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Experimentation in bachelor's education programs in biological sciences: a look from Fleckian epistemology

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ABSTRACT

This investigation consists of an epistemological analysis based on Ludwik Fleck's assumptions, which had as object of investigation nine Pedagogical Projects of Courses (PPC) offering a Bachelor's degree in Biological Sciences by Federal Universities in Southern Brazil. The aim of this research is to identify the development of Thought Styles on Experimentation in the PPCs of certified teacher education with a major in Biology. To identify Thought Styles, we performed the discussions based on the following Experimentation conceptions: Investigative (the most prevalent), Empiricist-inductivist (second prevalent), Demonstrative and Deductivist-rationalist (absent). With a focus on the analysis of mandatory referentials, it was possible to discuss, based on the excerpts obtained during the analyses of the nine PPCs, the following categories: Thought Styles and Thought Collectives, as proposed by Fleck, passing through the Thought Nuances, to ultimately find proximities in regard to the investigative thinking style, present in the most PPCs examined. Based on the results, we clearly identified that among the different Collectives (Institutions) examined, a Thought Collective is under development, oriented by the same investigative style considered for Experimentation, strengthening the understandings about it in order to provide an education of quality to future teachers in the area of sciences.

KEYWORDS: Curriculum. Thought categories. Conceptions. Fleck. Sciences Teaching.[1]

INTRODUCTION: WEAVING PATHS THROUGH FLECK'S EPISTEMOLOGY

The use of Fleckian epistemology in studies that deal with Science Education is recent in Brazil. Searches in literature revealed that in the mid-1990s, the first studies, in Brazil, in the area of Science Education based on said epistemological approach began to appear (DELIZOICOV *et al.*, 2002; SCHEID; FERRARI; DELIZOICOV, 2005; LORENZETTI, 2008; LORENZETTI; MUENCHEN; SLONGO, 2013; LEITE, 2016).

On that account, the need to conduct studies with a focus on epistemology applied to Science Education appears, considering that, according to Chicóra, Aires and Camargo (2018), it is extremely important to consider Ludwik Fleck's epistemological perspective in the construction of science and the relationships that are established in Teaching in order to broaden the understanding of the thinking processes of the teachers in the area.

Ludwik Fleck sought to understand the role of the sociocultural interactions both in the production of knowledge and its dissemination, outlining his epistemology in the work "Genesis and Development of a Scientific Fact" of 1935, presenting Science as a social approach (DELIZOICOV *et al.,* 2002).

To Da Ros (2000):

> Fleck values the historical-psycho-cultural context by analyzing how a scientist is introduced to a new way of thinking (a new Thought Style) and integrates to his analysis aspects related to the social determination of the scientific investigation involved in knowledge production processes using and categorizing the main epistemological categories (Da ROS, 2000, p. 14) [our translation].

From that, his main categories of analysis are born: Thought Styles, which determine a collective way of thinking and acting in a Thought Collective, through which a group of researchers share conceptions and whose way of thinking is regulated by the same Thought Style, allowing to become closer to, or distant from, the Thought Styles by means of Thought Nuances (FLECK, 2010).

In this regard, it is important to make interpretations based on Fleck's assumptions, connecting them with the relationships that are established in the different Teaching settings, as described here, since, according to Lorenzetti (2008):

> For an analysis of the emergence of the fields of knowledge, which are related with the understanding of some scientific facts, the use of Fleck's epistemology has allowed a characterization of the historical-epistemological genesis of produced knowledges and insights relating to these facts (LORENZETTI, 2008, p. 22) [our translation].

Based on such arguments, we can understand and focus on the historical issue that severely affects the context of Brazilian Education, as regards teacher education in the field of Science on Experimentation (GONÇALVES; MARQUES, 2012). When we investigate Experimentation, we are prompted to discuss how it is understood by teachers, especially in Basic Education environments, since "students and teachers have deep-rooted epistemological theories that require problematization, as they are, in general, simplistic, coined in a neutral, objective,

progressive, empiricist view of Science" (GALIAZZI; GONÇALVES, 2004, p. 326). In this sense, we point to the importance of understanding different conceptions of Experimentation in Science Teaching, that is, characterizing them as: demonstrative, underpinned by the proof of established truths; empiricist-inductivist, based on observation as a source of knowledge; deductivist-rationalist, which takes into account provisional scientific knowledge and is subject to reconstruction, since theoretical assumptions ultimately affect observations; or investigative, which ignites the critical and autonomous spirit, providing students with a leading role in such activities (ROSITO, 2008; MOTTA *et al.,* 2013).

As a consequence, among other possibilities, the curriculum appears as a discursive practice, capable of producing different meanings (MOTTA *et al,* 2017). Thus, the present investigation aims to identify the development of Thought Styles on Experimentation in Pedagogical Projects of Courses (PPCs) that offer a teaching degree in Biology and, based on this, indicate how these thoughts are shared among different Thought Collectives, which occurs by means of an inter-collective circulation of ideas, identified by the PPCs for the education of teachers of Biological Sciences in Federal Universities in the South of Brazil, considering that Fleck's epistemology provides different contributions to the Education/Teaching of Sciences. Among such contributions, Lorenzetti, Muenchen and Slongo (2013) cite:

> [...] it enables to understand the constitution of a field of knowledge; explains the sociological character of both production and dissemination; identifies the conditions for the establishment of a Thought Style linked to Science; makes one understand the importance of intra- and inter-collective communication in the establishment and transformation of a Thought Style; analyzes the contents of teaching courses to be included in a Thought Style; makes one understand better the theoretical and practical relationship in teachers' education; critically analyzes the pedagogical practice of teachers; develops alternatives for the inclusion of the history of sciences into the course's grid (LORENZETTI; MUENCHEN; SLONGO, 2013, p. 194) [our translation].

Based on these reflections, we propose the following questions: Which Thought Style(s) on Experimentation is/are present in the PPCs of the courses that train individuals to earn a bachelor's degree in Biological Sciences education? In addition to this core question, which aspects present in the PPCs investigated indicate the circulation of ideas on experimentation? It is possible to identify Thought Nuances about Experimentation in the PPCs?

METHODOLOGY

The paths outlined for this qualitative documental analysis (LÜDKE; ANDRÉ, 2001) about the categories proposed by Fleck follows an epistemological approach that allows to understand how Experimentation transcends throughout the curriculum and training (Da ROS, 2000). For this purpose, we looked for elements that can translate such categories and then relate them, selecting at first 14 PPCs of courses that train undergraduates to become licensed teachers of Biological Sciences that are effective at federal universities in the south of Brazil, namely: Federal University of Pelotas (UFPEL), Federal University of Pampa (São Gabriel campus), Federal University of Rio Grande (FURG), Federal University of Fronteira

Sul (UFFS Cerro Largo, Laranjeiras do Sul and Realeza campuses), Federal University of Santa Catarina (UFSC), Federal Technological University of (UTFPR Dois Vizinhos, Ponta Grossa and Santa Helena campuses), Federal University of Paraná (UFPR Curitiba, Palotina and Matinho campuses), Federal University of Santa Maria (UFSM Camobi and Palmeira das Missões campuses).

While outlining the methodological procedures, we followed some steps to streamline our workflow. First, we collected information on the target course pedagogical projects (CPPs) on the websites of the sampled universities and then organized it in a table to clearly identify the courses that were pedagogical and their respective required reading lists. However, during the analysis, some CPPs were excluded from this study, as their descriptions did not present references and would not allow us to clearly understand their collectives of thinking.

Because basic teacher education programs have different curriculum structures, one needs to understand the web of historical-cultural, political, epistemological, pedagogical and ethical relationships existing in different contexts and, therefore, to identify the marks left by pedagogical courses in curriculum-based teacher education (NETO; QUEIROZ; ZANON, 2009). In the present study, we analyzed nine course pedagogical projects from the following universities: Federal University of Pelotas, Federal University of Pampa (São Gabriel), Federal University of Rio Grande, Federal University of Fronteira Sul (Cerro Largo, Laranjeiras do Sul and Realeza), Federal University of Santa Catarina (degree and bachelor's degree) and Federal University of Technology – Parana (Dois Vizinhos).

For a better display of the data, Table 1 shows the names of the universities and the Curriculum Units (CUs) that were addressed in this study.

Table 1 – Institutions and their Curriculum Components with pedagogical content

PPCs	Institution	CCs
PPC 1	Federal University of Pelotas	1.1 Supervised internship I – at Elementary and Secondary Schools 1.2 Teaching didactics in Biology (PCC) 1.3 Supervised internship III 1.4 In-school investigation (PCC)
PPC 2	Federal University of Pampa – São Gabriel	2.1 Research and pedagogical practice in Elementary/Middle School 2.2 Didactics of biological sciences 2.3 Research and pedagogical practice in Secondary School 2.4 Curricular internship in Secondary School
PPC 3	Federal University of Rio Grande	3.1 Integrating Seminar in Sciences and Biology I 3.2 Integrating Seminar in Sciences and Biology II Biology Internship 3.3 Integrating Seminar in Sciences and Biology III 3.4 Methodological foundations for Teaching Biology I 3.5 Methodological foundations for Teaching Biology III
PPC 4	Federal University of Fronteira Sul – Cerro Largo	4.1 Teaching practice: Methodology and Didactics in Sciences Teaching

PPCs	Institution	CCs
		4.2 Teaching practice: Experimentation in Sciences Teaching
PPC 5	Federal University of Fronteira Sul – Laranjeiras	5.1 Practices as curricular component VI
PPC 6	Federal University of Fronteira Sul - Realeza	6.1 Sciences Teaching Laboratory 6.2 Biology Teaching Laboratory
PPC 7	Federal University of Santa Catarina – Teacher's degree	7.1 Sciences and Biology Teaching Methodology 7.2 Didactics A
PPC 8	Federal Technological University of Paraná – Dois Vizinhos	8.1 General Didactics 8.2 Teaching Theory and Practice of Sciences and Biology 1 8.3 Integrating Project 1
PPC 9	Federal University of Santa Catarina – Bachelor's/Teacher's degree	9.1 Teaching methodology of Sciences and Biology 9.2 Didactics A

Source: Own authorship (2020).

In order to emphasize the understanding of what is proposed by the following disciplines concerning Experimentation and its role at/during teacher education, we prepared Table 2, which contains the mandatory guiding referentials, categorizing them according to the following Experimentation conceptions: Investigative, Empiricist-inductivist, Demonstrative and/or Deductivist-rationalist (MORAES, 1998; ROSITO, 2008; MOTTA et al, 2013). We also highlight in this table the CCs indication, as shown in Table 1, where such referentials are present.

Table 2 – Mandatory referentials translating the Experimentation conceptions

Experimentation conceptions	References	CCs
Investigative	MARANDINO, M.; SELLES, S. E.; FERREIRA, M. S. *Ensino de Biologia: histórias e practices em diferentes espaços educativos.* [in English: Biology Teaching: histories and practices in different educational settings]. 1ª ed. São Paulo: Cortez, 2009. 215p	1.1, 1.2, 1.3; 3.4, 3.5
	CARVALHO, A. M. de P. *Ensino de Ciências: unindo a pesquisa e a prática* [Sciences Teaching: combining research and practice]. São Paulo Cengage Learning, 2012.	1.1, 1.2, 1.3, 1.4; 6.1, 6.2;
	CARVALHO, Anna M. Pessoa de; GIL-PÉREZ, Daniel. *Formação de professores de Ciências* [Teacher Education in Sciences]. 9. ed. São Paulo: Cortez, 2009.	2.1, 2.2, 2.3, 2.4; 4.1, 4.2; 7.1; 9.1
	KRASILCHIK M. *Práticas de Ensino de Biologia* [Biology Teaching Practices]. São Paulo: Ed. EDUSP, 2004.	3.1, 3.2, 3.3, 3.4, 3.5; 5.1; 6.2; 7.1; 8.2, 8.4, 8.5; 9.1
	FAGUNDES, S. M. K. *Experimentação nas Aulas de Ciências: um meio para a formação da autonomia?* [Experimentation in Science Classes: a means for autonomy	4.2

Experimentation conceptions	References	CCs
	acquisition?] In: GALIAZZI, M. do C. et al, *Construção curricular em rede na educação em ciências: uma aposta de pesquisa na sala de aula.* [Curricular construction network in sciences: a bet on research in the classroom] Ijuí, Ed. Unijuí, 2007. p. 317-337	
	GONÇALVES, F. P.; GALIAZZI, M. do C. *A natureza das atividades experimentais no Ensino de Ciências* [The Nature of experimental activities in Science Teaching]. In: MORAES, R.; MANCUSO, R. (Orgs.). *Educação em ciências: produção de currículos e formação de professores* [Education in Sciences: curriculum production and teachers' training]. Ijuí, Ed. Unijuí, 2004. p.237-252.	4.2
	LABURÚ, C. E.; MAMPRIN, M. I de L. L.; SALVADEGO, W. N. C. *Professor das ciências naturais e a prática de atividades experimentais no Ensino médio: uma análise segundo Charlot* [Teacher of Natural Sciences and practice of experimental activities in Middle School: a Charlot-based analysis]. Londrina: Eduel, 2011.	4.2
	PACHECO, D. *Um Problema no Ensino de Ciências: Organização Conceitual do Conteúdo ou Estudo dos Fenômenos* [A Problem in Science Teaching: Conceptual Organization or Study of Phenomena. (p.63-81). Revista Educação e Filosofia, 10 (19), jan/jun, 1996.	4.2
	SILVA, R. R. da; MACHADO, P. F. L; TUNES, E. *Experimentar sem medo de errar* [Experiment without fear of making mistakes] In: SANTOS, W. L.; MALDANER, O. A. (org). *Ensino de Química em Foco* [Chemistry Teaching in Focus]. Ijuí: UNIJUÍ, 2010, p. 231-262	4.2
	BORGES, A. T. *Novos rumos para o laboratório escolar de Ciências* [New paths for science laboratory in schools] Caderno Brasileiro de Ensino de Física, 19, n. 3, p. 291-313, 2002.	6.1
	GIORDAN, A.; De VECCHI, G. 1996. *As origens do saber: das concepções dos aprendentes aos conceitos científicos* [The origins of knowledge: from learners' conceptions to scientific concepts]. 2ª ed. Artes Médicas: Porto Alegre.	7.2; 9.2.

Experimentation conceptions	References	CCs
	CAMPOS, M. C. da C.; NIGRO, R. G. *Didática de Ciências: o Ensino aprendizagem como investigação.* [Didactics of Sciences: Investigation as Learning Practice]. São Paulo: FTD, 1999.	8.1, 8.2, 8.3, 8.4, 8.5
Empiricist-inductivist	MATEUS, A. L. *Química na cabeça* [Chemistry in the Head]. Belo Horizonte: Editora UFMG, 2003.	4.2
Demonstrative	-	-
Deductivist-rationalist	-	-

Source: Own authorship (2020).

Thus, seeking the best understanding in regard to the referentials and comprehensions/conceptions about Experimentation that they present, we will present fragments of the works described in Table 2 and others taken from the "Objectives of the Courses" of the PPCs examined, allowing to elucidate a given thinking style present in the curriculum framework which, sometimes, end up reflecting on the pedagogical disciplines and on the training itself. On this regard, Fleck (2010) highlights new discoveries that can be triggered by research efforts, making us think about their value and prize other new effects, paths and insights of different collectives (EMMEL; PANSERA-DE-ARAÚJO; GÜLLICH, 2011).

For that purpose, we point out the interest in indicating the development of one or more Thought Styles about Experimentation in Science Teaching which underline curricular discourses here represented by the PPCs of certified teaching programs in Biological Sciences, which allow us to understand the different thinking styles that permeate these collectives, approximating or distancing them.

RESULTS AND DISCUSSIONS

So that we could discuss the results, we brought three categories proposed by Fleck (2010): Thought Styles, Thought Collectives and Thought Nuances. According to Fleck (2010), collectives function as a spokesman of a given area of thought, i.e., a state of knowledge and culture in its historical development. On the other hand, "a Thought Style is understood as a quasi-unconscious 'willingness' that drives and converges the thought of the members of the collective community" [our translation] (CARNEIRO, 2015, p. 697). Thus, nuances can indicate distances from and closeness to the referentials that share the same Thought Style (LORENZETTI, 2008).

On this regard, the Thought Collectives described here are characterized by different Educational Institutions, which offer certified teaching programs in Biological Sciences, where each subject of the curricular menu has a Thought Style that is disseminated throughout the training repertoire. Under this perspective, Cutolo & Delizoicov (1999) emphasize the importance of investigating the curriculum and its execution, either through the curriculum grid, the menus and discipline contents or through the referentials, allowing substantial information for

investigations, as the curriculum cannot be separated from the totality and the social.

Based on the analyses, we could observe the presence of Thought Styles that are intertwined throughout the CCs and institutions. Thus, as the relevant criteria for the present analysis are established, we point out to the possibility of contextualizing the Thought Styles from the dialogues argued by the referentials, with emphasis on the Investigative Experimentation conception (23 referentials), the most prevalent among the Thought Collectives, becoming a strong style in the midst of discussions, followed by the Empiricist-Inductivist conception, with only one referential.

When discussing Experimentation in Science Teaching, it is necessary to indicate it not only as a resource capable of providing the development of skills, but also as a possibility of ensuring teamwork and the promotion of a critical and reflexive character, as pointed out by Araújo and Abib (2002). These assertions are in line with the referentials presented in the CCs, characterizing a Thought Style marked by an investigative approach, although in different Collectives, and are focused on discussing the expansion of practical-experimental activities aiming to a shift of the experimental manipulation paradigm in order to allow more discussions and interactions between students (BORGES, 2002).

The idea that permeates such referentials considers that teaching sciences based on experimentation and experimental practices may become sterile if it remains closed to the world of knowledge dissemination, considering that the scientific spirit requires reflection and different modes of reasoning immersed in constant challenges and pursuit of solutions (CARVALHO, 2012). This justifies the conception of Investigative Experimentation which, according to Motta et al, (2013, p. 2), emerges in the classroom in order to give meaning to the collective words "[...] that are inherent to intense discussions about and with an experiment, the Science languages and discourses. To this end, the group must be formed by active, responsible, open-minded subjects, and the classroom a space of events" [our translation], that is, it is necessary to provide investigation cycles during the practical-experimental work, with emphasis on investigative questions capable of sustaining Experimentation and raising concerns among students, who coordinate their learning in face of the issues presented (CAMPOS; NIGRO, 1999).

Based on these premises, Experimentation has become an object of investigation in many research works, as it is an innovative strategy that has sought to break the traditional and boring feature since the 1930s (MARANDINO; SELLES; FERREIRA, 2009). According to Giordan and Vecchi (1996):

> Today, most of the scientific knowledge taught in schools will be forgotten by the students after a few years, a few weeks, or if it was ever really acquired. Transmission of scientific knowledge is laborious and does not ensure an integrative role in view of the amount of information that reach us through the media (GIORDAN; de VECCHI, 1996, p. 7) [our translation].

These statements elucidate the criticism to the Demonstrative Experimentation conception and become markedly significant in view of the Thought Styles existing in the Collectives (Institutions).

To Fleck (2010):

> as a community of people exchanges thoughts or is in a situation of reciprocal influence of thoughts, we have in each of these individuals a holder/ carrier of the historical development of an area of thought, of a given state of knowledge and culture, i.e., a specific thought style (FLECK, 2010, p. 82). [our translation]

When looking attentively to the present disciplines, we also noticed a referential that, differently from the previous ones, presents an empiricist-inductivist approach, for clearly indicating in its structure 82 experiments containing steps to be followed, which noticeably justifies the inductivist approach, for using a series of steps that must be followed, characterizing an empiricist-inductivist view of science and of Experimentation as well (SILVA; ZANON, 2000).

According to Krasilchik (2004), practical Science Teaching in schools works as a catalyst, as it leads each student to develop interests that may go beyond the practical limits that many disciplines impose, assuming a critical character.

These referentials appear in the PPCs mentioned, making that the Thought Style extends to the Thought Collectives through the "Objectives of the Course" present in the diverse curricular frameworks, as can be seen in the following PPCs that we translated:

> PPC 1: educate teachers to be able to understand the social reality of the school (history, values, public polices), and well-prepared to undertake a critical and reflexive posture of transformation of this reality.

> PPC 3: develop creativity, critical thinking and scientific reasoning by means of theoretical and practical activities.

> PPC 6: provide the development of the basic skills for research and teaching and the extension programs in the areas of Sciences, Biology and Environmental Education, utilizing didactic-pedagogical resources such as experimental and technological activities.

On this regard, we highlight the prevalence of the investigative conception that supports the experimental approach and gives space for autonomy and for breaking paradigms on Experimentation such as manipulation and following steps only. The Thought Style represented by Thought Collectives, with respect to Experimentation as Investigative, proliferates throughout other collectives and is reflected in the "Objectives of the Course", which are translated as follows:

> PPC 5: train teaching professionals with an investigative, reflexive, creative spirit, with a critical, ethical posture and committed with the social, cultural, economic, environmental and educational settings, with theoretical and practical qualification for the production and dissemination of knowledge in the area of Biological Sciences.

> PPC 7 and 9: provide to future licensed teachers all Education-related skills and capabilities on the diverse areas of activity, the required knowledge on biological concepts and phenomena, to ensure the development of a coherent, responsible, ethical and professional behavior and encouraging a critical and reflexive attitude about all kind of biological knowledge and its social implications.

> PPC 8: educate individuals to become elementary-school teachers in Sciences and middle-school teachers in Biology, who consider in their teaching practices the relationship between theory and practice.

Based on these objectives, we can see that many purposes are focused on the relationships between theory and practice as well as on building a critical and reflexive character that for now ensures students' concern with issues that arise from Experimentation.

According to Carvalho and Gil-Pérez (2009), it is necessary to offer teaching programs in such a way to allow future teachers to be able to review their practices through critical thinking and move towards didactic changes, rejecting the traditional Education methods. These premises are justified in the objectives, as one can see in the following [translated] excerpts:

> PPC 2: provide the means for an integrating trajectory of scientific and pedagogical contents, offering conditions for the future teacher to develop competencies and skills in order to understand the social role of school, to master contents and their interdisciplinary articulations, and master pedagogical contents and knowledge of investigation processes that enable improvement of their practice and management of their own professional development.
>
> PPC 4: provide the development of competencies and skills for Teaching and Research in Biological Sciences [our translation].

Based on these objectives, we noticed that the main focus of the teaching programs is on the development of competencies and skills to work on certain matters and, in regard to Experimentation, they are present in the disciplines listed. However, Experimentation still stands out as a major topic, developed to test and prove a theory, as Gonçalves and Galiazzi (2004) point out. Fagundes (2007) considers that Experimentation must appear as a way to demystify the viewpoint that teachers must apply it only after a series of theoretical information have passed, in other words, demonstration.

As conclusions, one can see that there is an affinity between the referentials that permeate different Thought Collectives, as they are anchored on the Investigative Experimentation conception, based on the development of skills, competencies and critical judgement, which makes us obtain the same thinking style. Thus, we can argue that there is a Thought Collective about Experimentation represented by the investigative thinking style and also point out the Thought Nuances, which arise from the fact that common ideas are shared along the objectives and the existence of equal referentials in the disciplines, which allows us to approximate them in the discussions, except for the Empiricist-inductivist perspective of Experimentation, which, besides reflecting a new Thought Style, also moves away from the ideas listed by the investigative approach of the predominant Thought Collective.

It can also be emphasized that the Thought Style here identified is characterized by the esoteric circle, as proposed by Fleck (2010), due to the fact that the PPCs of the courses reported in this study are documents developed by teachers who are specialists in course planning. We also indicated that there is a movement among these specialists (teachers) in order to maintain the thinking style by means of the inter-collective circulation of ideas, considering that, to involve other kind of intra-collective circulation, as denominated by Fleck, there should be the involvement of exoteric circles, which in this case is not present.

Lima and Teixeira (2011) argue that it is by means of socialization during Experimentation that the subjects are closer to develop, understand an apply the scientific concepts that somehow are reorganized by means of the collective and knowledge sharing that surround them. Because of this, a well-organized collective is able to support knowledge and surpass any individual's capacity, considering that the social framework favors the organization effort (FLECK, 2010).

CONCLUSION

Identifying Thought Styles and Collectives from different contexts is a way to contribute to the production of knowledge, in this case associated with the understanding of Experimentation, considering that teachers should understand the epistemological aspects that sustain the action of teaching. In view of this aspect, we sought to demonstrate the importance of understanding epistemology and the different trends that permeate the different ways of thinking and acting in teacher education processes.

So, we focused our investigation on the analysis of thinking styles on experimentation in certified bachelor's programs for teaching Biology available in universities in southern Brazil, by means of analysis of the PPCs. It is worth mentioning that the thinking style about Experimentation, although still rooted on the demonstrative approach, already shows some progress among the collectives described in this paper, thinking on the evolution and graduation of new teachers, making us think about a more critical and post-critical curriculum, more concerned in expanding and changing it.

As results, we identified that the referentials used in the PPCs, as well as the pedagogical subjects in the CCs menus of the courses indicated that the Investigative Thought Style has been fostered in the initial training processes, considering the great amount of referentials advocating this perspective. But we also observed, in a less prevailing scale, the use of referentials that indicate an empiricist-inductivist Experimentation perspective, which raised some concern since we have been working towards strengthening the understandings on the investigative potential that can be achieved through Experimentation.

We thus believe that the arguments given here are key pieces for future reflections and insights and that there is much more to do in the discussion about this topic, because our results do not indicate the development of the Thought Style in the courses investigated and that there are no guarantees that the premises identified through the analysis can be sustained in the teacher pedagogical practice in the classroom. But we understand that the investigative approach evidenced in the collectives represents a guiding approach into the practice, revealing the possibility of development of a Thought Style under this perspective in processes of initial training of teachers of Biology in southern Brazil.

Experimentação em cursos de licenciatura em ciências biológicas: um olhar a partir da epistemologia Fleckiana

RESUMO

A investigação em tela trata de uma análise epistemológica baseada nos pressupostos de Ludwik Fleck, tendo como objetos de investigação, nove Projetos Pedagógicos dos Cursos (PPC) de licenciatura em Ciências Biológicas das Universidades Federais do Sul do Brasil. O objetivo da pesquisa é identificar o desenvolvimento dos Estilos de Pensamento acerca de Experimentação em PPCs de formação de professores de Biologia. Para identificar os Estilos de Pensamento, realizamos as discussões embasados, em concepções de Experimentação: Investigativa (a mais prevalente), Empirista-indutivista (segunda prevalente), Demonstrativa e Dedutivista-racionalista (ausentes). Focando em analisar os referenciais de cunho obrigatório, foi possível discutir nos excertos obtidos durante as análises de nove PPCs, as categorias: Estilos de Pensamento e Coletivos de Pensamento propostas por Fleck, de modo a perpassar os Matizes de Pensamento e com isso constatar aproximações, no que diz respeito ao estilo de pensar investigativo, presente na maioria dos PPCs analisados. Diante dos resultados, destacamos que em meio aos diferentes Coletivos (instituições), há o desenvolvimento de um Coletivo de Pensamento norteado pelo mesmo estilo de pensar a Experimentação de forma investigativa, fortalecendo os entendimentos acerca desta para proporcionar uma formação de qualidade para a área do Ensino de Ciências.

PALAVRAS-CHAVE: Currículo. Categorias de pensamento. Concepções. Fleck. Ensino de Ciências.

NOTAS

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