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Conceptions of Practice as a Curriculum Component in the Undergraduate Courses in Chemistry of the Federal Institutes of Education, Science and Technology (Brazil)

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This article has as a research theme the Practice as a Curriculum Component (PCC) in the Undergraduate Courses in Chemistry offered in Brazil by the Federal Institutes of Education, Science and Technology. Its objective is to analyze the conceptions of the practice as a curriculum component pointed out in the Course Pedagogical Projects (CPP) of the Undergraduate Courses in Chemistry of the Federal Institutes in Brazil. As the research methodology, the document analysis was used and the CPP of these courses were defined as data source. To answer the questions proposed, this article presents, authors who discuss teacher training, the constitution of this field of research and its curricular models, as well as the regulations that establish PCC. Data analysis is organized into three subtopics that discuss the curricular organization of the courses analyzed; the prioritized knowledge in the disciplines that develop the PCC; and aspects of the field of teacher education that are expressed in CPP.

***Keywords*:** Practice as a curricular component; Undergraduate in Chemistry; Teacher education; Federal Institutes of Education, Science and Technology.

Background

Practice as a Curriculum Component (PCC), defined in the National Curriculum Framework for Teacher Education (Resolution No. 01, 2002), has provided broad discussions about its purpose and has been organized into various curriculum formats. Its diversity of conceptions and practices demonstrates the complexity of the discussion about the practical dimension in teacher education and its role, especially in Undergraduate Courses.

Research on the practice as a curriculum component has shown its potential to redefine ways to organize Undergraduate Courses, as well as difficulties in planning and explaining them in official documents. Given this, different interpretations of the PCC can also be made from the reading and implementation of guidelines for teacher education. The Course Pedagogical Projects (CPP) can present various conceptions about the purpose and way to organize the PCC. Thus, we do not have one single way of conceiving practice as a curricular component, but several. Therefore, different questions are raised in this article: How does the practice as a curricular component fit

into the pedagogical projects of the Undergraduate Courses in Chemistry of the Federal Institutes? Which conceptions of practice as a curricular component stand out in these pedagogical projects? What knowledge is prioritized in the disciplines that develop PCC activities? What principles in the field of teacher education are assumed in the curriculum proposal of PCC activities?

Due to these guiding questions, the objective of this article is to analyze the conceptions of the practice as a curriculum component pointed out in the course pedagogical projects (CPP) of the Undergraduate Course in Chemistry of the Federal Institutes in Brazil. Thus, the document analysis is defined as the research methodology, according to Gil (2008), considering as data source documents that have not received analytical treatment yet: the course pedagogical projects (CPP).

In order to answer the proposed questions, this article presents authors who discuss the field of teacher education, from 1960 to the present, the guidelines that guide the insertion of the PCC in the curriculum of Undergraduate Courses and the teacher's knowledge in the perspective of Shulman (2005). It also presents a topic with the methodology used and the data analysis divided into 3 subtopics that discuss the curricular organization of the pedagogical projects analyzed; the knowledge prioritized in the disciplines that develop the practice as a curriculum component; and aspects of the field of teacher education that are expressed in the CPP.

Conceptions of Practice as a Curriculum Component in Teacher Education

To assist in the analysis of the CPP of the Undergraduate Courses in Chemistry offered at the Federal Institutes and of the PCC, we present authors who discuss the field of teacher education from 1960 to the present. These authors help to understand the changes in the research field of teacher education that introduce in the guidelines the proposal of curricularization of the practice that instituted the PCC. Still, from the current perspectives of the field of teacher education, the teacher's knowledge is presented. Based on the current issues in this field, it is essential to expose the standards that guide the insertion of the PCC in the Undergraduate Courses curricula.

The field of Teacher Education

The field is a structured social space whose properties depend on the position of the agents inserted in it. In this sense, it is considered that teacher education, as a field of research, with its own object, constitutes a field in the Bourdeusian perspective. To elucidate the construction of this field and its current tendencies, we present the ideas of the following authors: Cunha (2013), Diniz-Pereira (2013), Estevão (2001), Saviani (2009), Contreras (2012) and Marcelo (1998; 1999).

Teacher education as a field of study was constituted over time with the delimitation of its research object and its ways of investigating it. For Marcelo (1999, p. 26), teacher education is an area of knowledge and research that "[...] focuses on

the study of the processes from which teachers learn and develop their professional competence"[1]. These ways of investigating change as social relations demand new ways of understanding the pedagogical practice and the teacher's preparation for their performance. Estevão (2001) complements this analysis and defines this education as a social practice that acts as an institution having social functions of regulation and legitimation of social values, sometimes contradictory. Thus, teacher education can be understood from its historical and social trajectory. Therefore, from the concept of field by Bourdieu (1989) and different authors who study teacher education, the objective is to present the historical and social panorama of the area, especially in Brazil, from 1960 to the present day.

Diniz-Pereira (2013), based on Bourdieu, understands that a field is constituted from relations of conflict and/or alliance of social agents who fight for the possession of capital forms or material and symbolic goods valued in this field. The author, when analyzing the field of teacher education, shows the fights between different agents and their conceptions from 1970 to 2013, starting from studies by several authors in the area. Thus, Diniz-Pereira (2013) delimits the birth of the field of teacher education in 1973 with the publication of the *Handbook of Research on Teaching* organized by Robert Peck and James Tucker. This publication made it possible for teacher education to acquire the status of line of research. The author points out that research on the subject was already being done, but until then they were linked to other topics within education. Therefore, the publication of this book, gathering research on teacher education, marks its emergence as a field of research.

In the 1960s and 1970s, this field of research in teacher education favored the analysis of the technical dimension of teaching. Consequently, teacher education in that period was committed to these ideals and understands the teacher as:

> [...] an organizer of the components of the teaching-learning process (objectives, content selection, teaching strategies, assessment, etc.) that should be rigorously designed to ensure highly effective and efficient instructional outcomes. Consequently, the major concern regarding teacher education was technical instrumentation (Diniz-Pereira, 2013, p. 146–147).

During this period, research on teacher education published in Brazil was mostly from North America, behavioral in nature, placing teacher effectiveness at the center of analysis (Cunha, 2013). It was understood that "[...] teacher competence was assessed by the product, and [...] this was the result of the objective conditions of teaching" (Cunha, 2013, p. 5). Thus, "[...] anyone who could stimulate the development of an aptitude for as many students as possible would also be able to make them progress in any other situation [...] and/or [...] with any category of students" (Cunha, 2013, p. 5).

From the 1980s onwards, a movement began to question the technicist view of teacher education. In 1982, the First Seminar "Didactics in Question" was held in Rio de Janeiro, where researchers in the area of didactics discussed the critical points

1 All quotations in this paper were translated by its authors.

of teacher education, with a special concern for Undergraduate Courses, and were committed to building a multidimensional didactics, which articulates the technical, humane and political dimensions. This movement is the genesis of a great discussion and production about teacher education that sought to rescue the political character of pedagogical processes with the objective of overcoming the authoritarianism of the period of military dictatorship experienced by the country. During this period, the studies focused on the structural and political aspects of the career and performance of teachers. It enabled a change on the objects of research of the area and just as in the "[...] school floor, movements claiming greater autonomy of the institutional collectives and leading innovative experiences were promoted, which intended to break with the traditional practices of teaching and learning" (Cunha, 2013, p. 7).

Cunha (2013) points out that new perspectives were given to teacher education and the teacher was no longer understood as a technician, but as a professional "[...] within the structure of power of the society, in which identity is conceived as a social and cultural construction" (Cunha, 2013, p. 6). In this period, there is a conversion of studies to understand the objective conditions of teaching and of studies in which teachers and students were displaced from a context, thus it was possible to understand this context and its relations with the teaching process.

In this scenario, it is noteworthy that the teacher education model established in Brazil in 1930, called technical rationality, is established from Decree No. 1.190 of 1939, which outlined the structure of Undergraduate Courses. Therefore, from this guideline, a process started whereby the teacher education courses became segmented between the specific knowledge and the pedagogical knowledge, because, firstly, the undergraduate studied disciplines of their specific area of education and, at the end of the course, attended pedagogical disciplines and teaching practices. Research conducted in the field of teacher education until recently indicates that undergraduate degrees in Brazil were organized in this model known as 3+1, i.e. three years of specific disciplines and one year of pedagogical disciplines. Such duality is evidenced by numerous authors, among them Saviani (2009) and Marcelo (1999). This model comes to be questioned due to the discussions in the 1980s.

The teacher education model proposed by the '3+1 plan' is based on an academic perspective that can also be called 'bachelorization'. In this model, as postulated by Marcelo (1999), the teacher is an expert in a specific area. These curricula value a strong scientific training and a scarce and incomplete pedagogical training (Marcelo, 1999). Contreras (2012) complements the analysis of this model, considering that, in this perspective, the practice becomes only the application of theoretical and technical content.

After this period of intense social and political changes in the 1980s, in the 1990s the direction of the discussions on teacher education changed. From the macrosocial aspects, it begins a process of microsocial studies. Diniz-Pereira (2013) points out that during this period, studies on school daily life increased, and teaching knowledge and

school knowledge became a constant object of research in the country. This movement of microsocial studies and the use of qualitative research methodologies advances through the 2000s, intensifying criticism of prescriptive teacher education programs, and research start focusing on the following question: How do we become educators? (Diniz-Pereira, 2013).

For Marcelo (1998), the field of teacher education has grown quantitatively and qualitatively, and the research concerns have shifted from the perspective of efficiency to issues involving teachers' knowledge, that is, how one learns to teach. Cunha (2013) reinforces this idea, since she understands that from 1990 to 2000 the field of teacher education was permeated by policies centered on the epistemology of practice. For the author, in this perspective, the teacher is a

> [...] reflective subject that takes practice as the starting point of training and its professionality, contextually resignifying the theory. They assume self-training as a principle and reflection as a possibility for development. They consider the institutional and social contexts where they act (Cunha, 2013, p. 12).

The epistemology of practice, still present and intense in the field of teacher education, allowed this field to assume, since the 2000s, cultural narratives and professional development as central concepts in research. According to Cunha (2013, p. 12), in this perspective the teacher "[...] acts based on structural knowledge coming from different sources and contexts. They build their knowledge from the multiple influences of training, in comparison with the cultural and institutional context where they act".

It can be seen that changes in the field of teacher education indicate that there is an epistemological change in the organization of Undergraduate courses and teacher education, as it converges from the model of technical rationality, or 3+1, to a model of professionalization.

Thus, the curriculum for initial education needs to go beyond the scientific knowledge of the specific area, but promoting the appropriation of a "[...] set of behaviors, knowledge, skills, attitudes and values that constitute the specificity of being a teacher" (Nóvoa, 1991, p. 65).

The lines of research that use the perspective of the teacher's knowledge and expertise constitute an approach that has been gaining more space in research in education, and especially in teacher education, since 1980. In this article, as theoretical foundation, we chose to bring authors who discuss and use the term knowledge about teaching practice and their professional knowledge in their studies. This option puts the knowledge produced in the teacher's pedagogical practice on the same level as the knowledge produced in the academy, according to Fernandez (2015):

> [...] knowledge is distinct from expertise and it is the reason why Shulman names his program of research "teachers' knowledge", because what is sought is the valorization of teachers' professional activity, elevating it to a space of transformation and building of knowledge specific to the profession. Thus, knowledge is the specialization of expertise, that is, knowledge goes through the reflection of knowing how to do, raising

> the practice to a level of awareness, reflection, analysis, systematization and intention. When Shulman uses the expression Pedagogical Content Knowledge (PCK) instead of expertise, he is really equating the status of what the teacher produces in practice (PCK) with the knowledge that is produced in the academy that influences and is influenced by the PCK. Such knowledge belongs to the knowledge base-subject knowledge, pedagogical knowledge and contextual knowledge, all of which are informed to the teacher by the academy (Fernandez, 2015, p. 504).

Shulman (2005), in the 1980s, during reforms in teacher education policies in the United States, positions himself in a movement that researches the practice of teachers in counterpoint to the research of that time. In this context, the author researches what is called teachers' knowledge. By observing and analyzing the pedagogical practice of experienced teachers, the author finds various knowledge and its sources. In this context, Shulman (2005) identifies seven different teacher's knowledge. The first one called "Content Knowledge" is the specific knowledge about the subject that the teacher teaches. The second is "General Didactical Knowledge" or "Pedagogical Knowledge", which is the principles and strategies of teaching organization that can be translated into didactics and teaching methodologies. The third is "Curriculum Knowledge", which is characterized by mastery of teaching materials and programs. The fourth is the "Student Knowledge", which involves the learning characteristics of the students. The fifth is the "Knowledge of Educational Contexts", which covers the functioning of the school, school management and the cultural characteristics of the community. The sixth is the "Knowledge of the Fundamentals of Education", which is the understanding of educational goals and values and their historical and philosophical foundations. Finally, the "Pedagogical Content Knowledge", which can be considered the professional knowledge of teachers. According to Shulman (2005, p. 11), this knowledge is defined as "[...] this special amalgam between subject and pedagogy that constitutes an exclusive sphere of teachers, its own special form of professional understanding".

This knowledge is constituted from four sources: the academic training of the discipline that will be taught; the institutionalized educational materials and contexts; social phenomena and research on education and human development; and the knowledge acquired in practice. Consequently, the teacher's knowledge is built on the pedagogical practice. Therefore, practical experience relates to theory in order to create new knowledge that makes teaching an act of understanding, reasoning, reflection and transformation. According to Shulman,

> As we have come to conceive of teaching, it begins with an act of reflection, continues with a process of reasoning, culminates in the action of teaching, eliciting, participating, seducing, and being the object of greater reflection until the process can restart. In the analysis of teaching that follows, we will emphasize teaching as an act of understanding and reasoning, of transformation and reflection (Shulman, 2005, p. 17).

The curricular model of practical rationality, exemplified above by Shulman (2005), is called reflective by Contreras (2012), since it articulates action, that is, practice

with reflection on it. The author considers that, although the reflection in action requires the articulation of teaching with the context in which the teacher is inserted, it also has as limitation a narrow reflection to this micro context, not allowing the teacher to reflect on the broad social and political issues that interfere with teaching. Among these social issues, we can point out the teaching career and social inequalities.

Contreras (2012) proposes a model of teacher education that goes beyond reflection on practice. This model entitled critical intellectual comprises the training of the teacher for social transformation from the knowledge of the social and political conditions that, to be overcome, require collective struggle.

In the discussion on teacher education, Contreras (2012) presents the concept of teacher's professional autonomy in three distinct models entitled: 1) Technical Specialist; 2) Reflective Professional; 3) Critical Intellectual. For this author, these models of teacher education permeate the professional autonomy understood from distinct political views that are associated with the processes of social and economic changes. In addition, for Contreras (2012), three elements are transversal to the teaching professionalism and change over time due to social, economic and cultural issues, and consequently influence the teacher's degree of professional autonomy: 1) The moral obligation; 2) Commitment to the community; 3) Professional competence.

According to Contreras (2012), the nature of education and teaching presupposes a moral contract that is above any employment contract. Teaching requires a moral commitment to students' development, as it consists of a direct and continuous relationship that aims to exercise influence. Thus, the pedagogical relationship is based on the teacher's moral commitment to students' learning, while establishing with the community an ethical relationship for exchange and dialogue, since education as a public responsibility requires the community to participate in decisions about teaching, which makes the teaching practice a social commitment to this community.

Contreras (2012) understands that the moral obligation and the relationship with the community is effected through the teacher's professional competence. For the author, teaching requires mastery of the teaching methodologies, knowledge of the cultural and conceptual aspects that constitute the object of teaching and the complex competences that interweave skills, principles and awareness of the meaning and consequences of pedagogical practices.

In the three models proposed by Contreras (2012) to analyze teacher education, professional autonomy is seen in different ways. Therefore, the commitment to the community, the moral obligation and the proposed professional competence are also based on different principles.

In the technical expert model, professional autonomy is built from the status of authority that the specific knowledge of each area of knowledge provides for teachers. Contreras (2012) considers illusory this form of professional autonomy, as it is based on technical guidelines on which the teacher is dependent, and may also hinder the development of capacities to respond to the uncertainties and dilemmas of society that

are present in the formative spaces. In this model, the technique is valued and teaching is seen as application. Therefore, at the end of a teaching process one gets a product. Thus, in teacher education this model considers pedagogical knowledge and different teaching methodologies as more or less efficient means of teaching. Contreras (2012) warns that this training model does not provide professional autonomy for teachers to have the ability to make better decisions in the face of teaching situations.

The reflective professional model shifts teacher training from technical to practical aspects. Therefore, there is also a transfer of the educational process from teacher to student. Thus, professional autonomy, according to Contreras (2012), materializes in the teacher's individual capacity to solve problem situations that make educational practice impossible or interfere with student learning. This model highlights the concern with pedagogical practice and its continuous improvement through reflection on and in the action. Therefore, in this model the limitation that arises is not the difficulty of dealing with the uncertainties and complexities of the school space, but the reflection focused only on the improvement of the pedagogical practice disregarding the social and economic context that interferes in the school life and, consequently, in the classroom. It can still be understood that in this model the teacher is the only responsible for the educational process. Thus, the teaching profession is constituted individually and self-sufficiently.

According to Contreras (2012), the teacher's model as a critical intellectual has the purpose of training an autonomous professional. In this model, the emancipation of teachers is expected. Thus, the moral obligation is built on a teaching practice directed to individual and social emancipation. In turn, the commitment to the community is in the defense of values such as justice and equality and participation in social movements for democratization. Professional competence, on the other hand, is based on the reflection on social conditions, on the critical analysis of social reality and on the participation in transformative political actions. Therefore, professional autonomy is collective and is directed to the transformation of institutional and social teaching conditions.

In this sense, in order to constitute the critical intellectual teacher as the model of teacher education, it is necessary to build professional autonomy from emancipation and not from self-sufficiency, as discussed by Valério:

> The keys to teacher autonomy lie in personal (moral and ethical commitment) and social (relationship and guiding values) aspects. It is a human issue, not a technical one; an educational element rather than work related; a circumstantial quality of processes and situations, rather than an individual or psychological characteristic. There is autonomy in teaching when teachers are aware of their insufficiency and partiality; when they are supportive and sensitive to the other actors in the process, especially the students. This autonomy, of which Contreras speaks, moves away from self-sufficiency to approach emancipation (Valério, 2017, p. 331).

It can be seen that the construction of the critical intellectual model of teacher education resides in the criticism of reflection as something immediate and reductionist,

that is, focused only on the improvement of the practice, because teaching is a:

> [...] collective social and also institutionalized practice (externally affected and/or conditioned), the criticality of the reflection should aim not only at creating new ideas for teaching, but a plunge into the professional itself and in the context of the educational phenomenon. Since education and teaching are public occupations commissioned by the social collective, teacher autonomy should consider the community as a reference and as co-responsible for the conditions in which they occur. Teachers should be aware that technical strategies (methodologies) cannot be analyzed by merit alone (being effective or not), but by what they represent as educational pretensions and reasons (Valério, 2017, p. 331).

Although we understand the contributions of practical rationality to teacher education, especially by valuing the practical dimension of knowledge, it is necessary to consider the absence of the social and political aspects essential to critical education. This consideration becomes more urgent when we consider the guidelines for teacher education in Brazil, as they are influenced by the models of practical rationality for teacher education. Thus, it can be understood from practical rationality that Practice as a Curriculum Component can assume the role of professionalization of the teacher since the beginning of the Undergraduate Course, because it can bring the Undergraduate student closer to the context of the teaching profession. Moreover, this practice can, in its curricular organization, articulate different knowledge that make up the Undergraduate curricula. Therefore, the PCC as knowledge has the potential to promote the theory and practice relationship throughout the initial education process of the Undergraduate student. However, in a country marked by social inequality, it is essential that the PCC consider in its articulations the social and political dimensions of education, encouraging undergraduates to develop critical thinking about the reality, which enables them to develop a transformative pedagogical practice. In this sense, it is considered that the opinions that discuss the PCC and Resolution No. 2 of 2015, despite presenting important advances in the field of teacher education and in the curricular organization of Undergraduate Courses, do not encourage or promote a critical education of Undergraduate students who will act in a complex social and educational reality.

Practice as a Curriculum Component in the Legislation

Inserted in the social and economic processes that enabled the emergence of practical rationality and, consequently, in the reflective professional model, PCC emerged in the legislation for teacher education in 2002 when it came into force the Resolutions of the National Education Council, 01 and 02 of 2002, which define the national guidelines for teacher education for Basic Education and the workload of Undergraduate Courses. These 2002 guidelines were recently updated by Resolution No. 2 of 2015, which seeks greater organicity for teacher education for Basic Education, uniting in a single document initial and continuing teacher education (Dourado, 2015).

These guidelines take as their objective the consolidation of a new model of

teacher education based on the model of practical rationality, whose main characteristic is the articulation of specific and pedagogical knowledge for the construction of teaching professionalism. Therefore, Undergraduate Courses should not be confused with a Bachelor's Course, but should have an identity of their own. In this scenario, PCC is encouraged as a way of ensuring that the articulation between theory and practice occurs throughout the Undergraduate education. The appreciation of the practice appears in the guidelines as a way to develop competences and skills of undergraduates to work in the Basic Education. Thus, the possible articulations by the guidelines' orientations are based on the reflective teacher model proposed by Contreras (2012), so it may present limitations disregarding, in the reflection, the social and economic context that interferes in the daily school life. This reductionist view can be found in Report No. 28 of 2001 that considers PCC as experiences of knowledge application, that is, employing knowledge.

According to Report No. 28 of 2001, which discusses the workload of Undergraduate Courses, Practice as a Curriculum Component is defined as:

> [...] the set of training activities that provide experiences of applying knowledge or developing procedures proper to the teaching exercise. Through these activities, the knowledge, skills and abilities acquired in the various training activities that make up the course curriculum are employed in teaching. Activities characterized as Practice as a Curriculum Component may be developed as a core or as part of disciplines or other training activities. This includes the practical disciplines related to pedagogical training, but not those related to the technical-scientific foundations corresponding to a certain area of knowledge (Report No. 28, 2001).

According to Report No. 28 of 2001, it is clear that the guidelines understand that the PCC must be present in the education of the Undergraduate student throughout the Undergraduate Course. This interpretation is reaffirmed by Mohr and Pereira (2017), who, when analyzing the legal documents that regulate the PCC, conclude that it needs to be organized throughout the course through activities that do not necessarily include being in school, but that promote reflections on the pedagogical practice. Therefore, the authors argue that the guidelines for teacher education understand the PCC as a preparation for teaching practice throughout the initial education process, breaking with the idea that the internship is reserved for practice, while the classroom is the space for theory. In this sense, it is reinforced that the PCC has potentialities for articulations between knowledge and between theory and practice that are fundamental for teacher education.

From this interpretation of the PCC, presented by Mohr and Pereira (2017), it should not be confused with the mandatory internship, as the latter requires the development of practice in the school space. This distinction between PCC and mandatory internship is discussed in Report No. 28 of 2001 that defines the supervised curricular internship as a form of in-service training activity and that can only occur in school units, where the intern assumes the role of teacher, being the moment of effectiveness of the teaching-learning process developed throughout the training in Undergraduate

Courses (Report No. 28, 2001).

Real (2012), when analyzing the guidelines that define the PCC, argues that, as a curricular component, it has its own space in the curriculum, which differs from the supervised internship and establishes an integration axis between the theoretical dimension and the teaching activity. Thus, PCC does not need to occur at school, but can be contextualized in the school reality including the use of technologies.

The understanding of the PCC and its distinctions from the curricular internship, or even its distinction from the experimental practices required by specific areas, such as Chemistry, present themselves as challenges facing the construction of the CPPs. At the same time, it is argued that the PCC, as a curricularization of practice, can constitute an initial education space for teachers, breaking with the model of technical rationality by articulating theory and practice and becoming a space for the development of teacher's knowledge articulating the specific and pedagogical knowledge with/for/in the pedagogical practice. Consequently, it is emphasized that the reports that discuss the PCC and Resolution No. 2 of 2015 present important advances in the field of teacher education and for the curricular organization of Undergraduate Courses even if they are marked by conceptions of practical rationality.

Methodology

Qualitative research in education, according to Minayo (2015), proposes to answer particular questions of the social world, developing its investigations from the meanings, reasons, values, aspirations and beliefs of the human being. Characteristics of this form of research are the environment or social reality as a direct source of data, concern with the description of meanings, concern with the process rather than the product, and the use of inductive reasoning in the form of analysis (Triviños, 1987). This means that qualitative research articulates theory and empirical data starting from social reality and considering practice as an expression of theory. Given these fundamentals, the choice of methodological procedures is based on the nature of the research object and its objective, because the reality cutouts in qualitative research can be diverse and their foundations allow the appropriation of different methods (Flick, 2009). Therefore, qualitative research is considered a craft work that builds a language and a rhythm (Minayo, 2015).

Given the objective proposed by this article, the nature of its object and the foundations of qualitative research presented, this research is characterized as documentary, because, according to Gil (2008), its data source are documents produced by different institutions that have not received analytical treatment yet: the course pedagogical projects (CPP).

From this perspective, a document is considered any object, written or not, that may contribute to the investigation of a phenomenon (Gil, 2008). In this study, the analyzed documents are written and considered primary source, as they were not created in the context of the research, but in a specific social context that was examined

from the context information provided by the document.

The first step of this research was the survey of the Undergraduate Courses in Chemistry offered by the Federal Institutes of Education, Science and Technology (IFEs) in all regions of Brazil by consulting the E-Mec portal. This portal powered by the Ministry of Education (MEC) provides data from higher education courses throughout the country. It was found 82 Undergraduate Courses in Chemistry offered by IFEs in the country, distributed in different regions and states. Then, it began the search on the Internet for CPPs in the portals of each institution. 24 CPPs were not found, thus email contact was made with these institutes trying to gain access to these projects not found on the websites of these institutions and documents from 7 other institutes were obtained. Therefore, the analysis was carried out with 65 course pedagogical projects, which corresponds to 79.27% of the Undergraduate Courses in Chemistry offered in the country's IFEs, according to data in Table 1.

Table 1. Number of Undergraduate Courses in Chemistry and Course Pedagogical Projects found and analyzed

Region	CPP Found		CPP Not Localizados		Total of courses	
	No.	%	No.	%	No.	%
Midwest	11	13.41	3	3.66	14	17.07
Northeast	25	30.49	9	10.98	34	41.46
North	4	4.88	1	1.22	5	6.10
Southeast	12	14.63	2	2.44	14	17.07
South	13	15.86	2	2.44	15	18.29
Total	**65**	**79.27**	**17**	**20.73**	**82**	**100.00%**

The analysis of the Course Pedagogical Projects (CPP) was performed in three stages. Firstly, all CPPs were read in order to find in the text, in the curriculum and in the programs the conceptions and forms of organization of the Practice as a Curriculum Component. Thus, two tables were organized. The first contains the disciplines in which the PCC is present and its respective program. The second with the textual quotes about the PCC from each of the CPPs. Then, these data were read to seek the conceptions expressed in the guiding principles defined for the PCC in the CPP, as well as the knowledge prioritized in the programs. Finally, we organized the text of analysis that presents the conceptions with the highest incidence in the CPP and the articulations of different knowledge in the curricular organization.

To present the textual elements of each course pedagogical project, a system of acronyms was elaborated to guarantee the anonymity of the institution. Thus, the 65 CPPs are named according to the region of the country, according to the following examples: IF–North-1; IF–South-29 and IF–Southeast-45. In this kind of nomenclature, we opted for a continuous numbering from 1 to 65, keeping the acronym IF followed by the region offering the course.

Conceptions of Practice as a Curriculum Component in the Course Pedagogical Projects

The conceptions of PCC in the Undergraduate Courses in Chemistry are presented in three topics in the following subsections.

Curricular Organization of the Practice as a Curriculum Component

Resolution No. 02 of 2015 advanced in relation to Resolutions No. 01 and 02 of 2002 by increasing the total workload of Undergraduate Courses and the minimum time of completion of the course by undergraduates to 4 years or 8 semesters, so it is pertinent to present the differences between these resolutions and how these distinctions fit into the analyzed CPPs.

The workload of the Undergraduate Courses defined in Resolution No. 2 of 2015 is divided into 400 hours of PCC; 400 hours of supervised internship; 200 hours of complementary activities, with theoretical and practical bias; 2200 hours of general training that covers the specific and interdisciplinary areas, and the educational field, its fundamentals and methodologies, and the various educational realities and the core of deepening and diversifying studies of the professional practice areas that includes specific and pedagogical contents. Thus, based on this resolution, the total minimum workload for Undergraduate Courses is 3200 hours. In turn, the previous guidelines, Resolution No. 2 of 2002, defined 1800 hours of scientific and cultural content plus 400 hours of PCC, 400 hours of supervised internship, 200 hours of complementary activities totaling 2800 hours.

Considering that the analyzed CPPs have a timeframe from 2005 to 2018, these differences in the workload were perceived in the analysis of the pedagogical projects of the course, as it was found that the total workload of the Undergraduate Courses in Chemistry varies between 2800 and 4000 hours. Such variation is justified due to the year in which the CPPs were approved, since until the publication of Resolution No. 02 of 2015, it was required by the legislation the minimum of 2800 hours of total workload in the Undergraduate Courses and from 2015, this requirement changed to 3200 hours. It is noteworthy that Resolution No. 03 of 2018 changed Article 22 of Resolution No. 2 of 2015, allowing Undergraduate Courses to adapt the new guidelines within 4 years. Therefore, despite the differences in workloads, the courses analyzed were within the legal deadline for making the changes.

Given this consideration, it appears that all CPP approved from 2015 have total workload from 3200 hours, and even in the previous period there are several CPPs that have workload from 3200 hours. From the total of 65 CPP analyzed, 22 had a workload of less than 3200 hours, that is, 34% of the courses should undergo restructuring to comply with Resolution No. 02 of 2015. Of these 43 CPPs, 66% had equal or greater workload than 3200 hours. Thus, it is noteworthy that Resolution No. 02 of 2015 may promote significant changes in Undergraduate Courses by increasing their workload.

Regarding the workload of PCC (Table 2) the legislation did not promote changes and most CPPs provide 400 hours of these activities. However, there are 19 CPPs (30%) that have a workload between 420 and 596 hours, three with a workload of over 500 hours. It was also found that there are two CPPs that do not have the PCC workload, although they present in the text its insertion in the course. A CPP from 2011 that has 370 hours of PCC is highlighted.

Table 2. Workload of Undergraduate Courses in Chemistry in the Course Pedagogical Projects analyzed

Total Workload of the Course			**Workload of PCC**			
Inferior to 3200 hours	**Equal or Superior to 3200 hours**	**Total**	**Inferior to 400 hours**	**Equal or Superior to 400 hours**	**No workload**	**Total**
22	43	**65**	1	62	2	**65**
33.85%	66.15%	**100%**	1.54%	95.38%	3.08%	100%

According to Record No. 15 of 2005 the PCC:

> [...] may be developed as a core or as part of disciplines or other training activities. This includes the practical subjects related to the pedagogical training, but not those related to the technical-scientific foundations corresponding to a certain area of knowledge. (Record No. 15, 2005, p. 3)

From this definition of PCC, it is indicated that it should be in the training activities of Undergraduate Courses in all curricular components, except, as in the case of the Undergraduate Course in Chemistry in technical-scientific activities specific to the area. Record No. 28 of 2001 also understands the PCC as a dimension of knowledge that must be present in Undergraduate Courses "[...] when working the reflection on the professional activity, such as during the internship, when exercising the professional activity" (Record No. 28, 2001).

In the CPPs listed below, the PCC is inserted in most of the disciplines throughout the course. It is shown that, in some passages, it is specified that the internship and laboratory classes will not have workload to develop PCC, meeting the prerogatives of the guidelines for PCC. In some CPPS, the option to insert the PCC in the various disciplines in the course is not explicit in the text, but is presented in the workload distribution in the curriculum. It is noteworthy that this form of organization comprises practice as a cross-sectional axis of the course, which develops throughout the professional training, as knowledge articulated with all other areas of knowledge.

> **IF-Midwest-1**: All disciplines, except Supervised Internship and Laboratory classes, will contemplate the PCC, under the guidance of the teacher. (2014, p. 32)

> **IF-Northeast-28**: Practice as a curriculum component involves teaching, research and extension activities aimed at teaching Chemistry, and should be covered throughout the course. (2013, p. 44)

> **IF-North-38**: The PCC should be developed throughout the academic training process. Under this understanding, in the Undergraduate Course in Chemistry [...], the PCC consists of activities that permeate certain curricular components as shown in the table below, which allocate a percentage of the total workload for activities related to teaching. (2011, p. 131)

> **IF-Southeast-47**: Thus, it was decided to distribute these 412 hours in specific and pedagogical disciplines, throughout all semesters. (2014, p. 30)

> **IF-South-61**: The Practical Activity as a Curriculum Component are activities focused on pedagogical practice distributed throughout the four academic years of the Undergraduate Course in Chemistry. (2016, p. 82)

From these reflections, it is noteworthy that the PCC needs to be present throughout the Undergraduate education. Thus, the curricular organization of the CPPs of the Undergraduate Courses in Chemistry was analyzed from three elements: how to insert the PCC in the curriculum, name given to the PCC and the prioritized knowledge in the development of the PCC. Thus, it was found in the CPP four ways to insert the PCC in the curriculum. The highest incidence distributes 400 hours of PCC in several disciplines, being a percentage of the workload of each discipline. The second form with higher incidence inserts in the curriculum specific disciplines that have all their workload to develop the PCC. With lower incidence, the third form contemplates the two forms previously mentioned, which is called hybrid. These forms of curricular organization of the PCC, and their incidence on the CPPs, are shown in Table 3.

Table 3. PCC insertion in the Course Pedagogical Projects

Forms of Inserting PCC in the Curriculum	Number of CPP	%
In several disciplines of the curriculum	28	43.08
Specific Disciplines created to develop activities of PCC	25	38.46
Hybrid Form	7	10.77
Undefined Form of Organization of PCC	5	7.69
Total	65	100.00

The model that inserts the PCC in several disciplines presents a degree of uncertainty about the PCC development, as it does not explore in the program or in the CPP text how these activities are developed. Thus, it is possible that only the PCC workload has been included in these disciplines to comply with the legislation without concern for the pedagogical discussion and/or change of conception of teacher education that the practical dimension could provide for the critical intellectual teachers' education model proposed by Contreras (2012).

These different ways of inserting the PCC in the CPPs of Undergraduate Courses in Chemistry show the increase in the practical dimension encouraged by the guidelines for teacher education and the possibility of building courses aligned with the perspective of practical rationality.

According to the CPP mentioned below, the PCC has been inserted into the curriculum by means of specific disciplines that have their entire workload focused on its development. In some CPPs these disciplines have denominations that involve various nomenclatures such as instrumentation, pedagogical practice, pedagogical practice workshop, teaching practice, educational practice, etc.

In addition to the different nomenclatures, the IF-Northeast-28 CPP stands out, presenting in its PCC proposal a contextualized and critical curriculum model close to the critical intellectual model proposed by Contreras (2012). Thus, the PCC has the possibility to promote articulations between theory and practice that are based on the critical intellectual model, because by unveiling the institutional and social conditions of pedagogical practice one can visualize collective responses to solve them and not just immediate and focused solutions in the technique.

> **IF-Midwest-5**: Pedagogical Workshops (OPP's) and Instrumentation for Chemistry Teaching. Next, the workload assigned to the practice is specified as a curricular component in the Undergraduate Course in Chemistry [...]. 2nd Semester: General Chemistry Pedagogical Practice Workshop (68 hr); 3rd Semester: Instrumentation for Chemistry Teaching (68 hr), Workshop on Computer Applied to Chemistry Teaching (68 hr); 4th Semester: Analytical Chemistry Pedagogical Practice Workshop (68 hr); Pedagogical Practice of Organic Chemistry (68 hr); 7th Semester: Physics-Chemistry Pedagogical Practice Workshop (68 hr). (2018, p. 21)

> **IF-North-40:** Practice as a curriculum component is carried out through the Educational Practice discipline offered from the first semester until the eighth semester. (2016, p. 81)

> **IF-Southeast-50**: Practice as a Curriculum Component will be taught as Pedagogical Practices (I to VI), covering 405 hours distributed from the 3rd to the 8th semester of the course, permeating the teacher training. (2010, p. 23)

> **IF-Northeast-28:** More specifically, the curricular components of Chemistry Teaching Practice I, II, III and IV (from the 1st to the 4th semester) and the curricular components of the Final Paper (TCC) I and II (in the 7th and 8th semesters) aim to build together with the undergraduates the pedagogical content knowledge, and these curriculum components are inserted in three fundamental dimensions: (I) the social context, which, in addition to other issues, suggests discussing the relationship between education and work; (II) the school context, which makes it possible to understand the school-society relationship, as well as the internal institutional and organizational arrangements, and (III) the classroom context, which works the learning environments and culminates in the supervised internship itself. (2013, p. 45)

> **IF-Midwest-11**: Teaching Practices (400 hr): Teaching practices will be divided into six of the eight semesters of the course, making a total of six disciplines of 67 hours each, distributed from the second to the eighth semester. (2014, p. 15)

By analyzing the distribution of specific disciplines, in which the PCC was inserted in the curriculum in disciplines with all its workload focused on its development, it was

seen that of the 25 CPPs only 10 distribute these disciplines in the curriculum so as to contemplate the entire training process as prescribed in Resolution No. 02 de 2015. Among the CPPs that did not allocate the PCC throughout the courses, it should be noted that 2 CPPs divide the 400 hours in just two disciplines, 10 CPPs allocated the 400 hours in 6 disciplines and 3 CPPs in 7 disciplines. In the above citations, some CPPs stand out for not contemplating the PCC throughout the Undergraduate Course: IF-Southeast-50, IF-Northeast-28 and IF-Midwest-11.

Among the different forms of organization of the PCC in the CPP of the Undergraduate Courses in Chemistry, it was possible to identify 5 that present in their text principles for the development of these activities and, in 4 of them, the workload. However, it was not possible to visualize in the curriculum or in the programs the organization of the PCC activities. These courses are as follows: IF-Northeast-16, IF-North-39, IF-Southeast-41, IF-Southeast-42 and IF-South-6. In this sense, the curricular restructurings that will be promoted by Resolution No. 02 of 2015 may change this scenario.

It is noteworthy that we could identify 7 CPPs that organize the activities of PCC in a hybrid way, that is, the workload is distributed in several disciplines of the curriculum, but also in some specific disciplines in which only the PCC is developed in the integrality of the workload and/or program. These courses are as follows: IF-Midwest-6, IF-North-38, IF-Southeast-45, IF-Southeast-46, IF-Southeast-52, IF-South-53, and IF-South-58.

In a study similar to this article, Almeida (2016) analyzed 18 Undergraduate Courses in Chemistry in the state of Goiás. In these courses, 40% organized the PCC in traditionally offered disciplines involving pedagogical and technical-scientific knowledge of the specific area of Chemistry. In turn, 22% of these courses chose to insert new disciplines in the curriculum with the sole purpose of developing PCC activities. The author also identified that 5% of the courses were organized in a hybrid way, that is, with the PCC in existing disciplines in the undergraduate courses and with new disciplines created to develop PCC activities. It is noteworthy that 33% of the CPP did not present clarity on how to insert or organize the PCC activities in the course.

When comparing the results of the study by Almeida (2016) with the data presented above, it is observed that the ways of organizing the PCC are repeated at national level and that the percentage of CPPs that are not clear in how to organize these activities decreases, corresponding to 7.69% of the analyzed CPPs.

Finally, we highlight in the analysis of the curricular organization of the analyzed CPP the potentialities of the guidelines for teacher education, because it is seen that the curricularization of the practice through the PCC enabled the Undergraduate Courses in Chemistry analyzed to promote greater articulations between theory and practice. Thus, it is considered that the CPPs are in line with the conceptions of practical rationality proposed by the guidelines for teacher education, and consequently, open ways to break with the predominance of technical rationality.

Curricular Prioritized Knowledge in Disciplines Developing Practice as a Curriculum Component

In order to understand the organization of knowledge in the CPP, the course programs that were planned to meet the PCC workload were analyzed. Thus, of the 65 CPPs analyzed, 28 were classified in their curricular organization as distributing the PCC in several disciplines. Of these twenty-eight CPPs, the 22 that left explicit the disciplines that considered PCC were analyzed individually. The CPPs that organized the PCC in a hybrid way were also analyzed. From the total of 7 CPPs, 6 were analyzed, because in a CPP it was not possible to classify the knowledge organization, as they did not present the programs in the CPP. This difficulty to explain in the CPP, and to put in which disciplines and which content will be developed in the PCC disciplines, also appears in the study by Kasseboehmer and Farias (2012) that, by analyzing the disciplines that develop PCC activities in 25 Undergraduate Courses in Chemistry of the North and Southeast regions of Brazil, realized that half of these do not explain how to develop or organize the PCC activities.

Of the 22 CPPs that organize the PCC workload throughout the course, 7 show standardized sentences about PCC in their programs. Two of them are presented below, since the passage that appears in the IF-Northeast-17 CPP is identical to the following CPPs: IF-Northeast-18, 19, and 20. The IF-Southeast-49 sentence also appears in the IF-Southeast-47 and 51 CPPs:

> **IF-Northeast-17**: In practice as a curriculum component of teaching the ability of the student to do the didactic transposition will be assessed, i.e. to transform a particular topic into a teachable product. (2017, p. 52)

> **IF-Southeast-49**: Relates, through practice as a curricular component, knowledge in General Chemistry with training activities that promote experiences and reflections proper to the exercise of teaching. (2014, p. 50)

By classifying the knowledge developed in the disciplines and their workloads of PCC, the knowledge was defined taking as parameters the teacher's knowledge proposed by Shulman (2005) and also those present in Resolution No. 02 of 2015. It is noted that this is an organization carried out in the research process and that the CPPs did not necessarily organize the knowledge in the perspective of Shulman (2005). Thus, all general disciplines that develop diverse knowledge of the following areas were considered: Physics, Mathematics, Language, Technologies, Research methodology and Philosophy of Science. In turn, specific disciplines are those that deal with knowledge of Chemistry. In the pedagogical disciplines, the ones considered were all those that involve the educational processes through Didactics, Educational Public Policies, Social and Philosophical Foundations of Education, and Psychology of the Development and Learning. In the classification performed, the articulating disciplines that develop the pedagogical content knowledge stand out, that is, they propose to articulate the specific knowledge of Chemistry with the pedagogical knowledge.

In general, Table 4 shows that the CPPs prioritize PCC workload allocation in specific disciplines of Chemistry, and only in IF-Southeast-43 this logic is different. Considering that, in the technical rationality model of teacher education, the specific area was not articulated with the pedagogical area, the insertion of PCC in specific disciplines might indicate that these courses assume a more articulated model of teacher education, closer to the practical rationality. However, the qualitative analyzes of the programs of these disciplines present contradictions that can be understood through the analysis of the contents prescribed in the programs, because even inserting the PCC activities in specific disciplines of Chemistry, the programs do not mention the pedagogical contents, or references as to how the PCC is developed in these disciplines. Thus, the contradictions indicate the need to advance the study of the PCC, from other data collection instruments such as interviews and classroom observations. An example of this form of programs is:

> **IF-South-56**: Organic Chemistry III: Planning of Organic Synthesis. Interconversion of functional groups. Protection Groups. Retrosynthetic analysis. Formation and reaction of organoboranes and organosilanes. Synthetic strategies in the preparation of biologically important natural products. Teaching practice. (2014, p. 65)

Table 4. Classification of Areas of Knowledge Privileged in the Development of the PCC (to be continued)

CPP Acronym	General Disciplines		Specific Disciplines		Pedagogical Disciplines		Articulating Disciplines		Total PCC Workload
	Hours	%	Hours	%	Hours	%	Hours	%	
IF-Midwest-4	140	25.93	250	46.30	40	7.41	110	20.37	540
IF-Midwest-6	94.7	23.58	233.6	58.17	0	0.00	73.3	18.25	401.6
IF-Midwest-7	80	21.05	220	57.89	40	10.53	40	10.53	380
IF-Northeast-15	45	9.09	165	33.33	180	36.36	105	21.21	495
IF-Northeast-17	100	21.28	220	46.81	120	25.53	30	6.38	470
IF-Northeast-18	100	21.28	220	46.81	120	25.53	30	6.38	470
IF-Northeast-19	100	21.28	220	46.81	120	25.53	30	6.38	470
IF-Northeast-20	165	36.67	105	23.33	110	24.44	70	15.56	450
IF-Northeast-22	100	21.28	220	46.81	120	25.53	30	6.38	470
IF-Northeast-23	85	20.99	200	49.38	120	29.63	0	0.00	405
IF-Northeast-24	60	14.46	150	36.14	115	27.71	90	21.69	415
IF-Northeast-25	50	12.35	240	59.26	115	28.40	0	0.00	405
IF-North-38	50	13.51	90	24.32	110	29.73	120	32.43	370
IF-Southeast-43	0	0.00	0	0.00	345	74.19	120	25.81	465
IF-Southeast-45	24	5.88	42	10.29	72	17.65	270	66.18	408
IF-Southeast-46	24	5.88	42	10.29	72	17.65	270	66.18	408
IF-Southeast-47	120	30.00	185	46.25	70	17.50	25	6.25	400

Table 4. Classification of Areas of Knowledge Privileged in the Development of the PCC (continuation)

CPP Acronym	General Disciplines		Specific Disciplines		Pedagogical Disciplines		Articulating Disciplines		Total PCC Workload
	Hours	%	Hours	%	Hours	%	Hours	%	
IF-Southeast-48	114	23.08	247	50.00	57	11.54	76	15.38	494
IF-Southeast -49	114	27.59	299.25	72.41	0	0.00	0	0.00	413.25
IF-Southeast-51	95	23.75	215	53.75	55	13.75	35	8.75	400
IF-Southeast-52	28	6.90	280	68.97	14	3.45	84	20.69	406
IF-South-54	48	11.88	174	43.07	86	21.29	96	23.76	404
Total	1736.7	18.20	4017.9	42.12	2081	21.81	1704.3	17.87	9539.85

In the analysis of the contents of the CPP, it is evident that, even inserting the PCC in the disciplines of specific Chemistry contents, the programs do not mention the pedagogical contents, or mentions how the PCC is developed in these disciplines, as it is the case of the discipline entitled Fundamentals of Chemistry at IF-Midwest-4. In the courses that chose to create specific disciplines to develop the PCC, for example in IF-Midwest-5, it is observed in the program of the discipline entitled Workshop of Pedagogical Practice in General Chemistry, the integration between the specific and pedagogical contents and elements of the pedagogical content knowledge:

> **IF-Midwest-4**: Fundamentals of Chemistry - Matter and Energy. Elements, compounds and mixtures. Mol and molar masses. Stoichiometric calculations and chemical equations. Solutions (ways to express the concentration of a solution, Solutions and electrolytes). Chemical reactions (balancing; type and conditions for occurrence). Electronic structure of atoms. Periodic properties. Chemical bonds (ionic and covalent bonds). Electronegativity. Radioactivity. (2013, p. 32)

> **IF-Midwest-5**: General Chemistry Pedagogical Practice Workshop - General Chemistry Pedagogical Practice. Reading, analysis and discussion of scientific articles and books related to the teaching of General Chemistry. Discussion about public communication with emphasis on teaching practice. Discussion of ethnic-racial issues. Production of teaching materials related to the teaching of General Chemistry, focusing on the production of alternative and low cost materials. Chemistry and environmental education. (2017, p. 63)

This same lack of articulation between knowledge, which is expressed in the programs of the specific disciplines of Chemistry that develop the PCC, is perceived in disciplines of pedagogical education or general humanistic education. In these cases, there is also a lack of relationship with the specific area, as well as a lack of description of the development of the PCC. It is common for these disciplines to focus only on pedagogical knowledge and not to articulate with Chemistry or Science teaching, as in the case below, in the discipline of Didactics in the IF-Northeast-14. However, even less frequently, it was found in the IF-South-54 CPP a Human Development and Learning discipline with a program that is predominantly pedagogical but articulates its content

with Chemistry teaching:

> **IF-Northeast-14**: Didactics: Didactics within pedagogical theories. Liberal Pedagogical Trends [Traditional, Progressive, Non-Directive, and Technicist]. Progressive Pedagogical Trends [Liberation, Libertarian, Critical-Social of Contents, Socio-interactionist]. Teaching planning: critical perspective, strategies, stages for elaboration. Teaching knowledge, skills and attitudes. Didactic skills for teaching. Didactic procedures: elements for teaching planning. Evaluation of the teaching-learning process. Interdisciplinarity. Teaching methods and techniques. Appropriate use of instructional resources. (2010, p. 76)

> **IF-South-54**: Human Development and Learning - Study, analysis and reflection on theories of Human Development and Learning, with emphasis on: 1) Theories of human development and learning - HDL 2) Physical, cognitive and psychosocial development and the processes of learning at several stages of human development, from conception to old age; 3) Applications of theory in the school context and Chemistry teaching. Knowledge production in HDL. Technological development, creativity and innovation in HDL. (2014, p. 48)

In the 7 CPPs that develop PCC activities in a hybrid way, that is, the workload is distributed in several disciplines of the curriculum, but also in some specific disciplines in which only the PCC is developed, only in one CPP it was not possible to classify knowledge organization, as they did not present the programs in the CPP. In the others, it was observed that the articulating disciplines have greater workload to develop the PCC, followed by the specific disciplines of Chemistry, as it can be seen in Table 5.

Table 5. Insertion of the PCC in the Pedagogical Projects of Hybrid Courses

CPP Acronym	General Disciplines		Specific Disciplines		Pedagogical Disciplines		Articulating Disciplines		Total PCC Workload
	Hours	%	Hours	%	Hours	%	Hours	%	
IF-Central-6	94.7	23.58	233.6	58.17	0	0,00	73.3	18.25	401.6
IF-North-38	50	13.51	90	24.32	110	29.73	120	32.43	370
IF-Southeast-45	24	5.88	42	10.29	72	17.65	270	66.18	408
IF-Southeast-46	24	5.88	42	10.29	72	17.65	270	66.18	408
IF-Southeast-52	28	6.90	280	68.97	14	3.45	84	20.69	406
IF-South-58	92	18.55	232	46.77	0	0,00	172	34.68	496
Total	**234.7**	**13.70**	**549.6**	**32.07**	**144**	**8.40**	**785.3**	**45.83**	**1713.6**

It is considered that the specific content has a fundamental role in teacher education, because the teachers in their pedagogical practice articulate this knowledge to others in order to teach. Therefore, the pedagogical competence goes through the knowledge of the specific area, and the constitution of the pedagogical content knowledge goes through the deep articulation between specific knowledge, pedagogical knowledge and teaching experience. Thus, it is understood that "[...] the pedagogical

competence is linked to a specific content that is transformed, taking into account the students' difficulties with this content, the context, the instructional strategies, the forms of assessment, the curriculum, the objectives, etc." (Fernandez, 2015, p. 504).

Given the above considerations, it is clear that the CPP present the contents in different ways in the programs, and by proposing specific disciplines for the PCC, they can clarify the articulations between the fields of knowledge necessary for the constitution of the pedagogical content knowledge, while that by inserting the PCC in a diluted form, they do not explain the place of practice as knowledge, nor the articulations between specific and pedagogical knowledge. Still, one can observe the need to make explicit the articulations between the knowledge and the development of the PCC in the curricula, regardless of the format adopted to insert it in Undergraduate Courses in Chemistry. Thus, even if it is possible to observe curricular changes in these courses, which put them in a perspective of practical rationality, the difficulty to clarify the PCC in the CPPs may indicate that the allocation of these practices in the courses was only to comply with the guidelines for teacher education. Therefore, an approximation of the contexts in which these activities are developed, with other data collection and analysis instruments, may show the permanence of technical rationality and the possibilities of practical rationality.

Professionalization of Teaching as a Principle of the Field of Teacher Education in the Practice as a Curriculum Component

In the analysis of the PCC conceptions, several conceptual elements of the field of teacher education are expressed and assumed in the CPP. The concepts that appear most frequently are professional practice, the articulation of specific and pedagogical knowledge, the relationship between theory and practice, and the relationship between the institution and basic education. Among the less frequent conceptions, interdisciplinarity and research as an educational principle. For purposes of analysis, it was decided to develop the concept of professionality, for the deep articulations and contradictions that it expresses in the CPP and on the understanding of the PCC. In addition, it is noteworthy that the prevalence of teacher professionalization in the PCCs brings them into alignment with a perspective of practical rationality.

Understanding the PCC as a professional practice is expressed in passages of the CPP, with the concept being used more often. The way to express this conception is in the text of the CPP that explains the conceptions and practices of PCC, as well as in the construction of the disciplines that specifically develop the PCC. Thus, we found textual elements of this conception, as well as disciplines of the curriculum that develop the PCC and has in its name the expression Professional Practice. Professionality is part of the field of teacher education, because considering that teachers learn and build their professionalism, some knowledge needs to be developed through some principles.

In the CPP, professionalization appears in diverse written contexts with their own meanings. Therefore, it can be seen in the excerpts below that the CPPs assume the PCC

as a way to bring the Undergraduate student closer to the pedagogical socio-cultural context of the teaching profession:

> **IF-Midwest-1**: This theory and practice correlation is essential for the education of the future teacher in the sense of fostering a professionality that demands a fruitful movement between knowing and doing in the construction of meanings for management, administration and solving problem situations inherent to the educational environment. (2014, p. 31)

> **IF-Southeast-41**: The professional practice presented here is far from the conception, considered true in other times, that the practice would represent the knowing how to do, or the simple work. Far from constituting a recipe for formulas, it is more specifically characterized as the opportunity to read and analyze the current reality from the perspective of daring the construction of the new, which, in some aspects, requires us to adopt procedures of deconstruction of the existing structure, closed in its plastered concepts, so that the universe of the school action can be in fact, locus in which the diverse cultures interact and where networks of knowledge are established. And all this is only effective with the adoption of different methodologies and, effectively, in changing the educator profile. (2014, p. 28–29)

Another way to present teacher professionalization appears in CPPs interwoven with supervised internship and focusing on the school reality. It is noticed that there is no differentiation between internship and PCC. The Record No. 28 of 2001 discusses the difference between PCC and supervised internship and explains that PCC is related to the various levels and modalities of formal and informal education and its difference with internship is the pedagogical relationship that it presupposes between "[...] a recognized professional in an institutional work environment and an intern student" (Record No. 28, 2001, p. 10). This guideline also reinforces that the supervised internship requires the "[...] direct exercise in loco, either by the participative presence in proper environments of activities of that professional area, under the responsibility of an already qualified professional" (Report No. 28, 2001, p. 10). As it can be seen in the following excerpts:

> **IF-Northeast-16**: Teaching Practice and Supervised Internship, both with a workload of 400 hours, totaling 800 hours, are understood as the learning time of teaching practice. It is a moment of vocational training either through direct on-site exercise, participatory presence in the school environment, or in the reflection and evaluation of the practice, under the responsibility of an already qualified professional and a guiding teacher. It comprises activities developed in the elementary schools of the region, which may also occur in this institution, especially in high school, providing the student with a link between theory and practice and an articulation with the classroom, besides the development of professional knowledge, giving a broader view of the work of an Undergraduate in Chemistry. (2013, p. 37)

> **IF-Northeast-21**: Professional development and the insertion of the student in the world of work require personal and technical skills that go beyond regular classroom training, which should be experienced throughout the course, in school and non-

> school educational spaces, ensuring the student's insertion in the professional context and totaling 400 hours. In this project of the Undergraduate Course in Chemistry, Professional Practice has been present since the beginning of the course, permeating all the teacher education. (2010, p. 66)

The way to develop PCC is expressed in several CPPs. Through it, one can explain ways to make the articulations between the fields of knowledge visible and at the same time meet the standards for teacher education, not confusing the moments of PCC and supervised internship. Among the PCC development strategies investigated, it can be seen that they can be carried out without the student acting in the classroom, similar to the internship, but at the same time having the school space as an object of reflection. Among the strategies are activities that think about teaching Chemistry and Science and promote the discussion about the specific contents of Chemistry in the curriculum guidelines for Basic Education and the preparation of teaching materials. Therefore, in these cases, there are possibilities for the development of pedagogical content knowledge that, according to Shulman (2005), is the teacher's own knowledge that articulates specific and pedagogical contents.

It is noteworthy that by adopting teacher professionalization as a conception, the analyzed CPPs are aligned with the practical rationality and the reflective professional model, as discussed by Cunha (2013) and Contreras (2012). Therefore, the guidelines for teacher education impact the construction of the CPPs and have strengthened the curriculum change from the technical expert model or technical rationality to the reflective professional or practical rationality.

From this perspective, it can be seen that there is an alignment between the guidelines for teacher education, the CPPs of the analyzed courses and the proposals for the teaching of natural sciences of the Common National Curricular Base (*BNCC in Portuguese*) that show practical rationality as a model that has been settled as predominant in the guidelines and policies for the teacher education and, consequently for the Basic Education.

According to Franco and Munford (2018) the BNCC consolidates itself from a conception of curriculum as an organizer of the pedagogical practice. Thus, this document proposes a set of established and stabilized competences and skills that put teachers and students on the fringes of the pedagogical process. From this perspective, the BNCC ignores the different social contexts and institutional conditions that exist in the Brazilian reality.

It can be seen that the guidelines for teacher education and the BNCC stand with the same understanding of the CPPs analyzed: practical rationality. This means that these courses assume a formative project for the Chemistry teacher that breaks with the technical rationality, or 3 + 1, and is closer to a model of professionalization of practical rationality. Thus, it is considered that the Undergraduate courses in Chemistry of the Federal Institutes, in different ways, assume a teacher education model in reciprocity with the field in which it operates. Therefore, it is still necessary to advance in teacher

education for the constitution of a critical intellectual teacher education model, as proposed by Contreras (2012).

Final Considerations

In the presentation of the article, some initial questions were proposed and throughout the text, they were answered: How does the practice as a curriculum component fit into the pedagogical projects of the Undergraduate Courses in Chemistry of the Federal Institutes? Which conceptions of practice as a curricular component stand out in these course pedagogical projects? What knowledge is prioritized in the disciplines that develop PCC activities? What principles in the field of teacher education are assumed in the curriculum proposal of PCC activities?

Regarding the ways of inserting the PCC with CPP of the Undergraduate Courses in Chemistry, it was evident in this article that there are three forms of curricular organization in the courses offered at the Federal Institutes of Education in Brazil. The first form of organization distributes 400 hours of PCC in different disciplines, with the PCC being a percentage of the discipline's workload. The second form of curriculum organization presents specific disciplines for developing the PCC, that is, the disciplines have all their workload for these activities. In turn, these disciplines had different nomenclatures such as instrumentation, pedagogical practice, pedagogical practice workshop, teaching practice, educational practice, etc. Finally, the third form called hybrid, which contemplates the two previous forms.

The conceptions of the PCC developed in the CPPs are diverse and show that the interpretations of the guidelines for the teacher education are linked to the contexts in which the courses are developed. Therefore, although it was possible to identify the presence of the PCC in all CPPs, it can be seen that in the curriculum, in the programs and texts about this practice there is a lack of explanations about the forms of PCC integration. Considering the analysis performed, it is advocated, similarly to Almeida (2016), the non-standardization of PCC activities, but the need to clarify them more clearly in the CPPs.

It is noteworthy that the articulations between the specific and pedagogical knowledge, proper to the pedagogical content knowledge, are strongly present in the disciplines considered as articulators. Thus, by organizing disciplines that aim to develop PCC activities in the integrity of their workload, regardless of whether it is in the curriculum model that has specific disciplines for PCC or in the hybrid model that has 400 hours of PCC, in different disciplines and in specific disciplines, the full potential of PCC activities for teacher education is perceived. On the other hand, it shows that in the other ways of inserting the PCC in Undergraduate Courses in Chemistry, the hours may be evidenced in a bureaucratic way, just to comply with the legislation.

At the same time, the way the PCC is organized in the disciplines, and the different knowledge that they prioritize in the Undergraduate Courses in Chemistry, demonstrates the great contribution of the Chemistry area to these activities in the workload. From this

finding, it is understood that the courses analyzed are organized in order to assume the curricular model of Undergraduate Course from the practical rationality. This means that these courses assume a Chemistry teacher training project that breaks with the technical rationality, or 3 + 1, and is closer to a model of professionalization. Thus, it is considered that the Undergraduate Courses in Chemistry of the Federal Institutes, in different ways, assume a model of teacher education in line with the field in which it operates, since as well as the professionalization, it was seen the search for construction of curricula with research, interdisciplinarity and articulation of specific and pedagogical knowledge. In this sense, it is still necessary to advance in teacher education for the constitution of a critical intellectual teacher education model, as proposed by Contreras (2012).

Finally, the findings of this article are provisional and allow us to highlight the need to deepen this topic using other data collection instruments, in addition to document analysis. Thus, it would be possible, for example, to elucidate how the PCCs are being developed in the courses that distribute their workload over several disciplines, because, as the analysis showed, in these cases, the programs lack information to explain these relationships.

For studies with other research methodologies, in addition to the document analysis proposed by this article, we recognize the fragility of the theoretical frameworks that fit into practical rationality, as it is the case of Shulman (2005), because when discussing the conceptions of the PCC based on ideas, on pedagogical practices and on social agents, it is necessary to use references that discuss political and social issues related to teacher education.

References

Almeida, S. (2016). *A prática como componente curricular nos cursos de formação de professores de química no estado de Goiás*. (Dissertação de Mestrado em Educação em Ciências e Matemática). Universidade Federal de Goiás, Goiânia.

Bourdieu, P. (1989) *O poder simbólico*. Rio de Janeiro: Bertrand.

Decreto-Lei n. 1.190, de 04 de abril de 1939 (1939). Dá organização à Faculdade Nacional de Filosofia. Diário Oficial da União. Rio de Janeiro, RJ: Ministério da Educação e Saúde Pública.

Contreras, J. (2012) A autonomia de professores. São Paulo: Cortez.

Cunha, M. I. (2013) O tema da formação de professores: trajetórias e tendências do campo na pesquisa e na ação. *Revista Educação e Pesquisa*, 39(3), 609–624. https://doi.org/10.1590/S1517-97022013005000014

Diniz-Pereira, J. E. (2013). A construção do campo da pesquisa sobre formação de professores. *Revista da FAEEBA – Educação e Contemporaneidade*, 22(40), 145–154.

Dourado, L. F. (2015). Diretrizes curriculares nacionais para a formação inicial e continuada dos profissionais do magistério da educação básica: concepções e desafios. Educação e Sociedade, 36(131), 299–324.

Estevão, C. (2011) Formação, gestão, trabalho e cidadania: Contributos para uma sociologia crítica da formação. *Educação e Sociedade*, 22(77), 185–206.

Fernandez, C. (2015) Revisitando a base de conhecimentos e o conhecimento pedagógico do conteúdo (PCK) de professores de ciências. *Revista Ensaio*, 17(2), 500–528.

Flick, U. (2009). *Introdução à pesquisa qualitativa*. Porto Alegre: Artmed, 2009.

Franco, L. G., & Munford, D. (2018). Reflexões sobre a Base Nacional Comum Curricular: um olhar da área de Ciências da Natureza. *Revista Horizontes*, 36(1), 158–170. https://doi.org/10.24933/horizontes.v36i1.582

Gil, A. C. (2008). *Métodos e técnicas de pesquisa social*. São Paulo: Atlas, 2008.

Kasseboehmer, A. C., & Farias, S. A. (2012). Conteúdos das Disciplinas de Interface Atribuídos a Prática como Componente Curricular em Cursos de Licenciatura em Química. *Alexandria: Revista de Educação em Ciência e Tecnologia*, 5(2), 95–123.

Marcelo, C. G. (1998) Pesquisa sobre formação de professores: o conhecimento sobre aprender a ensinar. *Revista Brasileira de Educação*, (9), 51–75.

Marcelo, C. G. (1999) *Formação de professores*: para uma mudança educativa. Porto: Editora Porto.

Minayo, M. C. S. (2015) *Pesquisa social*: teoria, método e criatividade. Petrópolis: Vozes.

Mohr, A., & Pereira, B. (2017) Origem e Contornos da Prática como Componente Curricular. In A. Mohr, & H. G., Wielewicki. (Org.) *Prática como componente curricular: que novidade é essa 15 anos depois?* (pp. 19–38). Florianópolis: NUP/CED/UFSC.

Nóvoa, A. (1991). *Profissão professor*. Porto: Editora Porto.

Parecer n. 28 de 2001. (2001). Dá nova redação ao Parecer CNE/CP 21/2001, que estabelece a duração e a carga horária dos cursos de Formação de Professores da Educação Básica, em nível superior, curso de licenciatura, de graduação plena. Diário Oficial da União. Brasília, DF: Ministério da Educação.

Parecer n. 15 de 2005. (2005). Solicitação de esclarecimento sobre as Resoluções CNE/CP nºs 1/2002, que institui Diretrizes Curriculares Nacionais para a Formação de Professores da Educação Básica, em nível superior, curso de licenciatura, de graduação plena, e 2/2002, que institui a duração e a carga horária dos cursos de licenciatura, de graduação plena, de Formação de Professores da Educação Básica, em nível superior. Diário Oficial da União. Brasília, DF: Ministério da Educação.

Real, G. C. M. (2012) Prática como Componente Curricular: o que isso significa na prática? *Educação e Fronteiras On-Line*. 2(5), 48–62.

Resolução n. 01 de 2002 (2002). Institui Diretrizes Curriculares Nacionais para a Formação de Professores da Educação Básica, em nível superior, curso de licenciatura, de graduação plena. Diário Oficial da União. Brasília, DF: Ministério da Educação.

Resolução n. 02 de 2002. (2002). Institui a duração e a carga horária dos cursos de licenciatura, de graduação plena, de formação de professores da Educação Básica em nível superior. Diário Oficial da União. Brasília, DF: Ministério da Educação.

Resolução n. 02 de 2015. (2015). Define as Diretrizes Curriculares Nacionais para a formação inicial em nível superior (cursos de licenciatura, cursos de formação pedagógica para graduados e cursos de segunda licenciatura) e para a formação continuada. Diário Oficial da União. Brasília, DF: Ministério da Educação.

Resolução n. 03 de 2018. (2015). Altera o Art. 22 da Resolução CNE/CP nº 2, de 1º de 2015, que define as Diretrizes Curriculares Nacionais para a formação inicial em nível superior (cursos de licenciatura, cursos de formação pedagógica para graduados e cursos de segunda licenciatura) e para a formação continuada. Diário Oficial da União. Brasília, DF: Ministério da Educação.

Saviani, D. (2009). Formação de professores: aspectos históricos e teóricos no contexto brasileiro. *Revista Brasileira de Educação*, 14(40), 143–145.

Shulman, L. S. (2005). Conocimiento y enseñanza: fundamentos de la nueva reforma. *Revista de currículum y formación del profesorado*, 9(2), 1–30.

Triviños, A. N. S. (1987). *Introdução à pesquisa em ciências sociais*: a pesquisa qualitativa em educação. São Paulo: Atlas.

Valério, M. (2017*).* Autonomia dos professores. *Educar em Revista*, (66), 327–332. https://doi.org/ DOI/10.1590/0104-4060.52325

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