

## An Analysis of Curriculum and Undergraduate Students' Discourses about Environmental Education: A Debate Concerning Teacher Training\*

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### ABSTRACT

Teacher training on environmental education (EE) is a key element of promoting the restoration of ecological systems and insuring inclusive and equitable human development. Science and biology teachers play a significant role in favoring EE at Brazilian schools. This study investigates the presence of EE in the curriculum and aims to interpret the meanings of EE expressed in the discourse of students who are training to be biology teachers at a Brazilian public university, considering recent, related education legislation. The theoretical and methodological framework of French Discourse Analysis was adopted to identify social, political, and cultural influences expressed in the students' discourse. The discourse data comprised responses from voluntary undergraduate students to a semi-structured questionnaire. Most of the study participants claimed to have had contact with EE in their tertiary education and revealed multiple perceptions regarding this theme. The majority of the discourses indicated that EE meanings are restricted to conservation or preservation, and some indicated confusion regarding the purposes of both EE and ecology disciplines. There was little data indicating an association between EE and socioeconomic issues, which would be expected in terms of the more encompassing and interdisciplinary approaches recommended by legislation. The curricular matrix of this undergraduate course showed a predominance of hours devoted to courses that discuss the environment from the biological perspective in contrast to a small number of courses that discuss and promote EE from other perspectives. In addition, undergraduate students claimed that they had little contact with recent EE legislation. This scenario, reinforced by the naturalistic foundation discourse of EE in Brazil, probably affects the constitution of the discursive memories of these students, their discourses, and their future pedagogical practice. Recommendations are made in order to foster the development of citizenship at schools and to prevent the silencing of issues such as the conflicts and risks associated with environmental problems.

### KEYWORDS

Curriculum; Discourse Analysis; Environmental Education; Science Education; Teacher Training.

### ARTICLE HISTORY

Received 14 July 2016  
Revised 10 October 2016  
Accepted 30 November 2016

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\*This study is produced from the first author's doctoral thesis.



## Introduction

The aim of the study reported in this article was to investigate how the curriculum related to Environmental Education (EE) was being applied in a teacher-training course in biological sciences and to interpret the meanings of EE expressed in the discourses of undergraduate students in biological sciences at a Brazilian federal public university. The curriculum of the course was taken into account as well as the recent Brazilian education legislation, particularly Law number 9795/1999 of the latest National Curriculum Guidelines for Basic Education (*Diretrizes Curriculares Nacionais para a Educação Básica* [DCNEB]), which include a chapter focusing specifically on EE (MEC, 2013a). These two documents are the basis for EE in Brazilian schools and teacher training programs, as stated by the National Environmental Education Program (*Programa Nacional de Educação Ambiental* [ProNEA]) from the Brazilian Ministry of Environment (*Ministério do Meio Ambiente* [MMA], 2014). Both documents recommend an encompassing approach to EE that is based on the understanding that EE includes not only a sense of the need for conservation and ecological balance but also the social, economic, ethical, and cultural issues involved.

The theoretical and methodological framework of French Discourse Analysis (DA) was applied in this study to identify social, political, and cultural determinants in the construction of the meanings of EE in the discourse of undergraduate students in biological sciences. “Discourse” is understood here as written or oral text studied from a DA perspective in terms of its meaning in a given social context (Charaudeau and Maingueneau, 2014; Pêcheux and Fuchs, 2010).

Foucault (2013) conceived discourses as relatively rule-bound sets of statements that impose limits on what gives meaning. The ways in which meanings of a word, an expression, or an object are elaborated result from relations that are unveiled by certain discursive formations. Contemporary discourse analytical approaches do not identify only one knowledge regime in each historical period; “instead, they operate with a more conflictual picture in which different discourses exist side by side or struggle for the right to define truth” (Jorgensen and Philips, 2002, p. 13).

DA seeks to describe, explain, and evaluate from a critical perspective the production, circulation, and consumption of meanings that are materialized in texts. Our research question was whether legislative discourses and curricular matrix configuration influence and are reflected in the discourses about EE elaborated by pre-service biology teachers.

The research aimed to identify different discursive formations about EE expressed on legislation about it, on the courses of the curricular matrix, and in the participants' discourses. The goal in analyzing discourse is to reveal ideological marks, opposing discursive formations within a discursive field, and the conditions that operate on these formations. The concepts of "discursive formation" and "conditions of production/context" structured the present understanding of EE meanings expressed in the discourse of undergraduate students.

Other goals included encouraging reflection on EE within initial teacher training in biological sciences on the basis of DA and suggesting policies and practices that should contribute to promoting the incorporation of the EE theme in schools within a holistic/systemic and interdisciplinary perspective that is not limited to conservation, as recommended by the latest Brazilian legislation.

### **Environmental Education to achieve sustainability, Brazilian legislation about EE**

Possible pathways to sustainability are currently considered socially acute topics, widely debated and disseminated. The United Nations General Assembly, through Resolution 57/254, a Decade of Education for Sustainable Development (2005-2014), emphasized that "that education is an indispensable element for achieving sustainable development" and designated UNESCO as the lead agency for the promotion of this decade<sup>1</sup>. UNESCO (2015) stresses the role of education in promoting more sustainable societies and improving the ability of people to understand the problems related to the environment and development, enabling citizens to face present and future challenges and leaders to make relevant decisions for a viable world.

Considering EE as one of the key tools for environmental management and the population's capacity to participate in this process, ProNEA intends to guide public and private agents for reflection, construction, and implementation of public policies that make it possible to solve structural issues, aiming at environmental sustainability. According to the document (MMA, 2014), EE provides the opportunity to highlight successful experiences as well as integration between teachers and environmental technicians in training programs. The strategy aims to provide information to ensure public participation in the discussion, formulation, implementation, monitoring, and evaluation of environmental policies, supporting the search for sustainable socio-economic models.

Discussions about sustainability in Brazil came to light during the Rio-92 Summit. An outcome of the summit was the Treaty of Environmental Education for Sustainable Societies and Global Responsibility (MMA, 1992). This is a document prepared by a working



group of non-governmental organizations (NGOs) that gathered for this purpose on the First International EE Day (*I Jornada Internacional de EA*), an activity of the Civil Society Forum event held parallel to the Rio-92 Summit. Adopted as a Charter of Principles for various movements, such as EE networks in Brazil, and used as a reference for a series of public policies related to EE in Brazil and worldwide, this treaty states that EE “should involve a holistic approach, focusing on the relationship between the human being, nature, and the universe in an interdisciplinary way.”

Parallel to this, the recognition that higher education training of professionals focusing on EE is a key element in promoting the restoration of ecological systems and for inclusive and equitable human development has been set out in various treaties related to the environment and ratified in the documentation of the Rio+20 Treaty on Higher Education (Copernicus Alliance, 2012). This document was written and signed by a group of over 30 international higher education agencies, organizations, associations, and student networks in an initiative led by the Copernicus Alliance and launched at the UN Rio+20 Summit. It presents a collective vision of higher education networks, groups, and institutions seeking to ensure a more sustainable future through education. The recommended starting point is the recognition that the sustainable development agenda demands a shift in the education paradigm, including changes in institutional responsibility as well as reorientation in terms of curriculum and pedagogy to better serve the needs of current and future generations. The document also highlights the relevance of adopting a more integrated, interdisciplinary approach that allows universities to address global challenges in a more holistic and realistic manner. This point of view has been defended by researchers from different countries (Araújo, 2004; Fadeeva et al., 2014; González-Gaudiano, 2005; Leff, 2002).

In Brazilian educational policy, EE has been progressively highlighted through a range of legal frameworks. In fact, Brazil is considered a pioneer country in Latin America both in terms of implementation of specific legislation for formal EE (Trellez-Solís, 2006) and in terms of creating post-graduate programs with an environmental dimension (Eschenhagen, 2007). EE in Brazil emerged as public policy through the establishment of the National Policy of Environment (*Política Nacional de Meio Ambiente* [PNMA]), Law number 6.938 (1981), influenced by the Tbilisi International Conference that took place in 1977. This law stressed the relevance of educational processes in addressing environmental issues<sup>2</sup> (MMA, 2014). Research in EE in Brazil also emerged in the 1980s, and investigations about teacher training in EE were intensified during the late 1990s (González-Gaudiano and Lorenzetti, 2009; Neto, 2009). In the 1990s, EE became consolidated in the Brazilian educational sphere, particularly as it was emphasized as one of the

Transversal Themes (within Environment and Health) in the Parameters of the National Curriculum (*Parâmetros Curriculares Nacionais* [PCN]) and ratified by Law number 9795/1999 (Brasil, 1999) as mandatory at all levels of education, focusing on socioeconomic issues beyond conservation.

The Brazilian National Environmental Education Policy (*Política Nacional de Educação Ambiental* [PNEA]) was established through Law number 9.795/99 and is coordinated by the Ministry of Environment and the Ministry of Education. In 2004, ProNEA was launched. It establishes the guidelines for public policies concerning the environment and is considered to be a social participation instrument, which is reorganized frequently. The last edition was launched in 2014 and considers Law number 9.795/99 and the latest DCNEB to be the basis for EE in Brazilian schools and teacher training programs.

EE is regarded by the current educational legislation to be an essential component of basic and higher education, which should be developed in terms of an integrated, continuous, and permanent practice across all stages of education (*Ministério da Educação* [MEC] [Ministry of Education], 2013a, p. 531). ProNEA has as its guiding principle the perspective of environmental sustainability. Its actions are intended to ensure, in the educational field, the interaction and integration of multiple dimensions of environmental sustainability—ecological, social, ethical, cultural, economic, spatial, and political—seeking social involvement in the protection, restoration, and improvement of environmental conditions (MMA, 2014, p. 24).

### **Environmental education teacher training**

Despite educational legislation being a determining factor in EE consolidation in formal education in Brazil, it does not guarantee automatic and consensual EE activities at schools and universities, and it is not the only influence on directions regarding EE. Moehlecke (2012) points out that the limited power of curriculum guidelines is due to several factors, including the distance between normative discourse and school practices, the lack of continuity of Brazilian national curriculum policies, and the characteristics of teacher training.

Discrepancies between the curriculum contained in official documents and actual teaching practice reveal that school culture reframes the content defined in the legislation; thus, pedagogical practice determines which aspects gain greater prominence and which are relegated to the background. One factor that influences the way that the curriculum is put into action in schools is initial teacher education. Tardif (2012) states that teachers' knowledge is complex and dependent on their historical-ideological foundation as well as on their initial and continuing education, including issues of discipline, curriculum, and experiential



knowledge. Swinkels et al. (2013) argue that pre-service teachers' conceptions of learning and teaching influence the way they will approach situations as teachers. The influence of initial teacher training on their future activities within basic education is recognized by Law number 9795/1999, which states that the environmental dimension must be included in both initial training curricula and continuing education of teachers at all levels and in all disciplines or curriculum components.

To ensure that EE is included in all school curricula and promotes citizenship, it is essential to foster the training for teachers of all disciplines to be involved in EE projects before they begin in the teaching profession (Krasilchik, 2011). In spite of this, it remains essential to investigate the training of science and biology teachers in Brazil, as these professionals play a considerable role in promoting EE in schools because such teachers generally have a particular personal and professional identification with the environment (Campos, 2007). Furthermore, the tradition of the school itself remains somewhat fragmented, and therefore, it may have an effect, as may the predominance of references to environmental issues within the natural science curriculum (Pedretti, 2014).

A national survey conducted by the Brazilian Ministry of Education in 2006 revealed that 72% of schools that declared promoting EE did so by means of integration across two or more disciplines (almost always including science and biology teachers), and 18% did so within a single discipline, either science or biology (MEC, 2007). The same survey showed that the main motivation for EE in schools was based on the initiative of one teacher or a group of teachers. Thus, whether through an interdisciplinary or a single-discipline approach, within the sciences (at elementary schools) and biology (at high schools), teachers who have graduated from biology courses are often involved in EE. In fact, it is currently argued that, despite certain limitations, science education at schools can offer a range of opportunities to promote environmental awareness, which is highly compatible with EE (Hadzigeorgiou and Skoumios, 2013). Wals et al. (2014) point out the necessity of connecting EE and science education, which has been recognized by the North American Association for Environmental Education, and the authors argue that this connection can promote effective processes of engagement and learning, resulting in significant socioecological outcomes. In order to achieve this, science education and EE "must reimagine themselves to create a mutual and compatible agenda"; the rhetoric about what science education should be has altered, but it still has not achieved what many environmental educators seek (Pedretti, 2014, p. 312).

**Discourses about EE: Discourse circulation and curriculum development**

According to the Brazilian Ministry of the Environment (MMA, 2004), EE refers to educational practices related to environmental issues, and it is emphasized that various designations have been used to express the concepts by which practical and pedagogical reflections on such issues may be perceived. For Pedretti (2014), school-based EE consists of a diversity of narratives, which sometimes are discrepant with the contemporary philosophy of EE, effecting policy, pedagogy, and curriculum. Therefore, despite the considerable consensus that has been established regarding the importance of EE, discourses and debates about environmental issues are based on heterogeneous political and epistemological approaches and are associated with different conceptualizations and practices.

In fact, several authors have produced analyses that identify the different approaches, currents, and discursive formations that circulate in the EE field (Layrargues and Lima, 2014; Martins et al., 2008; Sauvé, 2005). In studies of the discourse, it is considered possible to relate different discursive formations with the ideological aspects that govern these relations, seeking to reach the network that influences the constitution of meanings on the subject studied.

Layrargues and Lima (2014, p. 25) argue that the field of EE consists of a diversity of social actors and institutions that share a core of common values and standards. On the other hand, these social actors elaborate different discursive formations, so they dispute the hegemony of the field and the ability to guide it according to their interpretation of reality and their interests.

Grounded in a review of the international literature on EE, Sauvé (2005) established fifteen different “currents”—the notion of “current” referring to a general way of envisioning and practicing EE. She divided them into two groups: those that have a long tradition (naturalist, conservationist/resourcist, problem-solving, systemic, scientific, humanistic, and value-centered) and the emerging currents (holistic, bioregionalist, praxic, socially critical, feminist, ethnographic, eco-education, and sustainability). The author stresses that this mapping is a theoretical proposition and that each current comprises a plurality and diversity of propositions; it is not a monolithic category. She argues that a single proposition (an approach, a model, a strategy, a program, an activity, etc.) may be associated with two or three different currents according to the angle from which it is analyzed. Therefore, although each current presents a set of specific characteristics that differentiates it from others, this does not imply that the various currents are mutually exclusive in every respect; some will have one or more characteristics in common, creating zones of overlap, and the currents must not be “reified” (Sauvé, 2005, p. 12). In fact, discourses undergo a constant restructuring process,





which makes the definition of a discursive formation unstable and dependent on context.

The broader context within which this research was developed is a widespread global concern about the environment, which is reflected in the educational legislation of basic and higher education in Brazil. Particularly, it is a historical and political moment in which the National Education Council (*Conselho Nacional de Educação* [CNE]) has approved a new DCNEB, which includes a chapter focusing specifically on EE (MEC, 2013a). It also led to several changes in undergraduate courses, which culminated in the approval of the National Curricular Guidelines for Teacher Training in Higher Education (*Diretrizes Curriculares Nacionais para a Formação Inicial de Profissionais do Magistério em Nível Superior e para Formação Continuada*) in 2015 (Brasil, 2015). These guidelines define the principles, foundations, training dynamics, and procedures to be followed regarding policy and management of initial teacher-training courses and programs, as well as in the planning, evaluation processes, and regulation of higher education institutions. It states that the training program should include solid theoretical and interdisciplinary training of professionals as well as socio-environmental, ethical, and aesthetic issues, and it must be linked to curriculum guidelines for Basic Education.

All of these documents, as well as Law number 9795/1999, recommend an encompassing approach to EE on the understanding that EE includes not only a sense of the need for conservation and ecological balance but also of the social, economic, ethical, and cultural issues involved. This encompassing perspective is considered suitable for promoting citizenship and social participation in environmental management.

Despite this, recent studies about teacher-training courses in the biological sciences at the universities of different Latin American countries have reported a hegemony of discourses about EE restricted to conservation and/or biological aspects (Mejía et al., 2013; Muñoz-Pedreras, 2014; Schulz et al., 2012). Similar results were found within post-graduate programs (Eschenhagen, 2007). Furthermore, some Brazilian investigations have found EE being interpreted by undergraduate students as the act of teaching concepts of ecology (Araújo and França, 2013; Galieta, 2014; Souza et al., 2011). On the other hand, González-Gaudiano (2001) states that although they are being influenced by discourses centered on conservation, Latin America countries include different perspectives, presenting a specific profile in comparison to other countries.

Goodson (2008) emphasizes the practicality of curriculum development, in which teachers play a central role as they adjust the



curriculum according to their goals, ideology, and interpretations. Indeed, this is why initial teacher education is inextricably linked to the efficacy of a school's curriculum, as professors, and in turn, teachers consciously and unconsciously select the content that is to be more or less prominent in their teaching. Arroyo (2013, p. 13) understands that the curriculum is a contested territory, as it constitutes "the nucleus and more structuring central space" of the functioning of educational institutions. The author points out that the guidelines, curricular matrix, and working hours constitute a power policy setting that seeks to standardize this space, which will be reframed and re-directed by the actors involved, including teachers. The latest version of the DCNEB (Brasil, 2013, p. 180) understands that the actual curriculum is a result of the relationship between the prescribed curriculum and the socio-historical-cultural context.

Ester et al. (2004, p. 62), in the context of a wide cross-national study about how the mass public and decision makers frame environmental problems and solutions, concluded that they are definitely rooted in different cultural perceptions, traditions, and values, so the cultural factor of environmental research merits a "dominant position on both the research and policy agenda."

Since discourses and pedagogical actions are influenced by the social, historical, cultural, and political contexts as well as by previously involved discourses, understanding the re-significations and reinterpretations of the legislative discourse of teachers, professors, and undergraduates as well as the factors influencing this phenomena can contribute significantly to the development and implementation of educational policies.

### **Discourse circulation and French Discourse Analysis as a theoretical and methodological reference**

In light of the power relations and discourse circulation that lie behind curriculum development, this research focused on the initial EE training of science and biology teachers and the discourses produced about EE among undergraduate (pre-service) teachers at a Brazilian federal public university - Federal University of Juiz de Fora (*Universidade Federal de Juiz de Fora* [UFJF]). In Brazil, EE is supposed to be addressed in the initial training of teachers in every undergraduate course, but despite being subject to the same laws in this regard, the particular configuration of each university course involves its own unique contexts and discursive formations.

French DA refers to the discourse of social and human relations as well as its production, emergence, strengths, and circulation conditions. Our aim was to identify and investigate the role and the representation of



EE in and through language as well as its operating modes in discursive practices within a biology teacher-training course. According to Williams (1999, p. 87), discursive formations comprise configurations of “enunciative modalities” that are conceived of as types of discursive activity. These “enunciative modalities” have rules of formation that are constituted for any particular discursive formation by a complex group of relations. We consider Brazilian legislation, the pedagogical project, and the curricular matrix of the undergraduate course to be “enunciative modalities” that interact and influence the pre-service teachers’ discourses. Once the manner in which “enunciative modalities” are articulated is not permanent, it is subject to constant modification, and discursive changes may be promoted by adopting different conducts.

Identifying the most recurrent discursive formations among students reflects what is discussed in the course and which discourses are promoting stronger effects in this arena. These investigations may indicate which discourses will be present in schools for the next few years, substantiating changes in curricular matrix and new proposals that address EE discussions within the pre-service teachers’ courses.

The adoption of DA to understand educational phenomena has its origin in linguistic research but has spread to other areas, such as communication, sociology, and science education. Current Brazilian academic production in science education shows a progressive increase in the number of studies that adopt the theoretical and methodological framework of DA (Veneu et al., 2015). In this sense, Galieta and Almeida (2013) point out that French DA has undergone a reinterpretation in the context of research in science education and has generated a substantial production. The authors stress that considerations of the settlement of this discipline by science education researches should be encouraged so that their results can be reflected in the teaching of basic science education.

In fact, in Brazil, some papers on science education have already employed DA within research on the initial and continuing EE training of science teachers. Martins et al. (2008) argue about the potential of critical discourse studies for research in EE, and they discuss the nature of the different discourses that constitute environmental educators’ practices, grounded on investigations of pre-service biology teachers wherein the researchers adopted video recording to analyze discourses. Santos et al. (2012) investigated the discourses about EE that were produced by schoolteachers during a course for environmental educators, also grounded in critical DA. They tried to identify articulations between external EE discourses and those that circulated within the course. Galieta (2014) interpreted the discourses of pre-service biology teachers by adopting French DA and trying to understand the context of production and the

meanings the students' elaborated about EE. The researcher analyzed texts written by students within an evaluation from a compulsory course.

## Materials and Methods

### The biology teacher training program: An overview

The biology undergraduate course investigated herein offers the option to graduate as a licensee (teaching credential) or with a bachelor's degree. There is a common-core curriculum for both options. Officially, applications for teaching credentials must be submitted during the fifth semester of the undergraduate course, and the pedagogical project (*Instituto de Ciências Biológicas* [ICB], n.d.) states that teacher training includes technical concepts, how to generate knowledge, and different courses that focus on citizen development.

Biology teacher training includes contents from scientific disciplines—biological sciences, chemistry, physics and health sciences—as well as pedagogical disciplines. School practice must take place during scientific and pedagogical courses. The previous (Brasil, 2001) and the recent (Brasil, 2015) legislation related to hours of teacher training do not specify the relative load of the scientific and pedagogical training; it states that each course can establish the form and the structure of the duration of working hours and the hours of other activities selected in addition to the organization of pedagogical practice and supervised training in schools as a curricular component.

According to the pedagogical project, the undergraduate curriculum follows the legal determinations of the educational legislation from MEC and the Brazilian guidelines for teacher training while also embracing suggestions from several discussion forums led and proposed by a committee.

### The analytical corpus

In French DA, the main theoretical and methodological framework adopted for the present research, the analytical *corpus* is constituted by objects and subjects that the researcher considers to be part of the political, social, and historical context of the research participants. The analysis starts by selecting this *corpus* and delineating its limits as the researcher determines certain omissions (Orlandi, 2012). For the present analysis, the *corpus* consisted of legislative documents related to EE in Brazil; legislative documents related to basic and higher education curriculum in Brazil; the pedagogical project, outlines, and contents of the various courses of the undergraduate program studied, and the responses

of undergraduate students of biology at UFJF to a semi-structured questionnaire (Table 1).

**Table 1: Elements of the *corpus***

| Elements that compose the <i>corpus</i> | Discourses about EE  |  |  |
|---|--|--|--|
|   | Brazilian Legislation  | Undergraduate course                                 | Pre-service teachers                         |
|   | Law number 6938/1981 as EE foundation discourse  | Outlines and contents of the various courses studied | Responses to a semi-structured questionnaire |
|   | Law number 9795/1999 and the National Curriculum Guidelines for Basic Education from 2013 as contemporary legislative discourses | Pedagogical project                                  |  |

### Research participants

The participants of this study were pre-service science and biology teachers who were actively registered from the sixth semester onward in the biological sciences undergraduate course at UFJF during the data collection period. The sample included only those undergraduates who had officially applied for teaching credentials and had contact with most of the courses in the curriculum. According to the Coordinator of Biological Sciences at UFJF, a total of 67 students were enrolled for teaching credentials from the sixth semester onward in October 2014. Of these, 40 participated in this research, accounting for 60% of the selected group.

### Research tools and investigative procedures

The discourse data comprised responses by voluntary undergraduate students to a semi-structured questionnaire. The semi-structured questionnaire was based on empirical and theoretical studies in the fields of EE and teacher training (Lamosa, 2010; MEC, 2007; 2013b; Ruy, 2006). The questionnaire contained thirteen structured questions and eight open-ended questions. Only a subset of these data will be analyzed here. To avoid pre-structuring the discourse (i.e., to minimize the chance of structured questions influencing answers to open questions), the open questions related to EE preceded the structured ones. Nevertheless, we believe that it is impossible to completely eliminate the influence of the question structure and the questionnaire completion context itself on the participants' responses.

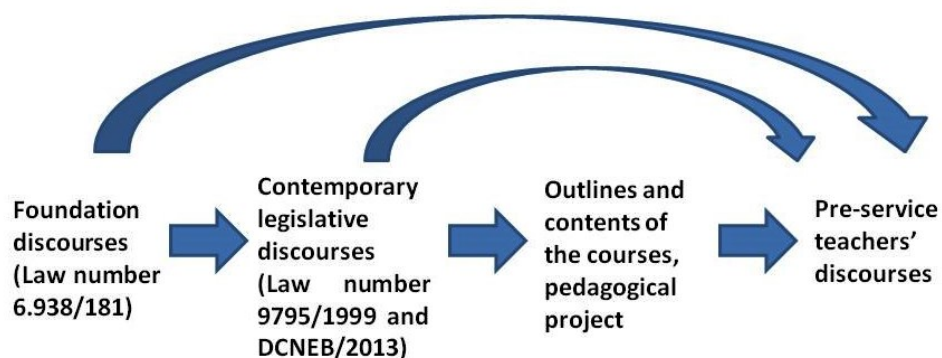
By adopting the theoretical and methodological framework of DA, comprehension implies seeking the production conditions of the discourses, in essence, the context in which the discourses were produced. Maingueneau (2006, p. 33) provides a list of the core constituents of

context: the participants, their space-frame, and the participants' goals. According to Williams (1999), French DA assumes that language expresses interaction. Such a relationship is underscored in contemporary debates, not only on the social plane—the external space for discourse production—but also on the internal, linguistic, and enunciative ones. Discourse production involves people, time and space, dimensions that are integrated into a zero point of its enunciation (internal enunciative space), and the spatial points that lie outside (external space for discourse production).

As an external space for the production of discourse about EE, we assumed that the research participants' discourses are related to others, such as the curricular matrix and pedagogical project of the undergraduate course, educational legislation, and EE legislation. We analyzed the legislation and the curricular matrix discourse because we consider the students' meanings to be the results of complex relationships and to be influenced by them.

Grounded on theoretical and methodological assumptions of DA we consider one discourse to be influenced by other pre-existing discourses; therefore, we understand that they interact as illustrated in Figure 1.

**Figure 1: Interaction between discourses of the *corpus* elements**



As an internal enunciative space for discourse production, it should be taken into account that the data were collected by means of a questionnaire in the classrooms of an initial teacher-training course at a Brazilian federal university (UFJF) at the time of the release of new legislation related to EE in schools. The participants were informed about the general objectives of the research, that it was part of a broader



investigation about their course, and that it formed part of the doctoral thesis of one of the researchers.

The questionnaire was administered at the end of classes for three compulsory subjects in the teaching credentials course. The questionnaire was administered with the prior permission of the teachers, who also acted as witnesses, as is required by the UFJF Ethics Committee on Human Research. Before the participants completed the questionnaire, the research objectives were clarified, with emphasis on the importance of the investigation in fostering reflection on the course and about the performance of science and biology teachers in schools. The participants read the Terms of Informed Consent before deciding whether or not they wished to participate. Contact was later made via the internet with certain students who were absent at the time, only one of whom came to answer the questionnaire at a later meeting. The questionnaire data were collected between October and November 2014.

The decision to use questionnaires was based on the high number of participants and the limited time they had available to answer our questions. In addition, the questionnaire format favored the presence of witnesses, as required by the Ethics Committee to ensure clarification about the research and to prevent coercion.

### **Ethical procedures**

In accordance with the UFJF Ethics Committee instructions, this research project was recorded in the Brazil Platform (*Plataforma Brasil*), identified by the code CAAE 34553614.4.0000.5147. In addition, the semi-structured questionnaire, Terms of Informed Consent, and infrastructure statements of the UFJF Department of Education and Institute of Biological Sciences were registered on the Platform. Finally, written permission to conduct the survey was requested by the Management and Coordination center of the UFJF Institute of Biological Sciences.

### **Results and Discussion**

The following subsections present the general results, an analysis of the discourses of the *corpus* elements, and an analysis of their interaction.

#### **Brazilian legislation: Foundation discourses and contemporary legislative discourses about EE**

As stressed in Table 1, the present analysis of legislative discourses on EE considered Law number 6938/1981 to be the EE foundation discourse in Brazilian Basic Education. According to Orlandi (1995), this “foundation discourse” is the starting point for other discussions; it constitutes part of the discursive memories about a subject or object. However, it cannot be

considered a “point zero,” as it is itself based on previously existing discourse.

Law number 6938/1981 established the Brazilian National Environmental Policy (*Política Nacional do Meio Ambiente*), its purposes and mechanisms of formulation, and its application. Article 2 states that such policy is intended “to preserve, enhance, and restore the environmental quality of life, in order to ensure, across the country, conditions for socio-economic development, the interests of national security, and the protection of the dignity of human life”. To achieve this, the principles to be met include a recommendation (not mandatory) for EE at all educational levels, aiming to enable people to participate actively in environmental protection.

Nevertheless, there is no term that indicates the requirement to include EE in school curricula. The definition of environment in item I of Article 3 is “the set of conditions, laws, influences, and interactions of physical, chemical, and biological elements that allows, shelters, and governs life in all its forms.” Article 4, section V states that the National Environmental Policy will target “the diffusion of environmental management technologies, the dissemination of environmental data, and the development of a public awareness of the need to preserve the environmental quality and ecological balance.”

As shown in the above transcript excerpts, Law 6938 expressed a discourse in which the environment only embraced the chemical, physical, and biological aspects, and the purpose of the EE was to raise awareness of the need for the preservation and maintenance of ecological balance; it was restricted to these aspects, silencing social issues. In fact, the law sought to establish rules and regulations for environmental licensing, fines values for breach of law, classification of economic activities according to their environmental impact, and so on. From an educational point of view, even though it constitutes the first piece of legislation to recommend the realization of EE at all levels of education, it did not established its obligate inclusion in the curriculum and did not address the basic principles of EE. As noted in endnote 2 this law was implemented while Brazil was still under civil-military dictatorship.

The Brazilian Federal Constitution (Brasil, 1988) established that the union, states, federal district, and municipalities are responsible for protecting the environment, combating pollution of any form, and preserving forests, fauna, and flora. We do not consider the Federal Constitution to be a part of the foundation discourse of EE, but its EE meanings are very similar to those of Law number 6.938/1981 regarding environmental issues. Article 225 states that “everyone has the right to an ecologically balanced environment, of common use and essential to a





healthy quality of life, imposing on both the Government and the community the duty to defend it and preserve it for present and future generations.” To ensure the effectiveness of this policy, section VI states that it is the responsibility of the government to promote EE “at all levels of education and foster public awareness to preserve the environment.” Once more, it was considered desirable but non-mandatory to establish EE in schools.

According to Krasilchik (2000), the official documents that are named “Parameters” and “Guidelines” form part of a set of “Political Indicatives” by which the intentions of the government for educational reforms are made explicit. The latest Guidelines and Basis of Education Law number 9394 (*Lei de Diretrizes e Bases da Educação [LDB]*) of 1996 were established in order to enable the application of the above provisions of the 1988 Constitution. This law defined a common national basis for the curricula of primary and secondary education in Article 26. In Article 9, it assigned to the union the tasks of drawing up the National Education Plan, establishing responsibilities and guidelines for basic education, and ensuring national evaluation of school performance. However, it made no explicit reference to EE (Brasil 1996).

As presented in Table 1, Law number 9795/1999 and the latest version of the DCNEB (MEC 2013a) will be analyzed here as representative of more recent legal discourses circulating in educational institutions, as they are considered the basis for EE in ProNEA (MMA, 2014).

The DCNEB, which have a legal character, were released soon after the 1996 LDB; they were revised and re-launched in 2012 after changes in legislation, such as an increase in compulsory schooling and the approval of Law number 9795/1999 (MEC, 2013a). The latest version of the DCNEB includes a unique section on EE, unprecedented in Brazilian curricular policy. Specifically, the document mentions the Rio+20 Conference and Law 9795/1999 as being greatly influential in the establishment of the Curriculum Guidelines for Environmental Education (MEC, 2013a). In Article 1 of Law number 9795/1999, EE is defined as follows:

Environmental Education is understood as a process through which the individual and the community build social values, knowledge, skills, attitudes, and competencies aimed at the conservation of environmental resources of common use, essential to a healthy quality of life, and sustainability. (authors’ translation)

Furthermore, Article 4 sets out some of the basic principles of EE:

[...] humanistic, holistic, democratic, and participatory approach; the conceptualization of the environment in its entirety, given the interdependence between the natural, socio-economic, and cultural

environment, with a focus on sustainability; pluralism of ideas and pedagogical concepts, from the inter-, multi-, and transdisciplinary perspective [...]. (authors' translation)

Article 5 establishes the goals that EE might achieve:

I—the development of an integrated understanding of the environment in its multiple and complex relationships involving ecological, psychological, legal, political, social, economic, scientific, cultural, and ethical aspects; II—ensuring democratization of environmental information; III—the stimulation and the strengthening of a critical awareness of the environmental and social problems; IV—to encourage individual and collective, permanent and responsible participation in preserving the balance of the environment and understanding the defense of environmental quality as an inseparable value of citizenship; V—the encouragement of cooperation between the various regions of the country, micro- and macro-regional levels, aiming at the construction of an environmentally balanced society based on the principles of freedom, equality, solidarity, democracy, social justice, responsibility, and sustainability [...].

The discourse transcript above profoundly shifts the EE meanings present in Law 6.938/1981, as it includes terms such as “critical consciousness” (rather than just “awareness”) and adds the word “social” to environmental issues. When dealing with “preservation,” it shifts its original meaning to associate it with quality of life and citizenship; likewise, when it includes social justice as one of the principles of “environmentally balanced society.”

The EE section of the new DCNEB states explicitly that it “conceives environmental education from a socio-environmental perspective of environmental justice, balanced trade relations, and sustainability concepts” (MEC, 2013a, p. 522). The document stresses that:

If EE was set at its beginning by a naturalistic tradition that fragments the analysis of reality, establishing the dichotomy between nature and society, it is essential to think of the Curriculum Guidelines for Environmental Education as seeking to overcome this mark. Accordingly, it is believed that such a mark can be overcome in view of a socio-environmental statement, building permanent interactive relationships between human life and social life in terms of nature. (MEC 2013a, p. 522, authors' translation)

Regarding pedagogical practice in EE, the document recommends a complex approach, whereby a school must seek a curricular organization



with interdisciplinary support rather than a fragmented view of knowledge. EE should include an “integrated and cross-curricular approach, inter-, multi-, and transdisciplinary, continuous and permanent in all areas of knowledge, curriculum components, and school and academic activities” (MEC, 2013a, p. 530, authors’ translation). The DCNEB also points out the need for courses and programs of higher education that value EE in teaching, research, and extension. In this regard, it states that “the socio-environmental dimension must be included in the curricula of the initial and continuing training of education professionals at all levels and in all disciplines or curriculum components” (MEC, 2013a, p. 531, authors’ translation).

According to Article 17, section I, curriculum planning and basic education institutions should encourage the following:

- a) an integrated and multidimensional view of the environmental area, considering the study of bio-geographic diversity and its vital ecological processes, political, social, economic, and psychological influence, among others, and the relationship between society, environment, nature, culture, science, and technology; b) critical thinking through philosophical, scientific, socioeconomic, political, and historical studies from the perspective of environmental sustainability, valuing participation, cooperation, and ethics; c) recognition and appreciation of the diversity of multiple scientific and popular knowledge and views about the environment, particularly of indigenous peoples and traditional communities; d) experiences that promote knowledge, respect, responsibility, and careful contact with living things and their habitats; e) reflections on socioeconomic inequalities and their environmental impacts, which mainly affect vulnerable groups, aiming at the achievement of environmental justice [...]. (MEC, 2013a, p. 540- 541, authors’ translation).

One of the items of the questionnaire applied in our research listed a number of documents related to EE and required participants to indicate with which they had come into contact during their undergraduate study. Participants could mark as many options as they wished. Only 16 of the 40 participants marked curriculum documents such as guidelines and parameters related to EE, showing that pre-service teachers had poor contact with them.

### **Curricular matrix and pedagogical project discourses about EE**

The pedagogical project of the undergraduate teacher-training course in biological sciences studied mentions EE in only two sections. On page 9, referring to the skills and abilities to be developed, and on page

23, describing a course named “Instrumentation in Environmental Education” (ICB, n.d.).

In the document, EE is listed as one of the skills the undergraduates must develop, but there is no information or directions about the approach to be assumed. On the official undergraduate website, it is stated that graduates will be able to act in EE as follows: “to guide the public on ways to preserve the environment in protected areas, zoos, parks, gardens and schools.” The social, political, and economic issues involved in EE are not expressed in this text.

In relation to the course “Instrumentation in Environmental Education”, the pedagogical project gives a generic explanation that does not refer specifically to this course but to all courses on instrumentation. It explains that, in addition to practical activities within curriculum components, certain courses named “Instrumentation” were created in ICB departments, seeking closer integration with the activities of the Department of Education and fostering interdisciplinary work:

In this sense, in addition to proposals for changes in curriculum components, and with respect to the principles contained in the Education Program, there must be a philosophical change by professors to contemplate both modes in the basic cycle. Therefore, in trying to provide application training that enables the professional to work in an integrated and interdisciplinary manner, a review of the presentation of the basic content distributed in the different disciplines and the integration of training with different areas of knowledge is recommended. (ICB, n.d., authors’ translation)

This alleged integration between ICB and FACED does not happen in practice, as evidenced in other stages of the research. Instrumentation courses are currently offered as electives that fall under the departments of the ICB. A pre-service teacher is required to attend only one of the five instrumentation courses offered, and one of them is “Instrumentation in Environmental Education.” The other 66 courses of curriculum are mandatory, 47 from ICB, 13 from FACED, and the rest from other departments.

The outlines and contents of each of the courses identified by participants in the questionnaire as promoting or discussing some kind of EE were consulted as given on the UFJF site in July 2014. The concepts and expressions that make reference to EE obtained in these outlines and content-related data are given in Table 2 as well as the number of undergraduate students that cited each one of the courses.



Despite expectations, there were no mentions of the course “Instrumentation in Environmental Education.” According to personal communication with the Graduate Coordinator of Biological Sciences, the course was offered infrequently. In addition, as mentioned before, it was only one among a range of five electives, of which pre-service teachers need to choose only one to fulfill current curriculum requirements.

As the course “Ecology of Population and Communities” was divided into two, namely “Population Ecology” and “Communities Ecology,” and their information was not available on the site, this was obtained from the respective professors in charge.

**Table 2: Courses cited by participants as including environmental education**

| Course   | Department  | References to environmental education (EE) in outlines and/or contents   | Number of citations |
|--|---|--|---------------------|
| Science Teaching II with School Practice<br>( <i>Ensino de Ciências II com Prática Escolar</i> ) | Education   | Interfaces between science education, health education, environmental education, as well as education about sexuality and ethno-racial issues. Conceptualizations of environment and EE in dispute. Curriculum policies and EE. Relations between social and environmental inequality, environmental justice, and EE. EE in school and non-school spaces: Objectives, resources, and teaching strategies that circulate in different educational spaces. | 11                  |
| Ecology of Population and Communities*<br>( <i>Ecologia de populações e comunidades</i> )        | Botany/<br><i>Instituto de Ciências Biológicas</i><br>(ICB) | No references to EE.   | 9                   |
| Population Ecology<br>( <i>Ecologia de populações</i> )  |   | No access to outlines, content, and bibliography.  |                     |
| Communities Ecology ( <i>Ecologia de comunidades</i> )   | Zoology/<br>ICB   | Topics in conservation: Economic development, global ecology, and global warming.  |                     |
|  | Botany/ICB  |  |                     |
| Fundamentals of Ecology<br>( <i>Fundamentos de Ecologia</i> )                                    | Biology/ICB   | No references to EE.   | 5                   |
| Ecology (non-specified )   | ICB   | Non-specified  | 5                   |
| Conservation Biology **<br>( <i>Biologia da conservação</i> )                                    | Zoology /ICB  | Introduction to philosophical, ecological, and anthropogenic aspects of environmental management and conservation. Discussion of the grounds for biological conservation, considering current conceptualizations of biodiversity. Discuss the role of environmental ethics and its importance to conservation and human societies.   | 5                   |
| Economic Botany<br>( <i>Botânica Econômica</i> )   | Botany/ICB  | Agribusiness and agro-ecology; Ethnobotany—history, concepts, economic importance, management, biodiversity conservation and education; environmental conflicts.   | 2                   |
| Practice in School II: Science / Biology*<br>( <i>Prática Escolar II</i> )                       | Education   | No references to EE.   | 1                   |

- Ciências/  
Biologia)

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|--|---------------|--|---|
| Supervised Training I (Estágio Supervisionado I)   | Education     | No references to EE.   | 1 |
| Supervised Training II (Estágio Supervisionado II)   | Education     | No references to EE.   | 1 |
| Scientific Knowledge and School Practices (Saberes científicos com Práticas Escolares)     | Education     | Scientific knowledge and popular knowledge: characterization and values. Trends and prospects of education in the natural sciences: STSE (science, technology, society and environment) approach, scientific literacy, EE. Interdisciplinarity in the school context: justification, concepts, modalities; analysis of interdisciplinary projects. | 1 |
| Methodology of Teaching Science and Biology (Metodologia do Ensino de Ciências e Biologia) | Education     | No references to EE.   | 1 |
| Instrumentation on Invertebrates (Instrumentação em Invertebrados)                         | Zoology / ICB | No references to EE.   | 1 |
| Instrumentation on Vertebrates (Instrumentação em Vertebrados)                             | Zoology / ICB | No references to EE.   | 1 |
| Restoration of Degraded Areas** (Recuperação de Áreas Degradadas)                          | Botany / ICB  | Overview of environmental policy and environmental licensing. Characterization of the physical environment. Diagnosis of biota (flora and plant cover). Characterization of the anthropic environment. Plan for recovery of degraded areas, mitigating and protective measures.  | 1 |
| Education (non-specified)  | Education     | Non-specified  | 1 |
| Zoology (non-specified)  | ICB           | Non-specified  | 1 |

Notes: Courses marked with an asterisk (\*) no longer exist. The data are given here for all responses, as it was not possible to determine which participant had attended which course. The courses marked with two asterisks (\*\*) are electives for a bachelor's degree in biology and do not count towards the total credits in the pre-service teachers' curriculum.

### Participant profiles and their discourses about EE

A profile of the group of participants emerged from an analysis of their answers to the questionnaire. Among 40 participants between 20 and 30 years of age, 25 were female and 15 male. Of this total, 12 were in the sixth semester, eight in the seventh, 17 in the eighth, and three in the ninth. Three reported concurrently pursuing or previously having pursued a bachelor's degree in biology, and one reported already having been awarded a bachelor's degree in environmental management. The remaining 36 reported exclusively pursuing undergraduate biology/science teacher training (teaching certificate). All participants had attended at



least one undergraduate course involving general education classroom observation at schools, which was a prerequisite for participation in the research. They reported 26 internship sites, and the six schools with the greater number of participants (with more than 10% of all participants in each) were part of the public network. Thirteen participants (32.5%) had spent time at non-formal education sites, including museums and science centers. Nine were fellows of the Institutional Scholarship Program for an Introduction to Teaching (*Programa Institucional de Bolsas de Iniciação à Docência* [PIBID]). PIBID is a program that provides undergraduate fellows oriented contact with the school environment, encouraging reflection on pedagogical practices among university professors and elementary school teachers.

In order to determine the EE perceptions of the participants, we analyzed their answers to certain open and closed questionnaire items. Anonymity is preserved in the data excerpts given here by using the letter U along with a number designation to distinguish participants. The question most directly related to an understanding of EE was “What do you mean by environmental education?” Additionally, we present their answers to two questions related to the courses of their program that they believe incorporated EE, and the ways in which they judge EE within these courses was discussed. The participants’ answers to these questions are presented in Table 3, categorized in terms of these themes.

**Table 3: Students meanings about EE, courses of the program students believe that incorporated EE and the ways in which they judge EE was discussed within these courses.**

| Participant/<br>Semester | What do you mean by EE?  | Program courses<br>cited                       | How EE was discussed  |
|--------------------------|--|--|---|
| U1/6th                   | “Teaching about the environment, about life and its relation to the abiotic. On conservation, preservation. Education can raise awareness of ourselves and change our habits.”               | Science Teaching<br>II with School<br>Practice | “It has discussed several environmental problems in the classroom, has exhibited documentaries.”  |
| U2/6th                   | “EE is a study field that allows the learning of man and nature involvement, an involvement that extends from the exploitation of resources to the degradation of natural resources.”        | Science Teaching<br>II with School<br>Practice | “It came up with the exposure of important concepts within EE and the production of educational resources to bring EE to the school environment.”               |
| U3/7th                   | “EE encompasses every facet of our society. The environmental, political, and social parts; it is present to form more critical and active individuals in society.”                          | Science Teaching<br>II with School<br>Practice | “It is being worked on and being characterized and conceptualized, by studying its historic tendencies, its problematization and teaching in high school.”      |
| U4/6th                   | “EE involves the study of the environment, relating to social and cultural issues and not just by treating the environment as nature, taking care of a green, protecting a tree or a beach.” | Science Teaching<br>II with School<br>Practice | “It has been studied in order to remove the image of nature adding a new concept, integrating the facts and situations, discussing the role of the population.” |
| U5/9th                   | “EE would be any environmental knowledge that enables a person to get an idea and learn caring for the environment sustainably.”   | NONE   |   |



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| U6/6th   | “EE would be a form of integration, communication between society and environment. Promoting greater community proximity to the environment.”  | Science Teaching II with School Practice                        | “The teacher discussed the different perspectives about EE, historical EE, and some situations that degrade the environment.”  |
| U7/6th   | “In my opinion, EE is caring for the environment. And this environment includes biotic and abiotic factors. Learning to keep it protected.”  | Science Teaching II with School Practice                        | “We read texts on the subject and discussed. We have analyzed theme images. “  |
| U8/6th   | “It is to show how environment works, its relationship with living beings, the effect that our actions interfere with the environment.”  | NONE  |  |
| U9/6th   | “Education that aims to clarify for students about the environment and its changes, anthropogenic or not. In order to form critical citizens to recognize their position in the environment.”  | Supervised Training II  | “Conceptually and critically.”   |
| U10/6th  | “EE would be studying the relationship (beneficial and harmful) between human beings and the environment in which they live, as well as analyzing environmental and social inequality, factors that generate the growing current imbalance.”   | Science Teaching II with School Practice                        | “EE has been studied with a historical approach, showing how it came about and its social implications as well as political implications.”   |
| U11*/6th | “I understand it as a critical and conscious experience about the environment, the relationships among organisms that are integrated, including man, and how these elements affect each other, providing more critical training and enabling human agency in order to live in better balance.” | Science Teaching II with School Practice                        | “We studied the history of EE, environmental conflicts and environmental problems and a bit that has been studied in this area by research groups at universities. We studied through discussing articles and news, analysis of videos portraying environmental problems. Discussion of minority reports that suffered environmental injustice and developing dynamics covering and featuring many facts.” |
| U12/8th  | “I believe it is the area where we use the concepts of ecology, zoology, health, etc. in order to educate the population towards a better life and environmental quality.”   | Supervised Training I   | “We set up a lesson about EE and waste, pointing out the effects that occur when the population does not have certain knowledge.”  |
| U13/8th  | “I believe EE is education that focuses on awareness of the importance, conservation, and preservation of the environment.”  | Fundamentals of Ecology Conservation Biology                    | “Biological and philosophical aspects were discussed.”<br><br>“The ecological aspect was approached, talking about conservation and management of biodiversity and natural resources.”   |
| U14/8th  | “EE is a field where concepts such as conservation, biodiversity, environmental problems must be highlighted. Furthermore, the solution to such environmental problems must be discussed.”   | Fundamentals of Ecology; Ecology of Populations and Communities | “The ecological concepts were approached in an expository manner, through film screenings and seminars presented by undergraduate students.”<br>(U14 did not specify in which course this occurred.)   |
| U15/8th  | “It is the way to present thousands of measures to dispose of garbage, for example. To inform about the importance of Nature’s balance and that its resources are finite. In general, it consists of trying to make people aware of the sustainable use of resources.”                         | Practice in School II Science/Biology***                        | “We had to prepare classes with controversial issues and the group of students decided to talk about the issue of garbage and recycling.”  |
| U16/8th  | “EE is the approach of attitudes related to the environment and the teaching of  | Conservation Biology  | “By discussing controversial issues in the conservation field and search for   |



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|         | these attitudes, for individuals to act correctly with environmental issues. It is the awareness of the population and should be performed in all disciplines, not just in biology.”   |   | solutions, one of which is public awareness and environmental education.”  |
| U17/8th | “EE would be the respect for the environment since we are part of it.”   | Conservation Biology;<br><br>Restoration of Degraded Areas                        | “Regarding the course conservation biology, EE is a basic principle, as when one conserves, he/she cares about the environment.”<br>“The theme occurs in the introduction of the course.”.   |
| U18/8th | “It is the student’s awareness towards the environment and natural resources. It is to educate students so that they understand how beings are integrated with each other and how important the conservation of all that is natural is.” | Conservation Biology  | “In this course, it was a study about EE relevance and examples of how or where it was made.”  |
| U19/8th | “EE is a way of acquiring or reeducating yourself sustainably. It provides tools and demonstrates the importance of what environment provides us so that we are aware of how much we owe to nature.”                                     | NONE  |  |
| U20/8th | “I understand as any type of activity in which teaching and learning occur related to the environment and its elements with regard to its formation, its functioning, its development, its preservation, and enhancement.”               | Fundamentals of Ecology;<br>Ecology of Populations and Communities                | “They presented in-depth concepts on the functioning of the environment, addressing situations that challenged their balance and their preservation.” (U20 did not specify in which course this occurred.)   |
| U21/8th | “It is a field in which knowledge turns to environmental issues. Thus, various aspects are/can be addressed so that an environmental issue is treated, leading usually to a greater awareness of the environment in which we live.”      | Zoology (non-specified)<br>“Zoology courses discuss the theme, nonspecifically.”. |  |
| U22/8th | “It is the process of knowledge transfer about critical and active training for students, done as well as possible so that students understand and act in society.”  | Ecology of Populations and Communities;<br>Economic Botany                        | “Through contextualization and dualization of themes (factors for and against the model).” (U22 did not specify in which course this occurred.)  |
| U23/9th | “It is the pedagogical method of constructing and transmitting concepts about the environment, seeking to construct ideas regarding its preservation and enhancement.”   | Ecology of Populations and Communities  | “Ecology of populations and communities highlights the theme of environmental education and ecology discipline itself also deals with the subject. It was shown students current issues such as environmental pollution, deforestation, and desertification processes, fires, carbon effects in the atmosphere, among others.” |
| U24/8th | “EE is the teaching of subjects related to the environment, such as conservation, use of natural resources, biodiversity, sustainable development, and ecology in general, in order to promote the critical development of students.”    | Ecology (non-specified);<br>Education (non-specified)                             |  |
| U25/8th | “Make people aware of the importance of the environment and what the impacts over this generate on the future of the planet and on their own life.”  | Ecology (non-specified);<br>Conservation Biology                                  | “It has been worked in a clear manner in regard to animal protection, to raise awareness and what to do in practice to protect.”   |
| U26/8th | “Raise awareness about the dynamics and balance of ecosystems and the impact we have on them.”   | NONE  |  |
| U27/7th | “Raise awareness on the issue of   | Ecology (non-   |  |

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|           | preservation, maintenance, and attitudes related to the environment.”   | specified)  |  |
| U28/7th   | “It is education that aims at people’s awareness about the environment, of what we can and must do to preserve the environment.”  | Ecology of Populations and Communities; Economic Botany   | “By discussing degraded environments, our interference in the environment, talking about family farms, non-traditional foods, the differences between agribusiness and family farming.” (U28 did not specify in which course this occurred.)                               |
| U29/7th   | “Teaching about the environment, about the ecological interactions of living beings of a certain environment. Emphasizing the relationship between human beings and their influence, positive or negative, on the environment.”   | Fundamentals of Ecology; Ecology of Populations and Communities; Instrumentation on invertebrates; Instrumentation on Vertebrates | “It demonstrated relationships within an environment and human influences.” (regarding ecology courses)<br><br>“Ludic ways to approach this topic were created.” (regarding instrumentation courses)   |
| U30/7th   | “EE can be understood as a discipline within the university or as a way to treat nature with respect, with awareness.”  | NONE  |  |
| U31**/8th | “The EE shall, in addition to educating, inform students, produce a behavioral and critical change in their life so that they take EE and transmit it along their life.”  | Scientific Knowledge and School Practices   | “Directing how we should do interdisciplinary practices in EE or in the field of Sciences.”  |
| U32**/7th | “Education in themes related to the environment should critically analyze current problems that have harmed the environment (e.g., pollution of air, water, and soil) and alternative forms of exploitation of natural resources. Concern about the technological waste etc.” | Ecology of Populations and Communities; Methodology of Teaching Science and Biology   | “How EE is explored in elementary and high schools and how we can address these issues. There was also the approach in a critical way about how is current society, the damage to the planet due to overfishing etc.” (U32 did not specify in which course this occurred.) |
| U33**/7th | “Education for management and preservation of the environment.”   | Ecology of Populations and Communities  | “In lectures.”   |
| U34**/6th | “Reeducate man in order to live in human-nature harmony.”   | Science Teaching II with School Practice  | “It was presented in general terms.”   |
| U35**/8th | “Fostering at a public target the practice of proactive actions for the environment in which they live and making them recognize what environment is and its natural, social, spatial, political, and economic interactions.”   | NONE  |  |
| U36**/6th | “EE consists of practices that aim to educate students about the importance of their relationship with the environment.”  | Science Teaching II with School Practice  | “By producing a didactic resource for high school.”  |
| U37**/9th | “Understanding environment-environment interactions and foremost the man-environment ones, its implications, and importance.”   | Ecology of Populations and Communities; Fundamentals of Ecology   | “Exclusively theoretically.”<br><br>“More broadly, with many practical lessons, discussions, seminars and many field visits.”  |
| U38**/8th | “I believe it is a tool that enables personal training for the conscientious use of materials that are present in everyday life as well as new technologies.”   | Ecology (non-specified)   |  |



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| U39**/6th | "I believe it is the way we handle, we behave and respect the environment around us, and in a sense makes us think about the issue of preserving the environment." | NONE                                     |   |
| U40*/7th  | "It is the understanding of the environment as a whole, social, natural, educational, interdisciplinary, etc."   | Science Teaching II with School Practice | "Showing its relation in various ways, from the natural to the social context." |

Notes: Participants marked with an asterisk (\*) were part of the study group organized by the Environmental Education Group of the UFJF Department of Education for a few months. Participants marked with two asterisks (\*\*) were PIBID fellows. The course Ecology of Populations and Communities was divided into two in 2012, into Population Ecology and Communities Ecology. As it was not possible to determine which participants had attended which course, the data are presented together here. The professor currently responsible for Population Ecology was previously responsible for Ecology of Populations and Communities. Three asterisks (\*\*\*) indicates a course that no longer exists.

As shown in Table 3, a question aimed at identifying courses considered by participants to promote EE was "Do you recall having attended any course in the University (at any stage) that promoted or discussed environmental education? If so, what was (were) the course(s)?" Thirty-three participants answered affirmatively to this question. As one participant could mention more than one course, Table 3 contains more than 33 responses. Seventeen responses were related to courses offered by the Department of Education in the field of teaching science and biology, and 30 responses referred to courses under the responsibility of the Institute of Biological Sciences. On the other hand, seven participants reported no contact with EE in any course, some of whom were already in their eighth semester (U19, U26, and U35) and one in their ninth (U5). One of these participants (U35) confirmed having had a course on EE in his environmental management graduate program.

Most of the participants claimed to have had contact with EE in their higher education. Fourteen courses in a curricular matrix of 71 courses were considered by the participants to have involved EE (Tables 2 and 3). Two among these are unrelated to the teacher-training matrix ("Biology of Conservation" and "Recovery of Degraded Areas") and do not count toward the number of hours that students must meet to graduate as teachers.

Polarization was observed between the participant group claiming to have experienced contact with EE only in courses offered by the Department of Education (*Faculdade de Educação* [FACED]) and the group claiming to have had EE contact only in ICB courses. Among the 33 participants who mentioned courses in which they had contact with EE, only two (U24 and U32) mentioned both FACED and ICB courses. Two

factors may have contributed to this situation. Firstly, the perceived meaning of EE may differ among pre-service teachers, affecting their discourse about related courses. Secondly, their choices may have depended on who taught the courses in different semesters. In certain courses, such as “Science Teaching II with School Practice,” “Scientific Knowledge and School Practices,” “Ecology of Populations and Communities,” and “Economic Botany”, the teachers varied from one semester to another.

Most participants who indicated ICB courses as including EE were in their eighth semester. The data of this group reflected multiple meanings regarding EE. Many discourses indicated EE as being associated with conservation or preservation (U13, U16, U17, and U20); the preservation of animal species (U25); environmental problems and pollution (U21 and U23); the action of man over nature (U29); and damage to the planet (U32). Few discourses in this group associated EE with socioeconomic issues, including discussions of sustainability. For example, U32 wrote that EE should “critically analyze current problems that have harmed the environment and alternative forms of exploitation of natural resources.” The view that human beings are part of nature was suggested in U17’s discourse, who wrote that “EE would be respect for the environment since we are part of it.” Regarding the interdisciplinary perspective of EE in this group, only U16 indicated this notion. The data also show that some participants’ meanings about EE were related to the teaching of ecology science. This tendency was evident from data such as that from U14 and U20.

Among the participants who mentioned FACED courses as discussing EE, there were more discourses reflecting a holistic or a socially critical perception of EE (Sauvé, 2005), with references to various issues related to the environment, including historical (U3, U6, U10, and U11), social (U4, U10, U11, U12, and U32), and political issues (U3, U10, and U11). Contextualization and interdisciplinary learning were also mentioned by some participants in this group (U3, U4, U31, and U32) as was the purpose of EE in promoting the development of public awareness (U3, U9, and U31). It is worth mentioning that U11, a participant in the Environment Education Group (*Grupo de Educação Ambiental [GEA]*), was the only one to employ expressions such as “environmental conflicts” and “environmental injustice,” aligned with socially critical perspectives of EE.

### Interactions between discourses of the *corpus* elements

An important aspect to be considered when analyzing discourses on EE is the context in which the field began to settle. For Santos et al. (2012), the multiple meanings of EE are closely related to its genesis and development. Even the official discourse about EE contained in the first

legislative documents related to the subject (foundation discourse) presented confusion between ecology and EE; therefore, the influence of such discourse on meanings about EE among pre-service teachers of science and biology is not surprising.

Specifically, as discussed previously, the foundation discourse of EE in Brazil was strongly marked by the naturalistic view, as demonstrated in Law number 6938/1981. Within this law, there is no definition of guidelines on EE, but the Brazilian Ministry of Education launched in 1985 a document that recommended the inclusion of ecological content throughout the training process for basic education in order to foster the ecological consciousness of future citizens (Dias, 2004). Both documents refer to EE only within the scope of the biological sciences, regardless of cultural, social, economic, ethical, and political issues. According to Acselrad (2010), Brazil only began in the late 1980s and early 1990s to include the relationship between environment and social justice in the political debate, culminating in new types of articulation. Taking into account the little contact undergraduate students have with recent legislation concerning EE, the foundation discourse probably has great influence among the group as well as in the curricular matrix design.

In terms of the curricular matrix, the combined results that reflect course outlines and contents as well as participants' discourses on how EE was carried out in such courses (Tables 2 and 3) show that the courses "Science Teaching II with School Practice" (cited most often as including EE), "Scientific Knowledge with School Practice," "Conservation Biology," and "Economic Botany" were predominantly highlighted by students who presented a discursive formation on EE more aligned with that advocated by Law number 9795/1999 and the new DCNEB (MEC, 2013a). These documents recommend considering the interdependence of natural, social, economic, and cultural approaches to EE in a contextualized, inter- and transdisciplinary manner.

The courses "Ecology of Populations and Communities" (often quoted as including EE) and "Recovery of Degraded Areas" made explicit references in their course outlines and contents to terms and concepts associated with the biological aspects of conservation and management. These courses were highlighted by participants whose discursive formation about EE presented protective perceptions regarding the conservation and management of nature, aligned with conservationist/resourceist currents (Sauvé, 2005). "Fundamentals of Ecology" was also cited by five participants, but there was no reference to EE in the course outline or contents, suggesting that some participants mixed ideas of EE with those of ecology education.

Reis et al. (2013) also concluded that undergraduate students of a biology teacher-training department made a strong connection with EE within their ecology course, granting greater relevance to biological and ecological knowledge over pedagogical knowledge in the performance of EE. For Santos et al. (2012), the identity construction of environmental educators is related to the sense of belonging and to the legitimacy of certain social groups. Martins et al. (2008) conducted a study among biology undergraduates at the Federal University of Rio de Janeiro and highlighted the greater legitimacy of ecology in relation to EE as a field of knowledge. In beginner classes, perceptions of EE elaborated by pre-service teachers were strongly related to ecology.

In the biology teacher-training course investigated in the present study, the curriculum contains a notably higher percentage of courses under the responsibility of the Institute of Biological Sciences than of the Department of Education. This is one piece of evidence that EE is regarded mainly from a biological point of view rather than a pedagogical one, and this may have a strong influence on students' discourse construction. Martins et al. (2008) pointed out that the proposed curriculum and the texts adopted in a course have effects on the knowledge, values, attitudes, and more of undergraduate students. Since discourses influence social practices, the curriculum should include a balance between pedagogical and biological courses or, at least, more interaction between these courses. The time allotted to plan interdisciplinary strategies must figure in educational policies as well as incentives to establish debates about legislation. These are basic assumptions meant to destabilize the hegemony of discourses restricted to the conservation approach in biology teacher-training undergraduates.

In addition, as shown by the outlines and contents of the courses in the curriculum investigated here, few disciplines appear to promote or discuss any kind of EE. Lopes and Zancul (2012) point out that the outlines and contents of a given discipline represent only the proposals of its approach. Thus, some professors might well be dealing with issues related to EE in their courses without necessarily making explicit reference to the term. For example, U30 declared having had contact with EE in higher education but never considered this as having completed a specific course related to EE. This may indicate the influence of university professors, even if indirectly. The participants' discourse suggested that contact with EE occurred "throughout higher education, as we are on a course that teaches you to respect nature and life, despite not having a specific discipline." Furthermore, U21 pointed out that generally "disciplines of zoology" carried out EE, as they "deal with the subject, but not as specifically."



Conversely, the meanings ascribed to EE in the discourses of these two participants (Table 3) are diffuse, general, and restricted to respecting nature and being aware of the environment, indicating a more casual approach, little contact with EE, and possible confusion between ecology and EE, as discussed above. Additionally, it must be taken into account that guidelines do provide insights into professors' curriculum priorities.

Another finding of this research is that the ways in which participants judge the EE that was discussed within an undergraduate course show a prevalence of traditional information-transmitting experiences (Table 3). Taking into account that there is widespread acceptance of the idea that critical thinking is an important dimension of science education (Bailin, 2002) and that training experiences during teachers' professional development programs influence their future teaching, changes in EE discussions and activities should be encouraged. These changes might occur not only within classes but also during undergraduate research, extension, training in basic schools, study groups, and with external agents at educational institutions. As indicated by U21 and U27 (Table 3), diverse training spaces influence students' perceptions of EE.

Legislative foundation discourse, the pedagogical project, and the curricular matrix of the undergraduate course were shown to be strongly related to students' discourses about EE, within which the conservation and ecological perspectives were hegemonic.

The undergraduate students who participated in the present survey showed multiple meanings regarding EE, but the hegemonic discursive formation is aligned with a meaning of EE as conservation and preservation of nature. Some participants' discourses combined the meaning of EE and ecology education. These results show the stability of traditional discourses, which are deeply rooted in the students' discursive memories.

On the other hand, there were few discourses in which the meanings of EE included not only conservation and preservation, but also socioeconomic issues, sustainability, and the prospect of human beings as a part of nature, aligning with discursive formations of holistic or socially critical currents in EE (Sauvé, 2005). These findings reveal that the recent legislative discourse is having some impact on the discourse arena, which indicates that the polysemy of EE is represented and that it is feasible to promote shifts in thematic meanings.

Galieta (2014) found similar results in an analysis of discourses on EE among undergraduate biology students in the context of assessment of a compulsory course at another Brazilian public university. In her participants' discourses, Galieta (2014) identified a mixture of

conservation and critical conceptions of EE. Santos et al. (2012) analyzed discourses about EE among biology teachers, lecturers, and exact sciences teachers in continuing education, and approaches to EE were found. Santos et al. (2012) reported that even discourses with ideas related to critical and emancipatory EE approaches were sometimes marked by expressions associated with a conservation approach to EE. From their critical DA perspective, Santos et al. (2012) claim that their data reveal signs of tension and ideological disputes in the field of EE.

Other studies also refer to a predominance of ideas around conservation in EE as well as confusion between the purpose of EE and the teaching of ecology (Araújo and França, 2013; Schulz et al., 2012; Verdi and Pereira, 2006). Pedretti (2014), although not applying the DA framework, examined EE discourses in contemporary schooling in relation to the range of ideological orientations, the hegemony of school-based disciplines, traditional ecological knowledge, and alignment with science education. She concluded that EE that is more socially just and action-oriented challenges the traditional schooling, where the reproduction of factual knowledge and unproblematic truths take place. For her, the necessity of creating a shared agenda between science education and EE must also take into account multiple perspectives seeking social justice and democratic participation.

The plurality of perspectives on EE can be constructive (Sauvé, 2005) and ecology can be an important tool for understanding the phenomena related to the environment and the interaction between living beings. Bermudez and De Longhi (2008) defend the teaching of ecological concepts as a basis for understanding the consequences of environmental problems and the reduction of biodiversity for the planet as well as to change the anthropocentric hegemonic ethical perspective, providing scientific basis for students to question even the consumerist and predatory economic logic in our societies. Indeed, Law 9795/1999 mentions that one of EE's objectives is "to develop an integrated understanding of the environment in its multiple and complex relationships involving ecological, psychological, legal, political, social, economic, scientific, cultural and ethical issues." What is argued here is that understanding EE as a synonym for ecology implies restricting it to biological aspects, giving little relevance to other aspects and encouraging education processes that are fragmented and detached from reality; this does not foster the development of citizenship within science learning.

### Conclusions and Recommendations

Our research question was whether legislative discourses and curricular matrix configuration influence and are reflected in the discourses about EE elaborated by pre-service biology teachers. Among our

main results, we stress that the curricular matrix of this undergraduate course showed a predominance of hours devoted to courses that discuss the environment under the biological perspective in contrast to a small number of courses that discuss it and promote EE under other perspectives. In addition, undergraduate students claimed little contact with recent EE legislation. This scenario, reinforced by the naturalistic foundation discourse of EE in Brazil, is probably affecting the constitution of the discursive memories of these students and leading them to elaborate hegemonic ecological and biological-restricted meanings of EE.

In our investigation, we attempted to go beyond documental analysis and included the evaluation of pre-service teachers' discourses. This approach proved to be feasible and could be applied in the evaluation of EE content of other pre-service programs. Nevertheless, since the elaboration of EE meanings involve multiple influences, we also recommend considering discourses of university teachers in such analysis, as in Pasin and Bozelli (2016).

According to Maingueneau (2006), discursive fields are spaces in which a set of discursive formations faces competition (in the broad sense) as they delimit one another. It is a game of unstable balance between various forces that move, at times, to establish a new configuration. Thus, it is neither homogeneous nor static. Considering this, discursive change may be promoted by professors teaching courses or guiding students in scientific and extension projects in such a way as to allow them to develop more encompassing conceptions of EE, taking into account not only aspects of the conservation and preservation of nature but also cultural, social, and economic issues.

Cosenza et al. (2014), based on the theoretical and methodological framework of DA, worked within a biology school teacher in-service, aiming to foster her interaction with environmental justice discourses. At the beginning of her work, the teacher elaborated EE meanings restricted to conservation. After readings, participation in local meetings of social and environmental organizations, and debates with the researcher, she developed hybrid discourses that incorporated social elements, which has the potential to promote shifts in her EE pedagogical practice.

Promoting greater contact of pre-service teachers with scientific articles related to education in both science and EE, in addition to curriculum content, is also indicated by Galieta (2014) and Martins et al. (2008) as a possible way to foster encompassing meanings of EE. Both studies, based on DA, were conducted upon pre-service teachers and found that texts requested by lecturers could expand or restrict the boundaries of students' understanding and the appropriation of concepts from a particular field, such as EE.

Interdisciplinary approaches are a strategy recommended by some authors to address EE in order to favor encompassing discourses. For Klein (2006), they are key factors in contemporary life, since “school- and university-level subjects are intersecting with a host of interdisciplinary fields, from international studies to environmental studies.” For Redshaw and Frampton (2014), multi-disciplinary courses may cross the natural-science barrier; but, they are still emerging, and the educators have not been trained in that way of thinking. Therefore, it relies on educators broadening their own horizons. In this sense, Mader and Rammell (2015) suggest that one of the responsibilities of universities is developing training courses that focus on inter- and transdisciplinary approaches to education, research, and extension in the environmental field. They consider universities to be vehicles of experimentation, development, debate, and dissemination regarding the necessary conditions for change in society. Lenoir (2008) also considers the establishment of interdisciplinary work teams to be a promising possibility, made up of lecturers collaborating in research and teaching, involved in planning and the articulation of content, teaching, and assessment. Other factors to foster this perspective are encouragement by government public policies and agencies for interdisciplinary undergraduate and post-graduate degrees as well as teaching, research, and extension initiatives that favor such an approach.

Finally, we believe that greater involvement of university professors with the teachers at the schools in which students do their supervised training and pre-service teaching would favor collective planning and the establishment of study groups on various issues. This could contribute to more contextualized and enriching experiences for all involved. Fazenda (1998) claims that teachers’ practices do not change by imposing regulations but through an interactive process in which they find themselves valued, are aware of the importance of their work, and participate in developing alternative practices.

PIBID is an initiative that favors such integration, as it provides undergraduate fellows intense and oriented contact with the school environment, encouraging reflection on pedagogical practices among university professors and elementary school teachers. Such contact between pre-service teachers, higher education teachers, and the school environment may also occur through other instances, such as within courses related to supervised training and school practices. In order to foster this channel, policies that include various incentives should be put in place.

We neither believe that divergent political and pedagogical positions will come to consensus on the basis of the above suggestions, nor do we suppose that existing tensions will be overcome. However, it cannot



be denied that professional teaching attitudes and practices can be renewed on the basis of such interactions. Once the manner in which “enunciative modalities” are articulated is not permanent, discursive changes may be promoted by adopting different conducts.

Construction of meanings regarding any particular subject results from relationships, as a discourse points to others that support it (Orlandi, 2012). Promoting contact and democratic debate between stakeholders (students, schoolteachers, and professors) with various discursive formations about EE would be characterized as a type of interdisciplinary planning and has the potential to result in shifts in the understanding, teaching, research, and extension approaches of some such teachers. Enhancing debates about socioeconomic issues and the development of citizenship in curricula may also affect both the initial training and the continuing education of science and biology teachers. These attitudes approximate science education and EE agendas in order to foster the development of citizenship at schools and to prevent the silencing of issues such as the conflicts and risks associated with environmental problems.

### Endnotes

<sup>1</sup> <http://www.un-documents.net/a57r254.htm>

<sup>2</sup> Despite this, though the interdisciplinary approach had already been recommended in Tbilisi as well as the inclusion of social issues within EE, Law 6938 did not align with this perspective. It is noteworthy that Brazil was still under civil-military dictatorship at that time.

### Disclosure statement

No potential conflict of interest was reported by the authors.

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Elizabeth Bozoti Pasin is a biology teacher at a Brazilian public school (Colégio Pedro II).

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### Acknowledgements

The authors thank all participants of this research and also to Post-graduation Program in Ecology from Federal University of Juiz de Fora (*Programa de Pós Graduação em Ecologia da Universidade Federal de Juiz*

de Fora), where the first author is developing her doctoral thesis under the second author supervision. Elizabeth B. Pasin thanks to Colégio Pedro II for the license grant for studies and Reinaldo L. Bozelli thanks to CNPq for a research grant.

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