BIOLOGICAL SCIENCES TEACHING DEGREES: ANALYSIS OF TEACHER FORMATION CURRICULUM FOR TEACHING SCIENCE AND BIOLOGY

LICENCIATURAS EM CIÊNCIAS BIOLÓGICAS: ANÁLISE DE CURRÍCULOS DE FORMAÇÃO DE PROFESSORES PARA O ENSINO DE CIÊNCIAS E BIOLOGIA

PROFESORADOS EN CIENCIAS BIOLÓGICAS: ANÁLISIS DE CURRÍCULOS DE FORMACIÓN DEL PROFESORADO PARA LA ENSEÑANZA DE CIENCIAS Y BIOLOGIA

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ABSTRACT: This paper aims to present an analysis of teacher formation curriculum for the teaching of science and biology in the final years of elementary school and high school, taking as its parameter eight teaching degrees in Biological Sciences from public universities in the states of Ceará, Paraíba and Rio Grande do Norte. Starting from the documentary analysis, we characterize the curricular matrices arranged in the Pedagogical Projects of the Courses. We concluded, among other points, that the curricular matrices present a variety of subjects and scientific areas, however, some of them are secondary in the curricula, such as Ecology and the disciplines of social sciences and humanities. With regard to pedagogical disciplines, from the analysis, we highlight two main axes: the first focuses on disciplines that emphasize the issues of how to teach science and biology; and the second addresses Education, with disciplines that situate it beyond teaching and the classroom.

KEYWORDS: Biological science teaching degrees. Curriculum. Teacher formation. Teaching of science and biology.

RESUMO: *Este texto tem como objetivo apresentar uma análise de currículos de formação de professores para o ensino de ciências e biologia nos anos finais do Ensino Fundamental e no Ensino Médio, tomando como parâmetro oito Licenciaturas em Ciências Biológicas de universidades públicas dos Estados do Ceará, Paraíba e Rio Grande do Norte. A partir da análise documental, caracterizamos as matrizes curriculares dispostas nos Projetos Pedagógicos dos Cursos. Concluímos, entre outros pontos, que as matrizes curriculares apresentam uma variedade de disciplinas e áreas científicas, porém, algumas delas estão secundarizadas nos currículos, como a Ecologia e as disciplinas das áreas de ciências sociais e humanas. Em relação às disciplinas de cunho pedagógico, a partir da análise, evidenciamos dois eixos principais: o primeiro se concentra em disciplinas que enfatizam as questões acerca*

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do saber ensinar ciências e biologia; e o segundo aborda a Educação, com disciplinas que a situam para além do ensino e da sala de aula.

***PALAVRAS-CHAVE**: Licenciaturas em ciências biológicas. Currículo. Formação de professores. Ensino de ciências e biologia.*

***RESUMEN**: Este texto tiene por objetivo presentar un análisis de currículos de formación del profesorado para la enseñanza de ciencias y biología en los años finales de la Enseñanza Primaria y en la Enseñanza Media, tomando como parámetro ocho Profesorados en Ciencias Biológicas de universidades públicas de los Estados Ceará, Paraíba y Río Grande del Norte. A partir del análisis documental, caracterizamos las matrices curriculares dispuestas en los Proyectos Pedagógicos de los Cursos. Concluimos, entre otros puntos, que las matrices curriculares presentan una variedad de asignaturas y áreas científicas, pero, algunas de ellas están puestas en los currículos, como la Ecología y las asignaturas de las áreas de ciencias sociales y humanas. Con relación a las asignaturas de sesgo pedagógico, a partir del análisis, evidenciamos dos principales ejes: el primero se enfoca en asignaturas que enfatizan preguntas sobre cómo enseñar ciencia y biología; y el segundo aborda la Educación, con asignaturas que la sitúan más allá de la enseñanza y del aula.*

***PALABRAS CLAVE**: Profesorados en Ciencias Biológicas. Currículo. Formación del profesorado. Enseñanza de ciencias y biología.*

Introduction

In the Brazilian educational academic literature, there are numerous studies that emphasize that, in the history of teacher education in Brazil, in specific undergraduate teaching degree courses (Chemistry, Mathematics, Portuguese Language, History, Geography, to name a few), the predominance of knowledge and disciplinary contents became the central mark in the curricular proposals of undergraduate courses. However, there is little attention to knowledge and curricular content focused on the Education area (AYRES, 2005; GATTI; BARRETTO, 2009; GATTI; NUNES, 2009; MEDEIROS, 2017; MEDEIROS; AGUIAR, 2018).

In the context of the teaching degree courses in Biological Sciences, it is no different, after all, the predominance of a teacher formation dissociated from the educational reality and its complexity configured in history what is called “baccalaureate formation” (GATTI; NUNES, 2009). The emphasis, in the curricula of undergraduate courses, on the knowledge and curriculum content of the disciplines that make up the Biological Sciences (Parasitology, Genetics, Zoology, Anatomy, Microbiology, among others), without proper articulation with the classroom in Basic Education, predominated in teacher formation. These, even concluding their teaching degree, know little about Education and sometimes fail to develop a critical-

reflexive reading about the professional environment in which they will work (AYRES; SELLES, 2012; FEITOSA, 2014; MEDEIROS, 2017).

As a consequence of the scenario pointed out in the previous paragraph, science teaching, in the final years of elementary school, and biology, in high school, was permeated, in most of the history of Basic Education in Brazil, of uncritical approaches, focused only on content and apart from social, environmental, generational, cultural, economic issues, among others, which are important for the social development of the country and of subjects undergoing formation (AYRES; SELLES, 2012; FEITOSA, 2014; MEDEIROS, 2017).

This text aims to present an analysis of teacher formation curricula for science and biology teaching in the final years of elementary school and high school, taking as a parameter eight (08) Biological Sciences Teaching Degree Courses from public universities in the states of Ceará (03), Paraíba (03) and Rio Grande do Norte (02). In detail, we seek (a.) to characterize the curricular matrices arranged in the Course Pedagogical Projects (PPCs) regarding the organization of curricular subjects, with their knowledge and curricular content; (b.) as well as showing the organization of curricular subjects aimed at pedagogical formation for the teaching of science and biology in Basic Education - final years of Elementary and Secondary Education.

In this way, the study is associated with educational scientific productions that investigate the official curricula of teacher education, conceived in this text as institutionalized human prescriptions in the different contexts of Brazilian formal education (SILVA, 1990; SACRISTÁN, 2013; MEDEIROS, 2019). The official curricula add different scientific conceptions, political and ideological foundations, as well as knowledge and content produced and systematized by humanity to be taught (AYRES, 2005; APPLE, 2006). In teacher education courses, they print, through the different curricular documents, like the Pedagogical Course Project (PPC), which is intended for the professional formation of students.

In methodological terms, we emphasize that the study is based on the documentary analysis of eight (08) Pedagogical Projects of Biological Sciences Teaching Degree Courses from the following Public Institutions of Higher Education: Federal University of Ceará (UFC); Federal University of Cariri (UFCA); University for International Integration of the Afro-Brazilian Lusophony (UNILAB); Federal University of Rio Grande do Norte (UFRN); State University of Rio Grande do Norte (UERN); Federal University of Paraíba (UFPB); Federal University of Campina Grande (UFCG) and State University of Paraíba (UEPB).

For the constitution of the analysis material with the PPCs of the Degrees em Biological Sciences of the aforementioned universities, we consider the academic academic literature regarding teacher education and the normative documents on the formation of Basic Education

teachers in Brazil. Among them, we can cite Resolution CNE/CP no. 2, of 20 December, 2019, which defined new National Curricular Guidelines for the Initial Formation of Teachers for Basic Education and instituted the Common National Base for the Initial Formation of Teachers of Education Basic (BNC-Formação) (BRASIL, 2019).

We understand that, although the scientific production about the formation of Basic Education teachers in Brazil has already pointed out relevant considerations to the official curricula of teacher formation (AYRES, 2005; GATTI; BARRETTO, 2009; GATTI; NUNES, 2009; MEDEIROS; AGUIAR, 2018; REIS; MORTIMER, 2020), there are still, in the case of the curricula of the Teaching Degrees in Biological Sciences, important questions to think about teacher formation. Particularly, issues that are consistent with the curricular proposals aimed at teacher formation to work in science and biology teaching. We also consider that, with the recent publication of the normative document that defined the National Curricular Guidelines for the Initial Formation of Teachers for Basic Education and established the Common National Base for the Initial Formation of Teachers of Basic Education (BNC-Formação) (BRASIL, 2019), studies on the curricula of teaching degree courses are, in addition to being relevant, necessary and viable.

Having outlined this introduction, we organized the rest of the text into four sections. In the first moment, we briefly address teacher formation in Brazil, its history and normative basis, with an emphasis on teacher formation for science and biology teaching in the final years of elementary and high school. In the second section, we discuss the methodological aspects of this study. In the third moment, we present the analysis developed from what the Pedagogical Projects of the Biological Sciences Teaching Degree Courses attest in curricular terms. In the final section, we discussed the considerations learned in this investigation.

Teacher formation for science and biology teaching in Brazil - brief history

According to Gatti and Barretto (2009), when we look at the history of teacher formation in specific disciplines of Basic Education in Brazil, inevitably questions arise: “History teacher or historian?”; “Bachelor of Biology or Licenciado[3] of Biology?”; “Chemist or chemistry teacher?”; “Geography teacher or geography specialist?”. For the authors, these questions

[3] *Licenciado* is the Brazilian designation of someone graduated at university level but, differently from the bachelors, with a formation focused on teaching, with pedagogical content that the “regular bachelor degree” doesn’t contemplate

routinely accompany scientific productions about teacher formation to work in the final years of elementary school and high school.

This happens, in the researchers' perspective, for several reasons, however, in our understanding, there is a main reason: the formation of Basic Education teachers in the Country has always been conditioned to the arrangements and interests of social and political groups. These, based on numerous social practices guided by economic factors and the industrial market (especially the international industrial market), led different educational policies and curricular legislation that interfered in formation courses, in their curricular organization and in contexts (colleges, higher formation centers, institutes and universities) in which teacher formation takes place.

In fact, when we associate the considerations of Gatti and Barretto (2009) with the history of teacher formation for science and biology teaching in the country (considering the final years of elementary and high school), we will see that it was promoted having as main indicator the social and political context of each historical period. That is, each social and political phase in the history of Brazil demanded a certain type of education that, in turn, defined the profile of the teacher and the model of curriculum and teacher formation to be followed.

Validating these aspects, the doctoral study by Ayres (2005) highlights that the first course, at a higher level, for the formation of secondary school teachers, currently corresponding to the final years of elementary and high school, only happened with the creation of the Philosophy Colleges[4], From the year of 1939.

Through Decree Law no. 1,190, of 4 April, 1939, the Philosophy Colleges originated, which, linked to a social project in the country, aimed at qualifying labor to meet the professional demands of the growing "urban-industrial Brazil"[5], started the construction of undergraduate teaching degree courses in Higher Education throughout the country. In this list, Natural History courses were born[6], envisaging the formation of teachers for the teaching of science and biology in old secondary education.

[4] In some states of the country, the Philosophy Colleges won another nomination, such as the Colleges of Philosophy, Sciences and Letters (MEDEIROS, 2019).

[5] Term used by Ayres (2005) to refer to the industrial expansion experienced by Brazil since the 1930s, with a strong predominance of the rural exodus.

[6] In the specialized literature that discusses the formation of teachers for teaching science and biology, there is no consensus about the year of creation of the Natural History Course. In Ayres (2005), for example, it is emphasized that the first course was born shortly after the creation of the University of São Paulo (USP), in 1934, however, without much success. Its expansion took place only after the publication of Decree Law no. 1,190, of 4 April, 1939, which enabled the creation of teacher formation courses, at a higher level, in Brazil, with the foundation of the Philosophy Colleges. These courses predominated in private institutions.

It is worth remembering that the Natural History Course, like the other courses that aimed to form teachers for secondary education (currently equivalent to the final years of elementary school and high school), was composed of four years, organized in two periods: first, formed by three years of studies, it consisted of specific disciplines, such as Biology, Chemistry, Physics, Geology, among others; the second period, of one year, consisted of vocational formation disciplines, understood as pedagogical disciplines - educational psychology, general didactics, specific didactics, sociological foundations, organization of secondary education, among others (AYRES, 2005).

We emphasize that the Natural History Course was not understood, in its entirety, as a teaching degree. With the completion of the first three years, the formation experienced by the student gave him the opportunity to be socially recognized as a bachelor, thus, only with the completion of the fourth year of formation, with the pedagogical disciplines, he received the degree of *Licenciado* (teaching degree). It is this perspective of teacher formation conceived nationally as the 3 + 1 model (three plus one) of teacher formation that has been perpetuated in undergraduate teaching degree courses in specific disciplines and which is also recognized as "baccalaureate formation".

The Natural History Course, having its birth at the Philosophy Colleges, only acquired a new nomenclature around the 1960s, after dividing the graduation into two courses: Geology and Biological Sciences. This division was due to the understanding of the Federal Education Council (CFE), the body responsible in the historical period for the recognition of undergraduate courses, the profession of geologist, which required a specific course for the formation of professionals (TOMITA, 1990). Even changing its nomenclature to Biological Sciences, according to Tomita (1990) and Ayres (2005), there were no significant changes in the 3 + 1 model (three plus one) of teacher formation within this course.

Another important aspect to emphasize in this section refers to the fact that, in the beginning of the 1970s, more precisely with the publication of Law no. 5,692, of 11 August, 1971, with the strong demand for teachers to work in secondary education, Short Teaching Degree courses were created[7]. These polyvalent graduations qualified teachers for subjects in the three-year period of study. In reference to the formation of teachers to work in the disciplines of science and biology, demanded the creation of the Short Teaching Degree Course in Science[8]

[7] We understand that the Short Teaching Degree Courses are the result of changes in Higher Education arising from the determinations punctuated in the first Law of Guidelines and Bases of National Education, Law no. 4,024, of 20 December, 1961, as well as of the University Reform, Law no. 5,540, of 28 November 1968.

[8] A partir do estudo de Reis e Mortimer (2020), entendemos que o nome e o modelo de curso das Licenciaturas Curtas em Ciências deram margem para o nascimento das Licenciaturas em Ciências Naturais ou Ciências da

that could enable, depending on the context and the curricular formation proposal, teachers in Mathematics, Physics, Chemistry and Biology.

In this historical phase (1970s), we clearly see two perspectives of teacher formation courses for the teaching of science and biology (aimed at secondary education - equivalent at the moment to the final years of elementary and high school): o first, conceived as a Degree in Biological Sciences[9], of full character, with duration of 04 years; and the second, understood as a Short Teaching Degree in Science, with a qualification in Biology, lasting three years.

However, with the end of the military regime in Brazil and with the promulgation of the Federal Constitution, in 1988, which provided conditions for the institution of Law no. 9,394, of 20 December, 1996, which established the new Guidelines and Bases of the National Education, the Short Teaching Degree Courses were extinct, prevailing the Full Teaching Degree in Biological Sciences. From the institution of this normative document, some legal curricular devices were established for the Basic Education teachers formation courses, resulting in teacher formation courses for the teaching of science and biology.

With regard to the Teaching Degree Courses in Biological Sciences, in a particular way, Opinion CNE/CES no. 1,301, of 6 November, 2001, was established, which obtained the national curricular guidelines specific for undergraduate courses in Biological Sciences[10]. These guidelines attempted, in part, to highlight referrals to the curricular organization of undergraduate courses.

Then, the first National Curricular Guidelines for Undergraduate Teaching Degree Courses were instituted, in general. Through CNE/CP Resolution 01, of 18 February, 2002, and CNE/CP Resolution 2, of 19 February, 2002, such guidelines were instituted, meaning guiding documents for all teacher formation courses from the country.

Despite the criticisms made by researchers and educational entities to these guidelines, as a result of the emphasis given to the development of competences in teacher education processes, in line with the dictates of the global industrial market, a document was finally established that established directly at national level, to undergraduate teaching degree courses,

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Natureza que, também de caráter polivalente, objetivam a formação de professores para mais de uma disciplina do currículo escolar da Educação Básica, a saber: Ciências; Biologia; Química e Física.

[9] A pesquisa de Ayres (2005) aponta o entendimento de que as Licenciaturas em Ciências Biológicas, em algumas instituições educacionais, foram registrados na história (e ainda são) com a nominação de Licenciatura em Biologia. Compreendemos que, talvez, essa variação na nomenclatura seja uma expressão de conceber o referido curso, ora formando docentes apenas para o Ensino Médio (Licenciaturas em Biologia), ora formando docentes para os anos finais do Ensino Fundamental e Ensino Médio (Licenciaturas em Ciências Biológicas).

[10] O referido documento atesta orientações tanto para as licenciaturas quanto para os cursos de bacharelado.

principles, foundations and procedures to be observed in the curricular proposals of the graduations that envisage the formation teachers for Basic Education.

In 2015, after many efforts and struggles developed by different segments of the Education area, such as the National Association for Postgraduate Studies and Research in Education (ANPED), the National Association for the Formation of Education Professionals (ANFOPE) and the National Forum of Directors of the Colleges, Institutes and Education Centers of Brazilian Public Universities (FORUMDIR), new National Curricular Guidelines for the Initial and Continuing Education of Basic Education Teachers were also instituted, Resolution CNE/CP no. 2, of 01 July 2015.

According to Dourado (2015), in these new Guidelines, unlike the previous ones (published in 2002), initial and continuing education were conceived as moments that are inseparable from teacher education - although they happen in different stages - aiming at their valorization. In addition, it was reinforced that the valorization of professionals in the teaching of Basic Education will take place through other dimensions, such as career, salary and working conditions, also associated with formation - initial and continuing.

In 2019, faced with new clashes in the political and governmental agenda of Brazil, in the intention of social control of the population by the State - which implies the control of Education and teacher formation -, the guidelines published in 2015 were revoked by via Resolution CNE/CP no. 2, of 20 December, 2019. This demarcated other National Curriculum Guidelines for the Initial Formation of Teachers for Basic Education and established the Common National Base for the Initial Formation of Teachers of Basic Education (BNC-Formação).

From the notes highlighted so far, we understand that the formation of teachers for the teaching of science and biology in undergraduate teaching degree courses has gone through different perspectives throughout history in the country, which at times referred to advances in teacher education curricula (such as the promulgation of national curriculum guidelines published in 2015) and, in other periods, attested setbacks (such as short degrees, among others). In view of the scenario described in this section, it is necessary to highlight, once again, that the perspectives of teacher education, guided by different curricular legislation, were based on the interests of social and political groups that devastated Brazil. All of this has implications for undergraduate teaching degree curricula, which gradually contribute to the formation of the professional identity of teachers in Brazilian schools of Basic Education.

Methodology

In view of the fact that the objective of this research is to present an analysis of teacher education curricula for the teaching of science and biology in the final years of elementary school and high school, taking as a parameter courses in Biological Sciences from public universities in the States of Ceará, Paraíba and Rio Grande do Norte, with emphasis on: a (a.) Characterization of the curricular matrices arranged in the Pedagogical Projects of the courses (PPCs) regarding the organization of the curricular subjects, with their knowledge and curricular content; as well as (b.) evidence the organization of curricular disciplines aimed at pedagogical formation for the teaching of science and biology in Basic Education (final years of Elementary School and High School), we carry out the following methodological procedures.

In the first moment, we surveyed the e-MEC Database of public universities in the States of Ceará, Paraíba and Rio Grande do Norte that offer Biological Sciences teaching degrees as regular bachelor's degrees. At that moment, we found eleven (11) institutions (six federal and five state), namely: Federal University of Ceará (UFC); State University of Ceará (UECE); Regional University of Cariri (URCA); Vale do Acaraú University (UVA); Federal University of Cariri (UFCA); University for International Integration of the Afro-Brazilian Lusophony (UNILAB); Federal University of Rio Grande do Norte (UFRN); State University of Rio Grande do Norte (UERN); Federal University of Paraíba (UFPB); Federal University of Campina Grande (UFCG) and State University of Paraíba (UEPB).

At the end of this procedure, as a second step, we visited the institutional websites of the universities highlighted in the previous paragraph and sought to identify the number of courses in each of them and on their campuses. After this procedure, we started the selection of Pedagogical Projects of Courses (PPCs) available on the institutional pages. Of the eleven (11) public universities located in the States of Ceará, Paraíba and Rio Grande do Norte that offer the Teaching Degree in Biological Sciences as regular bachelor's degrees, three (03) state institutions in Ceará did not provide information regarding the existence of curriculum documents (UVA, UECE and URCA). This fact led us to not include them in the research.

In all, we selected eight (08) Pedagogical Projects of Courses (PPCs) that individually represent a teaching degree from each selected public university. We clarify that, at UFPB and UFCG, there are courses located on more than one campus, however, only the PPCs of the Biological Sciences Teaching Degree at Campus UFPB/João Pessoa and UFCG/Cajazeiras were available. In this sense, the selected curriculum documents represent a course from each institution.

In the third instant, we read the official curricular documents, with special attention to the curricular matrices and to the composition of the subjects that are part of them, aiming to achieve the main objective of the research. With this procedure, we organized the information provided in the Pedagogical Projects of Courses (PPCs), in quantitative terms, in two tables and a graph, aiming at the qualitative interpretation and analysis.

Finally, in the fourth step, we developed the qualitative analysis, based on the information available in the tables and the graph, in an attempt to undertake reflections regarding the initial purpose of this investigation.

Teaching Degrees in Biological Sciences - curricular organization and teacher formation

Before focusing on the curricular analysis of the Pedagogical Projects of the Teaching Degree Courses in Biological Sciences of public universities in the States of Ceará, Paraíba and Rio Grande do Norte, we will present some initial considerations about the analyzed courses. First, of the eight (08) teaching degree courses selected, six (06) are located on the campuses of the institutions (UFC, UNILAB, UERN, UFRN, UEPB and UFPB), which denotes the predominance of this degree modality in more central contexts institutions, as well as in the capitals of the three states.

In addition to this characteristic, of the eight (08) graduations, only one course (01), from UFCA, has its teaching activities developed in the night shift. The other teaching degree courses work in two shifts (they are day courses), in the morning period or in full (morning, afternoon and night). We also highlight that, of the set of courses analyzed, only two (02), from UFC and UFCG institutions[11], present the Pedagogical Project of the Course (PPC) built/revised before 2016, an aspect that points to the updating of the curricular proposals of most of the analyzed degrees. In Table 1, we have organized other information regarding the Biological Sciences Teaching Degree Courses from public universities in the States that were part of this research:

[11] Na Licenciatura em Ciências Biológicas da UFC, o PPC disponível na página institucional da graduação data do ano de 2005, porém, há uma matriz curricular existente no *site* oficial datando do ano de 2014. No estudo, consideramos para análise a matriz curricular presente no Projeto Pedagógico de Curso (PPC), em razão de ela apresentar as ementas dos componentes curriculares. No que toca ao Curso da UFCG (*Campus* Cajazeiras) analisado, vimos que o valor de horas estipulado para a formação docente é inferior ao que prescrevem as Diretrizes Curriculares para a Formação Inicial de Professores, tanto no que concerne às diretrizes publicadas no ano de 2015, quanto às diretrizes publicadas em 2019. Isso decorre em virtude de o documento curricular se fundamentar nas Diretrizes publicadas em 2002, que demarcavam a quantidade mínima de 2.800 horas de formação docente.

Table 1 – Synthesis with Information from the Biological Sciences Teaching Degree Courses of State and Federal Universities of the States of Ceará, Paraíba and Rio Grande do Norte

Institution	Name	Campus/ Municipality	Shift	Year of Implementation of the PPC	Course Load	Academic Semesters for curricular completion
Ceará						
UFC	Biological Sciences	Fortaleza	Morning and Afternoon	2005	3.384	8
UNILAB	Biological Sciences	Redenção	Morning and Afternoon	2018	3.641	9
UFCA	Biology	Brejo Santo	Night	2017	4.200	9
Paraíba						
UFCG	Biological Sciences	Cajazeiras	Daytime	2011	2.910	8
UFPB	Biological Sciences	João Pessoa	Morning, Afternoon and Night	2019	3.540	8
UEPB	Biological Sciences	Campina Grande	Full Time	2016	3.530[12]	10
Rio Grande do Norte						
UFRN	Biological Sciences	Natal	Morning and Afternoon	2018	3.378	10
UERN	Biological Sciences	Mossoró	Daytime	2018	3.750	8

Source: Research data (2020)

Based on the information available in Table 1, we see, again, the need for some notes before starting to analyze the official teacher formation curricula. At first, we emphasize that, of the eight (8) courses, there is a teaching degree that is registered in the PPC with the name "Teaching Degree in Biology". This characteristic is attested in the UFCA Course. We believe that the justification for its nomenclature does not demarcate the term “Biological Sciences” is consistent with the proposition of graduation in the formation of teachers only for high school, not covering the final years of elementary school. Another aspect is the question of students entering the Course only after they have completed the Teaching Degree in Natural Sciences. What we understand is that the Teaching Degree in Biology refers to a qualification from the Natural Sciences Course. At the end of the first course, the students take advantage of the hours worked and migrate to the new formation (in the Biology Teaching Degree), receiving at the end the degree of *Licenciado* also in Biology (UNIVERSIDADE FEDERAL DO CARIRI, 2017).

[12] PPC also records the value of 3,515 hours.

Next, we note that the UFC Biological Sciences Teaching Degree is integrated with the Bachelor's Degree. In the Pedagogical Project of the Course (2005), the two undergraduate modalities (Bachelor and Teaching degree) are interconnected, an aspect that we have not identified in other curricular documents. Even in institutions that also offer the Bachelor of Biological Sciences modality, as is the case of UFPB, UFRN and UERN, there is a PPC for each type of graduation.

In addition to these notes, we were struck by the fact that half of the teaching degrees awarded more than eight (8) academic semesters of formation for curricular completion. We think that this is due to the high number of hours emphasized for teacher formation - five (05) undergraduate teaching degree courses register more than 3,500 hours. We also noticed that, in two (2) PPCs (from UFRN and UEPB), there are two curricular matrices within them. This aspect refers to the fact that courses are offered in more than one shift. For each shift, there is a curricular matrix that does not differ in the number of hours nor in the curricular subjects, however, they differ in the number of academic semesters. In this study, we considered the matrices for analysis with the highest number of semesters.

As for curriculum analysis, as a first dimension, we will list about the characterization of the curricular matrices arranged in the Pedagogical Projects of the Courses (PPCs), particularly with regard to the organization of the curricular disciplines that compose them, with their knowledge and curricular content. On this dimension, we systematize what we found in nine (9) axes of analysis, which were produced at the time of data collection[13]. Let's see Table 2:

Table 2 – Organization of Curriculum Matrices in hours from the Analysis Axes

Axes of Analysis	**Teaching Degree Courses in Biological Sciences**							
	UFC	UNILAB	UFCA	UFPB	UFCG	UEPB	UFRN	UERN
Cellular, Molecular Biology and Evolution	320 (9%)	315 (9%)	384 (9%)	555 (16%)	345 (12%)	525 (15%)	510 (15%)	540 (14%)
Biological Diversity	896 (26%)	720 (20%)	576 (14%)	720 (20%)	705 (24%)	915 (26%)	840 (25%)	730 (19%)
Ecology	240 (7%)	120 (3%)	128 (3%)	225 (6%)	180 (6%)	195 (6%)	120 (4%)	210 (6%)

[13] Para a organização dos eixos de análise, tomamos como base as áreas científicas referendadas no Parecer CNE/CES, nº 1.301, de 06 de novembro de 2001, que auferiu as diretrizes curriculares nacionais específicas para as graduações em Ciências Biológicas. No entanto, a partir da literatura educacional, fizemos ajustes em alguns eixos de análise, bem como acrescentamos outros com respaldo na realidade curricular oficial encontrada.

Fundamentals of Exact and Natural Sciences	480 (14%)	315 (9%)	800 (19%)	300 (8%)	345 (12%)	300 (8%)	360 (11%)	535 (14%)
Fundamentals of Social and Human Sciences	48 (0,7%)	390 (11%)	256 (6%)	240 (7%)	330 (11%)	315 (9%)	60 (2%)	215 (6%)
Fundamentals of Education and Pedagogical Formation	992 (29%)	1.080 (30%)	1.472 (35%)	1.080 (31%)	645 (22%)	780 (22%)	928 (27%)	930 (25%)
Optional Studies	192 (6%)	90 (2%)	256 (6%)	180 (5%)	90 (3%)	180 (5%)	360 (11%)	120 (3%)
Completion of Course Work (TCC)	16 (0,3%)	45 (1%)	128 (3%)	30 (1%)	60 (2%)	120 (3%)	-	210 (6%)
Complementary activities	200 (6%)	566 (16%)	200 (5%)	210 (6%)	210 (7%)	200 (6%)	200 (6%)	260 (7%)
Total amount of hours	3.384	3.641	4.200	3.540	2.910	3.530	3.378	3.750

Source: Research data (2020)

In the first axis of analysis, *Cellular and Molecular Biology and Evolution*, we allocate the curricular disciplines that attest to knowledge and curricular content about the organization and biological and evolutionary interactions, based on the areas of Biochemistry, Genetics, Immunology, Cellular and Molecular Biology, Embryology, Histology and Microbiology (BRASIL, 2001). From the scenario found in the official curricula, we understand that there is a frequent presence of disciplines from that axis in the curricular matrices of all analyzed courses. Of the nine (9) axes, it is the third, in quantitative terms, with more disciplines in the official documents. In a percentage perspective, its presence varies between 9% to 16% of the total hours dedicated to teacher formation in undergraduate courses. The Teaching Degree Courses in Biological Sciences at UFPB (16%), UEPB (15%) and UFPB (15%) are the ones that dedicate the most time and the largest number of curricular components for the study of knowledge and curricular content related to the subject under discussion.

The *Biological Diversity* axis of analysis is the second hegemonic axis in most of the curricular matrices analyzed. It presents the disciplines that gain knowledge and curricular content on the classification, phylogeny, as well as on the organization, ethology, physiology and adaptive morphofunctional strategies of living beings (BRASIL, 2001). Thus, the disciplines of Zoology, Parasitology, Anatomy, Biological Systematics, Morphology, Physiology, Entomology, Botany, among others, made up this analytical axis. With the exception of UFCA and UERN courses, all undergraduate teaching degrees allocate more than 20% of their total workload to the study of knowledge and curricular content that make up that

axis. Graduations from UFC and UFPB demarcate 26% of their total workload for the disciplines of the axis in question.

In the third axis, *Ecology*, we combine the components of the official curricula for analysis, with the knowledge and curricular content that allude to the relation between living beings and the environment in the course of geological times. We also selected the disciplines that pay attention to the knowledge of the dynamics of populations, communities and ecosystems, the conservation and management of fauna and flora, as well as the relation between health, education and the environment (BRASIL, 2001). To our surprise, the axis under analysis is that which circumscribes one of the smallest number of hours and subjects within the curriculum proposals. In the Biological Sciences Teaching Degree courses at UFC, UERN and UFRN, there are only two subjects (each consisting of 60 hours of study) that contemplate the knowledge and the curricular contents pontificate in this axis.

The axis of analysis *Fundamentals of Exact Sciences and Nature* consists of curricular components that guide the knowledge and curriculum content of Mathematics, Statistics, Chemistry, Physics, Geology, among others. In it, there are the disciplines that group the knowledge and the contents of the essential curricula for the understanding of biological processes that will be studied during their graduation (BRASIL, 2001). These subjects, in most cases, appear in the initial semesters/periods of teacher formation. In the curricular matrices analyzed, we identified that the prevalence of this analytical axis concerns 8% to 19% of the total hours of the official curriculum. A characteristic peculiar to the referred axis corresponds to the UFCA Teaching Degree Course, which, differently from the others, has 800 hours of teacher formation in the curricular matrix for the knowledge and curriculum contents of the disciplines referenced in this axis, appearing as the second axis with greater attention in the curriculum of the University graduate. We think that this is due to the fact that the Course is associated with the Teaching Degree in Natural Sciences, as we highlighted earlier in the text.

In the axis of analysis *Fundamentals of Social and Human Sciences*, the disciplines with the knowledge and curricular contents of the areas of Sociology, Portuguese Language, Brazilian Sign Language (LIBRAS), Philosophy, History, Scientific Methodology and Philosophy of Science, Anthropology and Geography are allocated. In the context of curricular matrices, this is one of the axes with less prevalence of hours in the total course load (ranges from 0.7% to 11%) and of curriculum components. In the Biological Sciences Teaching Degree Course at UFRN, for example, there is a single discipline (the LIBRAS discipline) in the curricular proposal for teacher formation that is associated with the emphasized axis.

The sixth axis, *Fundamentals of Education and Pedagogical Formation*, concentrates the subjects with the knowledge and curricular contents of the Education area (or of areas that are associated with Education, such as Philosophy of Education, Educational Psychology, among others) and / or that are aimed more directly at teacher formation for science and biology teaching. We state that the Supervised Internship area was considered in this analytical axis. Due to the curricular reality existing in the official documents studied, we found that, in six (6) courses, the axis under discussion is hegemonic in the curricular matrices. Only the UFCG and UEPB teaching degrees do not demarcate this characteristic, however, we have to validate that the hours destined to the Supervised Internship weigh for this scenario. Without this factor, the number of hours devoted to teacher formation for teaching science and biology, as well as the number of curricular subjects with this objective, would be much lower.

In the seventh axis, *Optional Studies*, we organize the subjects validated in the curricular texts as optional to the students, but that must be counted in the total formation hours. The areas of these disciplines are not demarcated, since they may be linked to areas of any axis of analysis presented above, however, we validate that there is an emphasis on the official curricula analyzed in the specific disciplines of Biology. The percentage of time for studies in these disciplines varies between 2% to 11%.

The penultimate analytical axis, *Course Completion Work*, formed by disciplines that aim at a conclusive/monographic study in the Teaching Degree Course, is what is located in the curricular matrices with the shortest time destined for teacher formation. The minimum percentage found corresponds to 0.3% of the total course load (from UFC) and the maximum refers to 11% (from UERN). It is important to note that in the Biological Sciences Teaching Degree Course at UFRN, there is no indication of hours or activity regarding the Course Completion Work (TCC).

In the ninth axis of analysis, *Complementary Activities*, are the indications of activities that integrate the curricula to be experienced during the professional formation of the students. Even though they do not refer to study in curricular subjects, these activities refer to participation in research, teaching and extension projects related mainly to the study of teaching. In this context, a range of possibilities are also validated, such as participation in academic monitoring and in scientific and cultural events, among others.

Remember that complementary activities are guided by the National Curriculum Guidelines for Initial Teacher Education (BRASIL, 2002; BRASIL, 2015; BRASIL, 2019). 200 hours of activities are included in the initial teacher formation processes. In this axis of analysis, *Complementary Activities*, we found that all the courses analyzed meet this curricular precept,

with the percentage of hours in teaching degree courses varying between 6% and 16% of the general workload. One aspect that deserves emphasis is based on the reality of the UNILAB Course, as its curricular proposal allocates 566 hours[14] to the axis under analysis, a high number if compared to other teaching degree courses.

At the end of the characterization about the organization of the curricular matrices of the analyzed courses, we will present some considerations as a way to summarize our analysis:

a) Regardless of whether curricular matrices concentrate a significant number of hours for the study of the fundamentals of Education and pedagogical formation, in our understanding, it is necessary to review the organization/distribution of knowledge and curricular content referring to this dimension within the official curricula of Teaching Degree Courses.

This understanding is supported by what CNE/CP Resolution No. 2 of 20 December, 2019 prescribes, more precisely with regard to the organization of the curricula of teaching degree courses. In the curriculum rules, a total of 3,200 (three thousand and two hundred) hours is indicated for teacher formation distributed in three groups. The document forwards:

> Art. 11. The aforementioned workload of the teaching degree courses must have the following distribution:
> I - Group I: 800 (eight hundred) hours, for the common base that comprises scientific, educational and pedagogical knowledge and justifies education and its articulations with systems, schools and educational practices.
> II - Group II: 1,600 (one thousand and six hundred) hours, for learning the specific contents of the BNCC's areas, components, thematic units and objects of knowledge, and for the pedagogical mastery of these contents.
> III - Group III: 800 (eight hundred) hours, teaching practice, distributed as follows:
> a) 400 (four hundred) hours for the supervised internship, in a real work situation at school, according to the Pedagogical Project of the Course (PPC) of the formative institution; and
> b) 400 (four hundred) hours to practice the curricular components of Groups I and II, distributed throughout the course, since its beginning, according to the PPC of the formative institution.
> Single paragraph. Formation and previous experiences may be used, provided that they are developed in educational institutions and other activities, under the terms of item III of the sole paragraph of art. 61 of LDB (Wording given by Law no. 12,014, of 6 August, 2009) (BRASIL, 2019).[15]

[14] As atividades complementares na Licenciatura em Ciências Biológicas da UNILAB se encontram organizadas no currículo oficial em um núcleo formativo nominado de "Núcleo de Estudos Integradores para Enriquecimento Curricular". Nele, se apresentam duas modalidades, a saber: atividades complementares e atividades de extensão. As duas modalidades contemplam o que entendemos neste texto como as atividades complementares, somando juntas 566 horas.

[15] Art. 11. A referida carga horária dos cursos de licenciatura deve ter a seguinte distribuição:
I - Grupo I: 800 (oitocentas) horas, para a base comum que compreende os conhecimentos científicos, educacionais e pedagógicos e fundamentam a educação e suas articulações com os sistemas, as escolas e as práticas educacionais.

We understand, from the analysis of the curricula, that the eight (8) courses, mostly, meet the regulations regarding the distribution of hours, knowledge and curricular content for Groups II and III, however, in what is consistent with the Group I, it is necessary to review it more carefully in the graduations. In seven (07) Teaching Degrees (UFC, UNILAB, UFPB, UFCG, UEPB, UERN and UFRN), the higher number of 800 hours for the analysis axis named by us as *Fundamentals of Education and Pedagogical Formation* does not meet what the Guidelines determine of 2019, since, when we subtract 400 hours for the Supervised Internship, the remaining hours for Group I becomes less than what the normative device guides.

b) In the curricular matrices, the axes of analysis *Ecology and Fundamentals of Social and Human Science*s are presented with a very reduced number of hours and disciplines when compared to the other axes that aim at specific knowledge and curricular content of the Biological Sciences and the Education area.

We understand that the curriculum is built, whether in the official or in the practical sphere, through ideological and, often, political disputes. It has the mark of those who produced it, not being neutral and exempt from the interests of those who contributed to its development (APPLE, 2006; SILVA, 2007; MEDEIROS; AGUIAR, 2018; MEDEIROS; DIAS; AMORIM, 2019). This statement may justify the absence of disciplines with knowledge and curriculum content from these two analytical axes in the curriculum proposals. It is noticeable, in some courses, the secondary nature given to the disciplines that form them. In reality, they appear loose in the semesters of teacher formation, without connection with the totality of curricula.

c) There does not seem to be a consensual understanding about what the Course Conclusion Work (TCC) would be in the analyzed curricula, as well as the importance of Education Research in teacher education.

These considerations are based on the observation that, in some courses, such as UFC, UNILAB, UFPB and UFCG, the time allocated for the construction of the TCC is very short.

II - Grupo II: 1.600 (mil e seiscentas) horas, para a aprendizagem dos conteúdos específicos das áreas, componentes, unidades temáticas e objetos de conhecimento da BNCC, e para o domínio pedagógico desses conteúdos.
III - Grupo III: 800 (oitocentas) horas, prática pedagógica, assim distribuídas:
a) 400 (quatrocentas) horas para o estágio supervisionado, em situação real de trabalho em escola, segundo o Projeto Pedagógico do Curso (PPC) da instituição formadora; e
b) 400 (quatrocentas) horas para a prática dos componentes curriculares dos Grupos I e II, distribuídas ao longo do curso, desde o seu início, segundo o PPC da instituição formadora.
Parágrafo único. Pode haver aproveitamento de formação e de experiências anteriores, desde que desenvolvidas em instituições de ensino e em outras atividades, nos termos do inciso III do Parágrafo único do art. 61 da LDB (Redação dada pela Lei nº 12.014, de 6 de agosto de 2009) (BRASIL, 2019).

In the UFRN Course, there is no mention in the curriculum matrix regarding this aspect. Research in Education, similarly, appears as an appendix (sometimes existing in a discipline) of teacher education linked to the disciplines of Scientific Methodology at the beginning of the Courses.

It is known, in studies in the area of Education, that research should occupy a central place in the formation of teachers of Basic Education (SOUZA; FAZENDA, 2017; MEDEIROS, 2019). After all, in addition to being a device that allows the production of knowledge about the educational and school reality, it helps in the critical development of subjects in formation (MICHELS; BARBOSA; FARIAS, 2017). In Higher Education, in the different types of courses (Bachelor, *Licenciatura* – Teaching Degree – and Technological), the research is understood as a reference to the qualification of the students.

Despite these considerations, we cannot deny that the analyzed curricula also refer to a plurality of subjects with curricular knowledge and content. If they are materialized in the curricula in the classroom in universities in a contextualized way, they will add up to a good qualification of teachers for teaching science and biology in Basic Education.

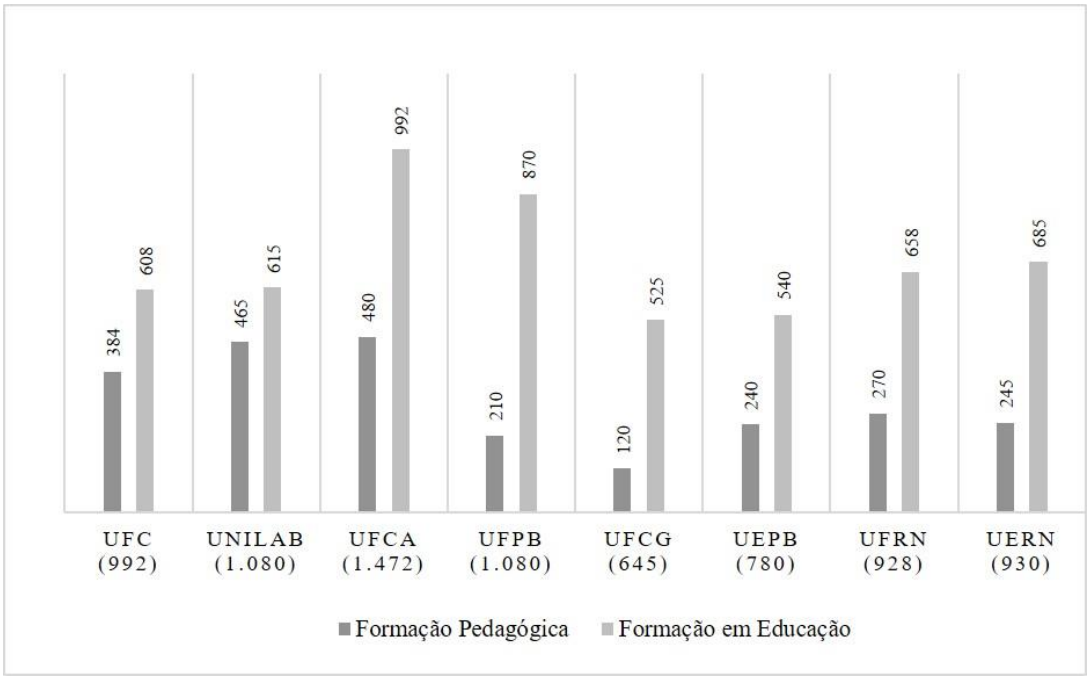
In the continuity of the analysis, we will show, from now on, the organization, in the matrices of the official curricula, of the curricular disciplines focused specifically on pedagogical formation for the teaching of science and biology in the final years of Elementary School and in High School. For that, we take as an indication the distribution of the subjects in two main axes, namely: *Pedagogical Formation and Formation in Education*.

We declare that the organization of curricular subjects with a focus on pedagogical formation for science and biology teaching in the final years of elementary school and high school emerged from the axis previously presented in the analysis, it is worth remembering, *Fundamentals of Education and Pedagogical Formation*. From the subjects presented inside, we classify the two new axes (*Pedagogical Formation* and *Formation in Education*). For the first, *Pedagogical Formation*, we credit the subjects that focus more centrally on the teaching of science and biology in the final years of elementary school and high school; for the second, *Formation in Education*, we consider the disciplines that focus attention on teacher education in a more general perspective, which pay attention to issues beyond classroom teaching.

The Supervised Internship, in this context, was considered in the second axis, since we understand that its contribution in the processes of teacher education does not match, exclusively, with the teaching issues. In our view, the internship allows a plural reading of Education (MEDEIROS; CASTRO, 2020). In Graph 1, we systematize the organization of the disciplines regarding the total hours dedicated to pedagogical formation for the teaching of

science and biology in the final years of Elementary School and in High School in the two analytical axes - Pedagogical Formation and Formation in Education:

Graph 1 – Organization of Disciplines regarding the total hours for Pedagogical Formation for Science and Biology Teaching in the final years of Elementary School and High School[16]



Source: Research data (2020)

The data presented in Graph 1 provide an opportunity to understand that the disciplines considered for pedagogical formation for the teaching of science and biology in the final years of Elementary School and High School are circumscribed, with greater time, to the axis of analysis *Formation in Education*. It is superior, in terms of hours, to teacher formation, when compared to the *Pedagogical Formation* analysis axis. We affirm that in each curricular matrix there is a different reality, in the sense of the disciplines and areas that involve the two axes under discussion, as well as the total hours that they support.

In the UERN Course, for example, the subjects for pedagogical formation include 930 hours. Of this amount, 685 hours are punctuated for the axis of analysis *Formation in Education*, with the subjects "Organization of Brazilian Education", "Fundamentals of Education", "Psychology of Development and Child Learning", "Psychology of Development and Adolescents and Adults Learning" and "Supervised Internships". In the *Pedagogical Formation* axis, 245 hours comprise the subjects of "Introduction to Didactics", "Instrumentation for Teaching Biological Sciences", "Didactics of Biological Sciences",

[16] Subtitles from the left to the right: Pedagogical Formation; Formation in Education.

"Didactics of Natural Sciences", among others (UNIVERSIDADE DO ESTADO DO RIO GRANDE DO NORTE, 2018).

By the example mentioned in the UERN Biological Sciences Teaching Degree, the nomenclatures of the disciplines aimed at pedagogical formation, in certain circumstances, address the biological sciences and, in others, highlight the natural sciences. The expressions "Teaching Biology" and "Teaching Science" are also emphasized in the names of subjects in some curricular matrices (UFCA, UNILAB, UFC, UFCG, UFPB, UEPB and UFRN).

In relation to the areas and/or disciplines that make up each axis, we saw, with weight, in the *Formation in Education* axis, the curricular areas and/or components of "Brazilian Education Organization", "Educational Psychology", "Educational Policy", "Informatics in Education", "Socio-historical and cultural studies of Education", "Educational Management", "Special Education", "Youth and Adult Education", "Anthropological Philosophical Fundamentals of Education", "Teacher Formation in Biological Sciences", "Organization of Work at School and Curriculum" and "Supervised Internships".

In general, in the analysis axis *Formation in Education*, the emphasis is on Supervised Internships and in the areas and/or disciplines that are associated with Education in order to contribute with knowledge and curriculum content of a historical, sociological, anthropological, philosophical nature, from psychology, educational policy, the organization of teaching systems and the curriculum, as well as education management.

With regard to the *Pedagogical Formation* analysis axis, the areas and/or disciplines that appear most are "Science Teaching Methodology", "Didactics", "Specific Didactics for Science and Biology Teaching", "Educational Practices", "Instrumentation for Teaching Biological Sciences", "Instrumentation for Teaching Science", "Instrumentation for Teaching Biology", "Technologies and Didactic Materials", "Assessment of Learning" and "Laboratories of Pedagogical Practices". We understand that these disciplines group knowledge and curricular content that focus on knowing how to teach. The focus of teacher education for teaching science and biology is contemplated, with greater precision, within it.

Having said these considerations, we believe that the official curricula project, in part, a teacher formation for the teaching of science and biology, especially in this dimension of the official curricula. It is in it (axis of analysis Pedagogical Formation) that the questions that relate to knowing how to teach science and biology in the final years of Elementary School and High School are strengthened. However, to deepen the debate, we see, like Ayres (2005) and Medeiros and Aguiar (2018), that it is necessary to analyze how the official curricula are carried out in the context of each graduation. Only then will we be able to develop new conclusions.

Final considerations

This text presented an analysis of teacher formation curricula for science and biology teaching in the final years of elementary school and high school. It took as reference eight (8) Biological Sciences Teaching Degree Courses from public universities (state and federal) in the States of Ceará, Paraíba and Rio Grande do Norte. As considerations learned from the analysis, we highlight, among others:

Curriculum matrices are composed of a variety of scientific areas and curricular disciplines. Among them, the Education area is covered with a focus on curriculum documents. However, your attention is especially on Supervised Internships. The disciplines of the axes of analysis *Biological Diversity* and *Cellular, Molecular Biology and Evolution* also appear more frequently in the curricula of the courses.

Pedagogical formation for the teaching of science and biology in the final years of elementary school and high school is found with greater time in the curricular subjects of a more general nature in the area of Education. These disciplines concentrate knowledge and curricular content from the historical, sociological and psychological fields, among others, associated with Education. In this discussion, Supervised Internships are also central.

Finally, the curricular components that have the most attention on how to teach science and biology refer to the disciplines of methodology and instrumentation for teaching science and biology, didactics, specific didactics, educational practices and pedagogical practice laboratories. Thus, when we study teacher formation for science and biology teaching, we should pay special attention to these components of the official curricula.

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