility for their self-development and the improvement of their practice, taking part in formative activities, and developing other activities that are considered relevant [...]" (BRASIL, 2019, p. 19).<br>**UnR.Sg86.Hb** "Working collectively and taking part in Learning Communities [...]" (BRASIL, 2019, p. 19). | |
| **UnR.Sg08.Cg** "Understanding, using and creating digital information and communication technologies in a critical, meaningful, reflective and ethical way in the different teaching practices, as a pedagogical resource [...]" (BRASIL, 2019, p. 13).<br>**UnR.Sg11.Cg** "[...] making choices aligned with the exercise of citizenship and their life project with freedom, autonomy, critical awareness, and responsibility" (BRASIL, 2019, p. 13).<br>**UnR.Sg26.Ce** "Participating in the school Pedagogical Project and in the construction of democratic values" (BRASIL, 2019, p. 14).<br>**UnR.Sg28.Ce** "Engaging professionally with families and the community" (BRASIL, 2019, p. 14).<br>**UnR.Sg41.Hb** "Adopting a proper repertoire of teaching strategies and didactic activities guided by active and student-centered learning" (BRASIL, 2019, p. 15).<br>**UnR.Sg85.Hb** "Contributing to the construction and evaluation of the school pedagogical project, being attentive to the priority that should be given to learning and the students' full development" (BRASIL, 2019, p. 19). | **Ci5**. Knowledge of contemporary demands: Technologies, diversity and engagement with the education principle |
| **UnR.Sg03.Cg** "Researching, investigating, reflecting, carrying out critical analysis, using creativity and seeking technological solutions [...]" (BRASIL, 2019, p. 13).<br>**UnR.Sg53.Hb** "Developing learning curation, using digital Technologies, virtual content, and other technological resources and incorporating them to the teaching practice to optimize and transform students' learning experiences, as well as stimulating an investigative attitude" (BRASIL, 2019, p. 17).<br>**UnR.Sg70.Hb** "Using suitable technologies in the teaching practices" (BRASIL, 2019, p. 18).<br>**UnR.Sg81.Hb** "[...] being able to use technological resources as pedagogical resources to guarantee the inclusion, development of the BNCC competencies and learning of the knowledge objects of all students" (BRASIL, 2019, p. 19).<br>**UnR.Sg87.Hb** "[...] incentivizing the use of technological resources to share professional experiences" (BRASIL, 2019, p. 19). | **Ci6**. Operational knowledge about technological resources and teaching active processes |
| **UnR.Sg04.Cg** "[...]selecting, organizing and planning challenging, coherent and meaningful teaching practices" (BRASIL, 2019, p. 13).<br>**UnR.Sg09.Cg** "[...]communicating, accessing and disseminating information, producing knowledge, solving problems and optimizing learning" (BRASIL, 2019, p. 13).<br>**UnR.Sg19.Ce** "Planning teaching actions that result in effective learning" (BRASIL, 2019, p. 13).<br>**UnR.Sg52.Hb** "Identifying teaching resources (teaching material, tools and other classroom artifacts) and their suitability for the achievement of the education objectives planned, so that they cater for the students' learning needs, pace and identity characteristics" (BRASIL, 2019, p. 17). | **Ci7**. Procedural knowledge to promote learning |
| **UnRE.Sg06.Cg** "Using different types of language – oral, bodily, visual, sound and digital – to express and make students broaden their expression model [...]" (BRASIL, 2019, p. 13).<br>**UnR.Sg16.Cg** "[...] promoting a collaborative environment in learning settings" (BRASIL, 2019, p. 13).<br>**UnR.Sg22.Ce** "Creating and knowing how to manage learning environments" (BRASIL, 2019, p. 14). | **Ci8**. Knowledge about classroom and learning space management |

(Conclusion)

| Examples of Register Units (UnR) | Initial Categories (Ci) |
|---|---|
| **UnR.Sg27.Ce** "Conducting teaching practices of knowledge objects, competencies and skills" (BRASIL, 2019, p. 14).<br>**UnR.Sg39.Hb** "Articulating strategies and knowledge that allow students to develop the necessary competencies, and favor the development of skills at the higher cognitive level" (BRASIL, 2019, p. 15). | |
| **UnR.Sg37.Hb** "Showing knowledge about the different diagnostic, formative and summative ways of assessing students' learning [...]" (BRASIL, 2019, p. 15).<br>**UnR.Sg61.Hb** "Applying different instruments and strategies to evaluate learning [...]" (BRASIL, 2019, p. 17).<br>**UnR.Sg64.Hb** "Using learning monitoring, register and follow-up systems employing technological resources [...]" (BRASIL, 2019, p. 17).<br>**UnR.Sg65Hb** "Knowing, examining and analyzing the results of large-scale evaluations to create strategies to improve education results [...]" (BRASIL, 2019, p. 18).<br>**UnR.Sg71.Hb** "Using proper pedagogical interventions to correct common errors made by students in the knowledge area" (BRASIL, 2019, p. 18). | **Ci9**. Procedural knowledge in the management of learning evaluations |

Key: UnR: Register Unit; Sgx: Corpus segment; Cg: General Competency; Ce: Specific competency; Hb: Skill; Ci: Initial Category.

Source: The Authors (2023).

Finally, after successive recursive movements of revisiting and analyzing the data, we established the relationship between teachers' knowledge that should be addressed in their initial education (Ci), according to the BNC-Education, with the dimensions (Ct) contained in the expected DPM of a Chemistry teacher. The conception set forth in the BNC-Education has its core anchored in the pedagogy of competencies. Such trend follows the motto "learning to learn" and emphasizes education towards the individual's adaptation to economic interests. According to it, education has pragmatic bases which aim to shape individuals with flexible behavior, which allows them to adapt in unequal and competitive societies (SAVIANI, 2010).

Chart 2 – Articulation between Initial Categories (Ci) and Intermediate Categories (Ct) in the DPM composition according to the BNC-Education.

(To be continued)

| Initial Categories (Ci) | Intermediary categories (Ct) |
|---|---|
| **Ci1**. Specific knowledge in the area, historical-social, cultural and ethical knowledge. (n=16) | **Ct1.** What is the teaching objective? (n=16) |
| **Ci7**. Procedural knowledge in the promotion of learning. (n=11) | **Ct2.** What has to be taught? (n=11) |

(Conclusion)

| | |
|---|---|
| **Ci3**. Interpersonal and Relational Knowledge. (n=5) | **Ct3.** What is the relevance of students' ideas and interests? (n=11) |
| **Ci4**. Practical knowledge and professional engagement. (n=6) | |
| **Ci2**. Pedagogical and curricular knowledge. (n=11) | **Ct4.** How can I teach? (n=43) |
| **Ci6**. Operational knowledge about technological resources and teaching active processes. (n=9) | |
| **Ci5**. Knowledge of contemporary demands: technology, diversity and engagement with the education principle. (n=8) | |
| **Ci8**. Knowledge about classroom and learning space management. (n=15) | |
| **Ci9**. Procedural and management knowledge about learning evaluation. (n=9) | **Ct5.** What is the evaluation like? (n=9) |

Key: n= number of register units (UnR); Ci= Initial Category and Ct=Intermediate Category
Source: The Authors (2023)

With the purpose of exposing the nuances of this study, examples of empirical units were presented in articulation to the analysis (Chart 1) of general and specific competencies and skills in the BNC-Education.

### 4.2 The DPM emerging from the BNC-Education analysis

Resuming the deconstructed UnR, rearticulated by the elements involved in the teacher's action, considering the search for the DPM set forth in the BNC-Education, required a recovery of the Teaching dimensions (Ct), which García-Pérez (2000) indicates as DPM markers.

The initial proposition is that, among the four DPM defined by García-Pérez (2000) (Figure 1), movements contrary to the **Traditional** trend were found, as highlighted in UnR.Sg41.Hb, where there is an indication of the need for "adopting a proper repertoire of teaching strategies and didactic activities guided to active and student-centered learning" (BRASIL, 2019, p. 15). The emphasis in this skill excerpt is the central role of students as active individuals in the teaching-learning process. However, in many segments, some features of the **Technological DPM** can still be seen. For example, the UnR.Sg64.Hb register, which indicates the "[...] use of monitoring, register and follow-up systems, employing the technological resources available" (BRASIL, 2019, p. 17).

In addition, the formative concept based on the promotion of competencies and skills is considered one of the requirements with references to the technicist trend, which is challenged by many opposers of the BNC-Education (GUEDES, 2020; GIARETA; ZILIANI; SILVA, 2022; RODRIGUES; PEREIRA; MOHR, 2021). Thus, it is important to consider that the BNC-Education does not elect the pedagogy of competencies in its constitution as something new in the country. Such pedagogy is already found in the education reforms of the past and its main stage was the DCN- Teaching Courses of 2002. Therefore, what the BNC-Education has done is to materialize certain fondness for the teachers' education control subordinated to a (de)formation by competencies and the market logic.



The UnR.Sg84.Hb, which proposes "building a learning environment that motivates students to solve problems, make decisions, learn throughout life, and

collaborate with a constantly changing society" (BRASIL, 2019, p. 19), is marked by the resolution of problems and exemplifies segments, which are close to the proposal of the dimension about "how to teach", from the **Alternative DPM**, for opening possibilities of investigative approaches, or the **Spontaneous DPM**, which is based on learning by discovery

Regarding chemistry teaching, according to the traditional thought, in this curriculum component, a fragmented and decontextualized approach is common, thus provoking meaningless situations for the students. Therefore, the proposition of formative competencies and skills is put forward to provoke a rupture with that thought, which is highly relevant in chemistry teaching courses.

In an attempt to "frame" the empirical units, we considered that the competencies and skills of the BNC-Education emphasize the need for the use of strategies involving practical knowledge in teachers' qualification. This would promote their professional ability to mediate knowledge in a versatile way and at the same time engaged with knowledge dimensions that go beyond content. In such context, teaching is open to new resources and teaching activities that are rich in cognitive repertoires that are meaningful to the students.

As regards the future teachers' qualification to conduct the teaching job in articulation with the National Common Curriculum Base (BNCC) for Basic Education, register unit UnR.Sg27.Ce points out "conducting pedagogical practices of the knowledge objects, competencies and skills" (BRASIL, 2019, p. 14). This excerpt reveals the explicit idea that teachers' initial education must be provided with competencies engaged to the BNCC principles.

Another point considered is that the BNC-Education was proposed with the purpose of securing the BNCC consolidation in Basic Education, by means of a relation of subordination of the teachers' initial education to the implementation of the education model defended by the BNCC. This fact draws attention to the instrumentalist view of teaching structured and strengthened by Resolution CNE/CP nº 2/2019, since some evidence of overvaluation of practice was observed, such as the use of terms like "applying" and other similar term, to the detriment of the theory and practice relationship. Therefore, we reinforce the need for pedagogical work that goes beyond this limited view.

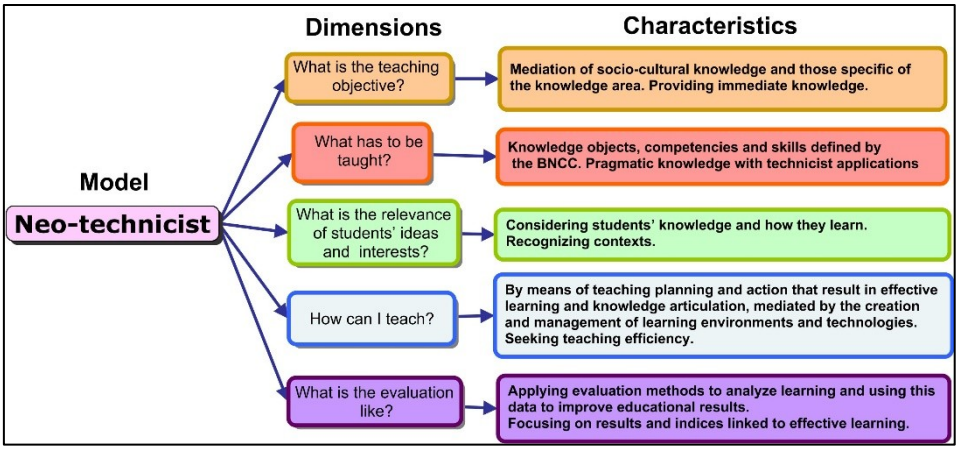
As for the communicative dimension of the education space and its appropriation in the mediation of pedagogical activities, UnR.Sg06.Cg points out that in the initial education, it is important to stimulate "[...] different types of language – oral, bodily, visual, sound and digital – to express oneself and lead students to broaden their expression model [...]" (BRASIL, 2019, p. 13). Regarding the knowledge to mediate chemistry activities, Chassot (1990, p. 30) points out that "Chemistry is also a language. Therefore, teaching chemistry must be a facilitator of readings of the world. Thus, chemistry is taught to allow individuals to better interact with the world". From our point of view, considering that the conduction of chemistry activities with students cannot be restricted to a technicist and applied view of chemistry knowledge, but rather as proposed by Aguiar, Cunha and Lorenzetti (2022, p. 3), who state that

> [...] Chemistry teaching occurs when students relate the theoretical knowledge studies with their life experiences, giving meaning to what was studied, and, in addition, reflecting on what they can do with the knowledge acquired to transform their environment.

To provide an answer to the question that guided this research, we should indicate that regarding the dimensions that typify DPM in the BNC-Education, hybridisms were found pointing to the absence of a single didactic model. This observation stands out when reviewing the set of empirical units grouped within the categories set. As pointed out by Rodrigues Junior *et al.* (2019), hybridity represents low differentiation or mutual acceptance of all characteristics of the four DPM, resulting in complex and undefined models.

For this reason, we proposed that the DPM emerged from the analysis carried out could be called **Neo-technicist**. This proposal aims at highlighting the several formative facets related to the BNC-Education competencies and skills that we believe are found in the DPM summarized in Figure 2. That model shows a movement of distancing from the **Traditional DPM** and hybrid elements from the **Technological**, **Alternative** and **Spontaneous DPMs**. The main characteristic found in several excerpts exemplified in Chart 1 was the pragmatism of knowledge in relation to deeper understandings of scientific nature.

Figure 2 – Neo-technicist DPM proposed by the BNC-Education




Source: The authors (2023).

Regarding the dimension including teaching objectives (Ct1), register unit UnR.Sg43.Hb, linked to the initial category Ci1, highlights that from the initial education, future teachers must "understand knowledge objects that articulate with the students' socio-cultural contexts, to provide them with meaningful learning and favor the development of general competencies" (BRASIL, 2019, p. 16). Considering that, we understand that teaching has objectives that go beyond the restrictive perspective of immediate articulation of knowledge in the students' context and the promotion of skills.

As for chemical knowledge, both documents, BNCC and BNC-Education refer to the reductionism and simplistic view of content to the pragmatic and immediate reality of students, which was proposed in this research as a technological and technicist idealization of teaching objectives. This observation goes against Gasparin's (2005) proposal of suitable mediation of knowledge.

> The teaching process must enable students, through the abstraction process, to understand the essence of contents to be studied, so that specific internal links of these contents can be established with their global reality. This considers the entirety of the social and historical practice. This is also the way through which students move from empirical knowledge to the theoretical-

> scientific one, revealing the essential elements of the content immediate practice and situating it in the whole social context (GASPARIN, 2005, p. 7).

The teaching dimension addressing what should be taught (Ct2), according to the proposed DPM, emphasizes explicitly the content listed in the BNCC knowledge area. Register unit UnR.Sg49.Hb, which integrates to the initial category Ci7, reinforces this observation by including an skill to be acquired in the initial education, namely, the ability to "elaborate a plan for experience fields, areas and curricular components, theme units, and knowledge objects aiming at the development of competencies and skills provided for in the BNCC" (BRASIL, 2019, p. 17).

The analysis of competencies and skills found in the BNCC for Natural Sciences and their Technologies at the high school level, favors chemistry topics related to technological and industrial applications, to the detriment of the understanding of chemical processes and phenomena in a critical-reflective and emancipatory perspective. Such observations highlight the pragmatic and mechanistic dimension, which supports the prerogative of what kind of knowledge should be developed with students in basic education and, therefore, with teachers in their initial education.

The relevance of students' ideas and conceptions appears in the third category (Ct3). It highlights the most constructivist teaching dimension and evidences historical-critical education emerging from the BNC-Education, as observed in register unit UnR.Sg24.Ce, which proposes "recognizing contexts" as a formative competency (BRASIL, 2019, p. 14) and in register unit UnR.Sg17.Cg, which describes that future teachers must [...] act and incentivize, individually and collectively, with autonomy, responsibility, flexibility, and resilience, being open to different opinions and pedagogical conceptions, making decisions based on ethical, democratic, inclusive, sustainable and solidary principles, so that the learning environment can reveal such values [...] (BRASIL, 2019, p. 13).

However, despite certain evolution occurred in relation to the traditional education towards investigative principles, when these BNC-Education excerpts are surveyed regarding competencies and skills related to chemistry teaching in the BNC Natural Sciences and their Technologies, strong appeal of knowledge directed to innovation and technological development is identified, which refers to the technicist view of the world of work.

The fourth category (Ct4) regards the dimension of how to teach and understand formative proposals where pedagogical and curricular knowledge articulate alongside the management of learning and its spaces. In this category, the operationalization of technological resources was explicitly noticed as its main strategy of content mediation.

This became evident in register unit UnR.Sg70.Hb, which describes an ability to be developed by future teachers as follows: "using suitable technologies in teaching practices" (BRASIL, 2019, p. 18). Furthermore, register unit UnR.Sg66.Hb implies that all mobilization of resources and methodologies focuses on "developing consistent practices inherent in the knowledge area, [...], so that learning experiences are active, incorporate current innovations and guarantee the intentional development of the BNCC competencies" (BRASIL, 2019, p. 18).

In that excerpt, when establishing its connection with the BNCC, Siqueira and Morandillo (2022) draw attention to the emptying of the role of curricular components and point out the emergence of pragmatism and superficial knowledge mediation, using as a justification the resolution of problems of students' everyday life and the world of work as the main teaching route. Teaching strategies are aligned to technological resources in the alienating flexible curriculum narrative to cater for economic interests and those of contemporary markets. Regarding chemistry teaching, there is also the formative discourse with investigative ideals, which intends to stimulate innovation and promotion of skills and competencies aiming at proposing new technologies of commercial interest.

As regards the dimension of how to evaluate (Ct5), some excerpts propose broad and progressive conceptions, as highlighted in register unit UnR.S23.Ce, which indicates that undergraduates in teaching courses should "commit to students' learning and practice the principle that everybody is able to learn" (BRASIL, 2019, p. 14).

However, according to the **Neo-technicist DPM** identified in this research, conceptions valuing large-scale evaluation procedures were observed, focusing on education indices linked to learning. Register unit **UnR.Sg65Hb** exemplifies this point of view in teachers' education as "knowing, examining and analyzing the results of large-scale evaluations to create strategies to improve education results in the school and education network where they work" (BRASIL, 2019, p. 18)

Taking Chemistry Teaching undergraduate courses as the focus of this study, from the DPM proposed according to the competencies and skills provided for in the BNC-Education, we understand that future teachers must acquire expertise in skills and competencies to implement the National Common Curriculum Base in the Natural Sciences and their Technologies area, which confirms pragmatism and reductionism as formative principles.

## 5 FINAL CONSIDERATION

Considering the objective of this research, we sought to understand the formative principles set in the BNC-Education competencies and skills, by means of connections, looks and understanding from the analytical movement based on Content Analysis. In general, many of the UR extracted from the research corpus evidenced formative conceptions of dichotomic character from the point of view of teaching dimensions and pedagogical trends. This thorough observation resulted in the proposal of the **Neo-technicist DPM**, in which the characteristics of other models introduced by García-Pérez (2000) are observed. However, this new model shows strong features of a formative model aligned with a technicist type of education, based on the promotion of competencies and skills.

In the new model, positive aspects of a student-centered education articulated to social and specific knowledge were observed. For example, when chemical knowledge is approached in a perspective engaged with contexts and realities. However, the evidence found also confirmed the main critique to the BNC-Education, and as pointed out by Freire (2017, p. 34), "[...] transforming the education experience into mere technical training is to deny what is fundamentally human in the education practice: its formative character". Such formative alert put forward by Freire (2017) is observed in the restrictive and instrumentalist view of

teaching, as previously mentioned, which is strongly marked by the proposition of pragmatic and reductionist competencies and skills.

Finally, we understand that teachers' initial education must be promoted beyond the BNC-Education and according to the identity of the education institutions in their Pedagogical Projects. In such context, teachers' education proposals that consider the mobilization and problematization of formative knowledge and needs are required since they enable undergraduates in education courses to reflect and confront their initial ideas in the re-elaboration of their professional education to face the challenges of the teaching job in the light of what is concealed in the BNCC and the real frailties and needs of the Brazilian education.

# O MODELO DIDÁTICO-PEDAGÓGICO DO PROFESSOR DE QUÍMICA: UM OLHAR SOBRE AS COMPETÊNCIAS E HABILIDADES ESTABELECIDAS NA BASE NACIONAL COMUM PARA A FORMAÇÃO INICIAL DE PROFESSORES DA EDUCAÇÃO BÁSICA

**RESUMO**

Considerando a reforma do Ensino Médio no viés da Base Nacional Comum Curricular (BNCC), apresentam-se os desdobramentos de um estudo acerca das competências e habilidades presentes na Resolução CNE/CP nº 2/2019 que instituem a Base Nacional Comum para a Formação Inicial de Professores da Educação Básica (BNC-Formação), sob o olhar do Modelo Didático-pedagógico do Professor (MDP) para a Licenciatura em Química, enfatizando as compreensões possibilitadas a partir de um movimento analítico fundamentado na Análise de Conteúdo. Nesse sentido, foram evidenciados, quais aspectos são estabelecidos para a formação inicial de professores sob a perspectiva MDP e viabilizado pela implementação da BNC-Formação. Como resultados, apontaram-se preocupações em torno da visão neotecnicista de cunho restritivo e instrumentalista que embasam o documento analisado. Por fim, ressaltou-se a importância da construção de espaços formativos que subsidiem o desenvolvimento de modelos didático-pedagógicos alicerçados na complexidade da prática docente, para além dos pontos pragmatistas e reducionistas identificados no documento.

**PALAVRAS-CHAVE**: Formação inicial. Licenciatura em Química. Modelo de professores. BNC-Formação.

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