

Epistemological Profile and Conceptual Profile: Uses, Abuses, and Confusion?

Perfil Epistemológico e Perfil Conceitual: Usos, Abusos e Confusões? Perfil Epistemológico y Perfil Conceptual: ¿Usos, Abusos y Confusion?

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Abstract

In this article, we conducted a literature review on how the concepts of Conceptual Profile, proposed by Eduardo Mortimer, and Epistemological Profile, developed by Gaston Bachelard, have been used and appropriated in Science Education. In its genesis, the Epistemological Profile characterized philosophical doctrines of scientific knowledge and their transformations, while the Conceptual Profile focused on the evolution of ideas and their interaction with the social and cultural context. The differences between these profiles' propositions and their applications in the reviewed research revealed theoretical and methodological conflicts, particularly in the epistemology-pedagogy relationship. From these elements, emerges the idea that the use of these concepts has been developed with some abuses and confusion, which this text aims to problematize.

Keywords: Epistemological Profile, Conceptual Profile, Science Education

Resumo

Neste artigo realizamos uma revisão da literatura acerca de como os conceitos de Perfil Conceitual, proposto por Eduardo Mortimer, e Perfil Epistemológico, desenvolvido por Gaston Bachelard, estão sendo utilizados pela comunidade do Ensino de Ciências. Em sua gênese, o Perfil Epistemológico caracterizou as zonas filosóficas do conhecimento científico e suas transformações, enquanto o Perfil Conceitual focou na evolução das ideias e na interação com o contexto social e cultural. As diferenças entre as proposições desses perfis e seus empregos nas pesquisas revisadas revelaram tensões teóricas e metodológicas, principalmente na relação entre epistemologia e pedagogia. De tais elementos, emerge a ideia de que, em certa medida, o uso desses conceitos tem sido desenvolvido com alguns abusos e confusões, “ruídos” que o presente texto busca problematizar.

Palavras-chave: Perfil Epistemológico, Perfil Conceitual, Ensino de Ciências

Resumen

En este texto realizamos una revisión bibliográfica sobre cómo los conceptos de Perfil Conceptual, propuesto por Eduardo Mortimer, y Perfil Epistemológico, desarrollado por Gaston Bachelard, son utilizados por la comunidad de la Enseñanza de las Ciencias. En sus génesis, el Perfil Epistemológico caracteriza las doctrinas filosóficas del conocimiento científico y sus transformaciones, mientras el Perfil Conceptual se centra en la evolución de las ideas y en la interacción con el contexto social y cultural. Las diferencias entre las proposiciones de estos perfiles y sus usos en las investigaciones revisadas revelaron tensiones teóricas y metodológicas, especialmente en la relación entre epistemología y pedagogía. De tales elementos surge la idea de que el uso de estos conceptos se desarrolla con algunos abusos y confusiones, que el presente texto busca problematizar.

Palabras clave: Perfil Epistemológico, Perfil Conceptual, Educación en Ciencias

Introduction

Epistemology, as a field of philosophical study, plays a fundamental role in scientific knowledge progress. It encompasses questions regarding nature, origin, methods, and limits of human understanding. By questioning how we know what we know, epistemology provides a critical framework for scientific inquiry (Veronez Júnior, 2021). Therefore, it helps scientists comprehend the basis of their theories, assess the validity of conclusions, and recognize the underlying assumptions in their work. An extensive understanding of epistemology is essential for the progress of science, allowing researchers to reflect on their practices and improve their methods (Galindo, 2021).

In the context of teacher education, discussions about epistemology are equally powerful. As mentioned by Cavalcanti et al. (2013), there is a direct relationship between epistemological education and teacher education. Good epistemological training provides science teachers with the necessary tools to understand the content they are teaching and the principles that underlie this knowledge. This means that teachers need to understand not only the “what” of scientific knowledge, but also the “how,” “why,” and “for whom” of this knowledge (Becker & Marques, 2010; Howard et al., 2000).

A lack of development in teachers’ epistemological education can have negative consequences for their teaching practices. If teachers do not understand the epistemological foundations of their subjects, they are more likely to approach them superficially. This means teaching information without contextualizing it or helping students understand the processes involved in scientific knowledge construction (Guimarães, 2024). Furthermore, a limited understanding of epistemology can lead teachers to adopt dogmatic approaches rather than encouraging critical thinking and inquiry by the students.

From the relationship between the epistemology of Science and Science Teaching, two strong notions emerge and, in the context of this work, deserve attention in terms of their definitions, limits, characteristics, and approaches: the Conceptual Profile and the Epistemological Profile. Considering their differences, we understand that it is important for the area of Science Teaching to point out their characteristics, relationships, limitations, and/or distinctions. This aims to contribute to the area and its studies, helping research development with “more epistemological” and “more Science Teaching” purposes. In addition, we emphasize that this study is based on the problem related to the various uses of the Epistemological Profile and the Conceptual Profile, which, in some cases, are applied without a clear understanding of their theoretical bases.

Given the above, in this article we conducted a literature review on the Conceptual Profile and the Epistemological Profile, highlighting how the two proposals are being used by the Science Education community. For this, a review without limiting the research time was carried out. The analysis performed provided a systematic method to extract meanings and recurring patterns in the works examined.

The results obtained through this investigation allowed us to verify how the different proposals arising from the notions of Epistemological Profile and Conceptual Profile are being explored, and that there is often a lack of clarity regarding the differences

in the use of the two proposals. Therefore, this research sought to contribute to the understanding of these two notions, their potentialities, weaknesses, and limitations; and their uses, abuses, and confusion.

Exploring and Differentiating the Theoretical Foundations of the Epistemological Profile and the Conceptual Profile

Epistemological Profile

The notion of Epistemological Profile was proposed by Bachelard (1991) to characterize, through a psychoanalysis of scientific knowledge, the various possible ways of understanding and interacting with the world that a given subject has. In his original formulation, the author defines five distinct zones: naive realism, empiricism, traditional rationalism, complete rationalism, and discursive rationalism. Therefore, the configuration of a person's Epistemological Profile in relation to a specific concept is determined by the frequency with which he or she mobilizes each zone to understand the physical world. In this sense, it is important to highlight that each zone is unique, that is, the evolution to a new zone only occurs through a break with the knowledge that involves the previous zone, not through knowledge accumulation.

We emphasize that the features that reveal Bachelard's possible concern regarding Science Teaching are intrinsically linked to his fears about the process of scientific production. He argues that rationalism applied to the scientific object must be preceded by the internalization of rational thought by the subject. According to Bachelard (1977), "an ontology of the idea taught then comes to cover the rationalism of teaching". For the author, this rationalism requires transferring one spirit to another. Since his approach does not delve into the discussion about the process of such "spiritual alteration" (p. 20), it is possible to assume that Bachelard remains on the edge of epistemological interest, not advancing in actions of didactic or pedagogical explanation. Although we can establish relations, from our current perspective, with the pedagogical process of didactic mediation, it is worth noting that the French epistemologist does not advance in this focus — one of the central elements of the differences between the proposals of the Epistemological and Conceptual profiles.

In didactic mediation, pedagogical action demands constant, vigilant teaching rationality to overcome challenges such as the teacher's lack of knowledge of the student's preconceived ideas. These conceptions, often rooted in a naive realism typical of common sense, represent, for Bachelard, significant epistemological obstacles that block the understanding and assimilation of scientific concepts in school. The author highlights the need to overcome this pedagogical obstacle through a reflective and attentive approach on the part of the teacher, recognizing and addressing the students' preconceptions to promote more effective learning. However, although he points out several elements at the didactic level, Bachelard does not go into depth in his discussions on pedagogical action in producing or overcoming these obstacles. In his work, there is

a greater interest in analyzing how the obstacle impedes the complexification of science itself, rather than discussing its genesis or control through the social or teaching process, for instance.

After this research investigation, it is important to underscore a significant limitation: the real difficulty of effectively drawing up an Epistemological Profile in a current research project along the lines proposed by Bachelard — an issue that we have highlighted in other analyses, such as that carried out by Martins (2004). The lack of a detailed discussion of Bachelard's construction process naturally makes this procedure more challenging. Furthermore, while remaining faithful to Bachelard's epistemology, a genuine construction of the profile requires a psychoanalytic approach to the concept. This implies a conscious self-examination work on the part of the subject or an analysis conducted by someone qualified to explore the subject's individuality (De Souza, 2006).

Despite this, we recognize that the Bachelardian framework plays a fundamental role in understanding and analyzing the possible evolutions of Epistemological Profiles, even if these evolutions are presumable. This framework also makes it possible to identify obstacles of an epistemological nature, which, in turn, can serve as a reference for planning teaching and learning actions, as already developed by Lôbo (2008) and Melo & Amantes (2022).

Conceptual Profile

Inspired by Bachelard and other authors, Mortimer (1996) presented his model, entitled Conceptual Profile. The author justifies that his proposal derives from Bachelard's ideas, but states that the new terminology is coherent due to the inclusion of aspects that, according to him, are not present in the notion of Epistemological Profile. Moreover, he asserts that each individual would manifest a specific profile for each concept (Melo & Amantes, 2022).

When proposing his notion of Conceptual Profile, Mortimer (1996) highlighted his intention to construct a model that would explain the evolution of ideas, structuring this investigation to look at both the social issues in the classroom and the subjects individually, as a result of the teaching process.

Mortimer's discussions underscored one of the fundamental questions for those involved in Science Teaching: language. Supported by Vygotsky (1979), one of the theorists appropriated by Mortimer in the later development of his ideas, there is a significant interaction between language and thought, so that acquiring a new language implies the acquisition of a new structure of thought, a new culture, and a new world perspective.

In other words, the different zones mobilized in a subject's Conceptual Profile reflect his worldviews. Each zone demands a process of didactic mediation and a specific language. Despite the diverse languages in each zone, the teacher's didactic guidance can facilitate interaction between various social languages, converging into just one. From this shared language, each culturally inserted subject interprets the phenomena under study (Lôbo, 2008).

Mortimer and El Hani (2014) highlight that the axiological component of the Conceptual Profile zones is associated with the values and norms guiding choices and judgments within each zone, which not only reflects different ways of understanding a scientific concept but also incorporates the underlying values that influence the way these understandings are evaluated and accepted. For example, in the empirical-inductive zone, the central value lies in empirical observation and experimentation, while in the religious or mythical zone, values may be more closely related to cultural or spiritual beliefs. In this way, the axiology of each zone expresses the norms of validity and acceptance that condition the learning and teaching of scientific concepts, demonstrating how different value systems shape the engagement of students and teachers with scientific knowledge.

According to the Conceptual Profile within the molecule notion, Mortimer underscored the inadequacy of discussing a fundamental concept for Chemistry apart from the context. According to him, the conceptual dispersion outlined by the profile offers the advantage of showing that how one approaches the world is closely related to the context in which one is inserted (Mortimer, 1996).

Mortimer, by highlighting that his model derives from the notion of Epistemological Profile, justified the name change due to the inclusion of elements that, according to his perspective, would not be included in Bachelard's conception, such as the differentiation between the ontological and epistemological characteristics of each profile zone, as can be seen in the following description:

despite dealing with the same concept, each profile zone may be not only epistemologically but also ontologically different from the others, since these two concept characteristics may change as one moves through the profile (Mortimer, 2000, pp. 78–79).

In addition, there is the Conceptual Profile definition as “a supra-individual system of thought forms that can be attributed to any individual within the same culture” (Mortimer, 1996, p. 34). Hence, it is not an attempt to classify and understand the different phases or stages that precede the development of Science, but rather the epistemological and ontological commitments of the subjects, which are influenced by cultural issues (Santos & Santos, 2023; Silva & Amaral, 2020; Teilor & Zimer, 2023).

Sepulveda, Mortimer, and El-Hani (2020) refine and update the Conceptual Profile proposal, addressing the challenges in applying the theory of Conceptual Profiles in different educational contexts. This update is understood through discussion on the more flexible exploration of the various conceptual zones, considering the dynamic interactions between science, culture, and learning environment. Furthermore, it is important to stress that this contemporary discussion is not present in the analyzed texts. This absence suggests a gap that can be explored in future investigations on the application of the theory of Conceptual Profiles.

Tensions and Divergences in Profiles: Epistemological vs Conceptual

When analyzing the two notions, we believe that the first conflict between the profiles was the issue of ontology, brought as an explicit addition by Mortimer (1996) to Bachelard's proposal (1991). According to Mortimer's proposal, if the Conceptual Profile is distinguished from the Epistemological Profile by dealing with an ontological level, a study of Bachelard's proposal allows us to highlight an ontological discussion already existent in the Epistemological Profile. In other words, even if this is not explicitly mentioned, Bachelard's philosophical regions are categorized with epistemological and ontological perspectives. Based on the work *The Philosophy of No*, we observe that there are elements that can be interpreted ontologically (Martins, 2012). We demonstrate this, for example, with Bachelard's general proposal, in which ruptures suggest an ontological perspective indicating that the nature of reality is not constant, but subject to fundamental transformations. This approach implies a dynamic ontology, where the understanding of being and reality is subject to significant changes (Corriero, 2020). Moreover, the dialectic proposed by the author indicates an ontological vision in which differences, such as old and new theories, are in constant interaction and transformation. We emphasize that Bachelard was not an ontologist, even though his philosophy can be interpreted in light of ontology.

To support our understanding of ontology, we rely on Martin Heidegger (2013). Although Bachelard and Heidegger address distinct philosophical issues in their works, they provide complementary insights into the nature of knowledge and existence. While Bachelard focuses on epistemology, exploring the construction of scientific knowledge and the paradigmatic ruptures necessary for its advancement, Heidegger delves into ontology, investigating the human condition and our relationship with the world. Despite their differences, both thinkers shared a deep interest in the relationship between subject and object. Bachelard emphasized the objectivity of scientific knowledge and the importance of scientific practice in the construction of worldviews, while Heidegger highlighted the subjectivity of human existence and the immersion of being in the world. A comparative analysis of their approaches can enrich our understanding of the nature of knowledge and existence, offering complementary views on fundamental questions of philosophy (Kafure, 2020).

According to Heidegger (2013), ontology transcends the mere analysis of abstract categories or universal entities. It is a deep exploration of human experience immersed in the world. He introduces the concept of "Dasein", which can be translated as "being-there", aiming to describe the specific form of human existence. The author seeks to deconstruct pre-established conceptions about being, redirecting attention to the singularity and concreteness of said existence. At the heart of his approach is the importance of hermeneutic interpretation in understanding being. Heidegger (2013) recognizes that truth is not static, but rather a dynamic process. Thus, Heideggerian ontology provided a complex and profound vision of being, underscoring the singularity of human existence, temporality, the relevance of language, and the need to deconstruct preconceptions to achieve an authentic understanding of being (Maciel et al., 2017).

In this conflict between Mortimer's differentiation concerning the Epistemological Profile and the Conceptual Profile, perhaps the ontological issue constitutes the main one. Regarding this, and assuming that the focus of this work is not to make this distinction, but to highlight how our area has used these proposals, it is important to consider the studies of Martins (2004; 2012), since this author problematized and brought elements that ratify the presence of ontology in Bachelard's studies.

Supposing ontology as the field of philosophy that considers the being in itself, the nature of reality and existence, Martins (2012) states that there are no doubts about the ontological proposals in the various zones of the Epistemological Profile:

if we consider Bachelard's analysis of mass, the differences in ontological nature become evident. In naive realism, mass (associated with large things) is strongly identified with extension itself, which makes no sense from an empiricist or classical rationalist point of view, for example. It is matter itself, and not a property of matter. When analyzing the rationalist notion of mass, Bachelard himself makes clear differences (which involve ontological aspects, in our view) about previous notions: "Before Newton, mass was studied in its being, as a quantity of matter. After Newton, it is studied in a becoming of phenomena, as a coefficient of becoming" (Martins, 2012, p. 276).

In this sense, given that there is a proposal, based on Mortimer, that problematizes a Bachelardian non-ontology and an interpretative possibility of ontological meaning in Bachelard, in the relationship between such proposals the conflict that the former brings to the latter is evident. Rather than defining or attributing the ontological title to one or the other proposal, we understand that within the scope of this work, it is sufficient, on this issue, to point out their tension.

Furthermore, from the arguments presented, we emphasize that the major divergence we identified between the two proposals is that the Conceptual Profile considers pedagogical issues, while the Epistemological Profile is centered on building scientific knowledge.

In the same vein, Mortimer's study proposes that pre-scientific levels should not be determined by philosophical schools of thought, but rather in relation to the epistemological and ontological commitments of the subjects, making the Conceptual Profile a supra-individual system of forms of thought, influenced by culture. For Bachelard, these levels represent the initial stages of thought, marked by epistemological obstacles that prevent the transition to scientific understanding. A second conflict emerges from these ideas. After all, Martins (2012) argues that Bachelard's perspective also partly considers this issue, in which the categories are independent of the context, being "one of the basic characteristics of the notion of Epistemological Profile" (Martins, 2004, p. 46). Apparently, the notion of Conceptual Profile is not related to the philosophical schools proposed by Bachelard, considering that the pre-scientific stages do not necessarily follow the sequence of naive realism, empiricism, and the other categories. Thus, we observe a significant cultural influence in the definition of the profile areas. In addition,

it was recognized that these areas may vary between different social classes. However, the categories are likely consistent within the same culture and independent of the context (Martins, 2012). In this sense, Martins highlights:

Given the variety of epistemological obstacles that individuals find throughout the conceptualization process, we could even think about “subdividing” certain regions of the profile, admitting a kind of “fine structure” for the most elementary zones. This may not even be necessary, but it would still not be at odds with Bachelard’s view, which refers — in the Philosophy of No — to the first region of the profile under the names of both animism and naive realism. We understand that, for him, this region is multifaceted precisely because of the polymorphism of the obstacles (Martins, 2004, p. 47).

However, we believe that this does not justify separating the “pre-scientific” levels from naive realism or empiricism, since in the history of ideas and research on alternative conceptions, the conceptions expressed by the subjects are present in an underlying way.

From this tension, we arrive at points of difference. Still regarding the structuring of the zones or levels of each proposal, the conceptions that involve the structure of the Conceptual Profile allow the researcher to have a certain freedom in establishing the categories of analysis that are used in the characterization of the distinct regions of the profile (Martins, 2012). We identified this methodological difference in the notions of the two profiles. For building the Conceptual Profile, its categories emerge from the corpus analysis. Thus:

although the determination of these categories and zones, for each concept, is courted with the literature related to alternative conceptions and with the History of Science, it has a strong relationship with the subjects’ discourse and the sociocultural environment, arising from the analysis of research data in a more empirical perspective (Martins, 2012, p. 279).

In contrast, in the notions of the Epistemological Profile, the categories are a priori, according to the structure of the existing philosophical zones. However, currently these categories may have other names, considering the advances of more recent studies. We can assume that these zones are based on the production and development of Science itself, as a possible way of evaluating the understanding that an individual manifests about a concept.

The theoretical-methodological differences between both profiles were emphasized by Martins (2012), as well as the possible advantages and disadvantages of choosing one of these perspectives. Therefore, according to the notion of Conceptual Profile, there is the possibility of exploring the conceptions of students, related to contexts that consider some epistemological, ontological, and pedagogical commitments, which can enhance the use of alternative conceptions; on the other hand, the notions of Epistemological Profile involve a more rationalist view, seeking to attribute meaning to the conceptions in the structure of Science production. Thus, although articulated, Science and its

Teaching comprise distinct elements of discussion, one being a task of epistemology and the other of Science didactics. In a similar way to Bachelard's Epistemological Profile, the Conceptual Profile suggested by Mortimer highlights distinct zones in the profile, so that each one has a greater explanatory capacity than the previous zones.

After discussing the similarities and differences that our analysis presents in characterizing the two proposals, the works obtained in a systematic review process using the profiles in their discussion will be presented below.

Methodological Path

The research on the works that use the notions of profiles consists of a literature review. According to Brizola and Fantin (2016), "literature review is nothing more than the gathering, the joining of ideas from different authors on a given topic, achieved through reading and research carried out by the researcher" (p. 27). To accomplish this task, we focused on identifying the journals, authors, years, definitions, and ways of using the ideas of Epistemological Profile and Conceptual Profile.

The research repositories included the CAPES Journal Portal and the Scientific Electronic Library Online (SciELO). Using both platforms was justified because they play fundamental roles in promoting research and sharing scientific knowledge at national and international levels. When searching on these digital platforms, we used specific search terms, which were translated into English and Spanish and combined with Boolean characters. Thus, we performed the search using the following combination: (Perf*) OR (Epistemologi*); (Perf*) OR (Conceitu*) in the three languages.

The initial searches revealed 153 texts on the Conceptual Profile and 103 on the Epistemological Profile. The original selection of the works considered the title, abstract, and keywords in the texts. To refine them to the corpus composition, the inclusion criterion used was the presence of discussions that objectively defined, classified, organized, or conceptualized the profiles investigated. In this sense, texts that, for example, only mentioned some of the profiles, without clarifying their theoretical bases, were excluded. This process allowed a corpus composition with 27 texts referring to the Conceptual Profile and 13 to the Epistemological Profile. As Booth and collaborators (2016) point out, it is possible that reviews like this do not cover all publications on the topic addressed, since there are always issues of research limitation that arise from both the bases and the terms used. After all, it is possible that some work in the context of the investigation will not be selected or, considering the perspective focused on the research, will not be integrated into the established inclusion criteria.

The works analyzed were in Portuguese, English, and Spanish, aiming to broaden the linguistic variety for a more comprehensive analysis. The search criteria limited the analysis to articles from scientific journals, as long as they were peer-reviewed, without determining a specific search period or area of study. This is due to our interest in understanding how these two proposals are discussed in the academic literature. The work selection made it possible to create Figures 1 and 2.

Figure 1*Texts belonging to the corpus of analysis of the Conceptual Profile*

Code	Text
T1	Silva, F. C. V. D., & Amaral, E. (2020). Articulando conhecimentos científicos e práticos sobre ácidos/bases: Uma análise de formas de falar e modos de pensar de licenciandos em química e cabeleireiras. <i>Ensaio Pesquisa em Educação em Ciências (Belo Horizonte)</i> , 22, e19348. https://doi.org/10.1590/21172020210124
T2	Coutinho, F. Â., Martins, R. P., & Vieira, M. C. (2012). Contribuição da filosofia da microbiologia para fundamentar a zona relacional do perfil conceitual de vida. <i>Ensaio Pesquisa em Educação em Ciências (Belo Horizonte)</i> , 14(3), 51–64. https://doi.org/10.1590/1983-21172012140304
T3	Santos, J. P. M. dos, & Santos, B. F. dos. (2023). Diretrizes para planejamento do ensino de ciências baseado na teoria dos perfis conceituais. <i>Ensaio Pesquisa em Educação em Ciências (Belo Horizonte)</i> , 25, e40890. https://doi.org/10.1590/1983-21172022240134
T4	Ribeiro, A. J. (2013). Elaborando um perfil conceitual de equação: desdobramentos para o ensino e a aprendizagem de matemática. <i>Ciência & Educação</i> , 19(1), 55–71. https://doi.org/10.1590/S1516-73132013000100005
T5	Pedrerros Martínez, R. I. (2014). Modos de pensar y hablar sobre el equilibrio térmico: significados y contextos de uso en las ciencias de la naturaleza. <i>Tecné, Episteme y Didaxis: TED</i> , (35), 113–132. https://revistas.upn.edu.co/index.php/TED/article/view/2726
T6	Vairo, A. C., & Rezende Filho, L. A. C. (2013). Perfil Conceitual como tema de pesquisa e sua aplicação em conteúdos de biologia. <i>Ensaio Pesquisa em Educação em Ciências (Belo Horizonte)</i> , 15(1), 193–208. https://doi.org/10.1590/1983-21172013150112
T7	Nicolli, A. A., & Mortimer, E. F. (2012). Perfil conceitual e a escolarização do conceito de morte no ensino de ciências. <i>Educar em Revista</i> , (44), 19–35. https://doi.org/10.1590/S0104-40602012000200003
T8	Karam, R. A. S., Cruz, S. M. S. C. de S., & Coimbra, D. (2006). Tempo relativístico no início do Ensino Médio. <i>Revista Brasileira de Ensino de Física</i> , 28(3), 373–386. https://doi.org/10.1590/S1806-11172006000300014
T9	Venturi, T. (2015). Discussões epistemológicas: contribuições para a educação em saúde realizada no ensino de ciências. <i>Revista Dynamis</i> , 21(1), 72–84. https://ojsrevista.furb.br/ojs/index.php/dynamis/article/view/5174
T10	Amaral, E. M. R., & Mortimer, E. F. (2001). Uma proposta de perfil conceitual para o conceito de calor. <i>Revista Brasileira de Pesquisa em Educação em Ciências</i> , 1(3). https://periodicos.ufmg.br/index.php/rbpec/article/view/4154
T11	Teilor, B. A., & Zimer, T. T. B. (2023). A construção de categorias analíticas na pesquisa sobre perfil conceitual de formação contínua de professores. <i>Revista Espaço Pedagógico</i> , 30, e14321. https://doi.org/10.5335/rep.v30i0.14321
T12	Mortimer, E. F., Scott, P., & El-Hani, C. N. (2011). Bases teóricas e epistemológicas da abordagem dos perfis conceituais. <i>Tecné, Episteme y Didaxis: TED</i> , (30). https://revistas.upn.edu.co/index.php/TED/article/view/1102
T13	De Araújo, A. O., & Fleury Mortimer, E. (2013). Calor: sensação térmica, substância ou energia? O perfil conceitual de calor em um curso de manutenção e instalação de aparelhos de refrigeração. <i>Enseñanza de las Ciencias: Revista de Investigación y Experiencias Didácticas</i> , (Extra), 2579–2583. https://raco.cat/index.php/Ensenanza/article/view/307946

Figure 1*Texts belonging to the corpus of analysis of the Conceptual Profile (continuation)*

Code	Text
T14	Neto, J. E. S., da Silva, J. R. R. T., Cruz, M. E. B., & Amaral, E. M. R. (2013). Emergência das zonas do perfil conceitual de calor em uma sequência didática. <i>Enseñanza de las Ciencias: Revista de Investigación y Experiencias Didácticas</i> , (Extra), 3348–3353. https://raco.cat/index.php/Ensenanza/article/view/308424
T15	Sepulveda, C., Mortimer, E. F., & El-Hani, C. N. (2013). Construção de um perfil conceitual de adaptação: implicações metodológicas para o programa de pesquisa sobre perfis conceituais e o ensino de evolução. <i>Investigações em Ensino de Ciências</i> , 18(2), 439–479. https://ienci.if.ufrgs.br/index.php/ienci/article/view/140
T16	Nicolli, A. A., Mortimer, E. F., & da Silva, I. M. (2012). Ensino de ciências: uma proposta de escolarização do conceito de morte por meio da abordagem do ciclo de vida. <i>Amazônia: Revista de Educação em Ciências e Matemáticas</i> , 8(16), 133–145. http://dx.doi.org/10.18542/amazrecm.v8i16.1664
T17	Menezes, V. M. S., Machado, S. M. F., & da Silva, E. L. (2020). Perfil conceitual a respeito da concepção atomística dos estados físicos da matéria de um grupo de alunos da educação de jovens e adultos–EJA. <i>Revista de Ensino de Ciências e Matemática</i> , 11(5), 223–242.
T18	Souza, E. V. (2009). Perfil conceitual complexo: a interação entre perfis conceituais. <i>Enseñanza de las Ciencias: Revista de Investigación y Experiencias Didácticas</i> , (Extra), 3068–3073. https://raco.cat/index.php/Ensenanza/article/view/294607
T19	Leitão, U. A., Fernandes, J. A., & Lage, G. (2018). Investigação de perfis conceituais em uma atividade experimental sobre força magnética no Ensino Médio. <i>Caderno Brasileiro de Ensino de Física</i> , 35(1), 290–315. https://doi.org/10.5007/2175-7941.2018v35n1p290
T20	Mortimer, E. F. (1997). Beyond chemical boundaries: A conceptual profile for molecule and molecular structure. <i>Química Nova</i> , 20(2), 200–207. https://doi.org/10.1590/S0100-40421997000200013
T21	Ribeiro Amaral, E. M., & Fleury Mortimer, E. (2004). Un perfil conceptual para entropía y espontaneidad: Una caracterización de las formas de pensar y hablar en el aula de química. <i>Educación Química</i> , 15(3), 218–233. https://doi.org/10.22201/fq.18708404e.2004.3.66179
T22	Mejía, G. A. C. (2017). Concepciones del profesorado de Biología sobre evolución biológica desde el perfil conceptual. <i>Bio-grafía</i> , 10, 771–779. https://revistas.upn.edu.co/index.php/bio-grafia/article/view/7208
T23	Simões-Neto, J. E., Lima, C. M., & Amaral, E. M. R. (2015). Una secuencia didáctica para abordar el concepto de calor en la enseñanza de estudiantes preuniversitarios. <i>Formación Universitaria</i> , 8(2), 3–10. http://dx.doi.org/10.4067/S0718-50062015000200002
T24	Orduña Picón, R., Sevián, H., & Mortimer, E. F. (2020). Conceptual profile of substance: Representing heterogeneity of thinking in chemistry classrooms. <i>Science & Education</i> , 29(5), 1317–1360. https://doi.org/10.1007/s11191-020-00152-4
T25	Mortimer, E. F. (1995). Conceptual change or conceptual profile change? <i>Science & Education</i> , 4, 267–285. https://doi.org/10.1007/BF00486624
T26	El-Hani, C. N., & Mortimer, E. F. (2007). Multicultural education, pragmatism, and the goals of science teaching. <i>Cultural Studies of Science Education</i> , 2, 657–702. https://doi.org/10.1007/s11422-007-9064-y
T27	Mortimer, E. F. (1998). Multivoicedness and univocality in classroom discourse: An example from theory of matter. <i>International Journal of Science Education</i> , 20(1), 67–82. https://doi.org/10.1080/0950069980200105

Figure 2*Texts belonging to the corpus of analysis of the Epistemological Profile*

Code	Text
T28	Carvalho Filho, J. E. C. (2006). Educação científica na perspectiva bachelardiana: Ensaio enquanto formação. <i>Revista Ensaio</i> , 8(1). https://doi.org/10.1590/1983-21172006080102
T29	Lôbo, S. F. (2008). O ensino de química e a formação do educador químico, sob o olhar bachelardiano. <i>Ciência & Educação</i> , 14(1), 89–100. https://doi.org/10.1590/S1516-73132008000100006
T30	Silva Júnior, A. G., Tenório, A. C., & Bastos, H. F. B. N. (2007). O perfil epistemológico do conceito de tempo a partir de sua representação social. <i>Ensaio Pesquisa em Educação em Ciências</i> , 9(2), 188–204. https://doi.org/10.1590/1983-21172007090203
T31	Melo, V. F., & Amantes, A. (2022). Validação de teste em três camadas para mapear perfis epistemológicos de densidade. <i>Ensaio Pesquisa em Educação em Ciências</i> , 24. https://doi.org/10.1590/1983-21172022240124
T32	Ramos, T. A., & Scarinci, A. L. (2013). Análise de concepções de tempo e espaço entre estudantes do ensino médio, segundo a epistemologia de Gaston Bachelard. <i>Revista Brasileira de Pesquisa em Educação em Ciências</i> , 13(2), 9–25. https://periodicos.ufmg.br/index.php/rbpec/article/view/4259
T33	De Melo, V. F., Amantes, A., & Vieira, R. D. (2020). Construção de uma taxonomia sobre o entendimento do conceito científico de densidade baseada na noção de Perfil Epistemológico. <i>Ensino, Saúde e Ambiente</i> , 13(1), 161–182. https://doi.org/10.22409/resa2020.v13i1.a21647
T34	Zanetic, J. (2006). Física e literatura: construindo uma ponte entre as duas culturas. <i>História, Ciências, Saúde-Manguinhos</i> , 13(suppl), 55–70. https://doi.org/10.1590/S0104-59702006000500004
T35	Viau, J. E., Moro, L. E., Zamorano, R. O., & Gibbs, H. M. (2008). La transferencia epistemológica de un modelo didáctico analógico. <i>Revista Eureka sobre Enseñanza y Divulgación de las Ciencias</i> , 5(2), 170–184. https://revistas.uca.es/index.php/eureka/article/view/3754
T36	Souza, P. H., Testoni, L. A., & Brockington, G. (2016). O conceito de tempo no ensino de Física: perfis epistemológicos e culturais. <i>Alexandria: Revista de Educação em Ciência e Tecnologia</i> , 9(2), 3–33. https://doi.org/10.5007/1982-5153.2016v9n2p3
T37	Dorigon, L., Silva, M. R., Costa, J. A., Oliveira, F. L., & Pereira, R. T. (2019). Perfil epistemológico para o conceito de transformações apresentado nos livros didáticos de química da 1ª série do ensino médio. <i>Revista Brasileira de Ensino de Ciência e Tecnologia</i> , 12(1), 584–597. http://dx.doi.org/10.3895/rbect.v12n1.9670
T38	Souza Filho, M. P. de, Boss, S. L. B., & Caluzi, J. J. (2012). Problematização no ensino de tópicos do eletromagnetismo por meio das etapas da psicanálise bachelardiana. <i>Nuances: Estudos sobre Educação</i> , 22(23), 72–95. https://doi.org/10.14572/nuances.v22i23.1751
T39	Pinto, A. C., & Zanetic, J. (1999). É possível levar a física quântica para o ensino médio? <i>Caderno Brasileiro de Ensino de Física</i> , 16(1), 7–34. https://periodicos.ufsc.br/index.php/fisica/article/view/6873
T40	Pazinato, M. S., Santos, L. H., Lima, A. P., Oliveira, F. C., & Ferreira, R. G. (2020). Epistemological profile of chemical bonding: Evaluation of knowledge construction in high school. <i>Journal of Chemical Education</i> , 98(2), 307–318. https://doi.org/10.1021/acs.jchemed.0c00353

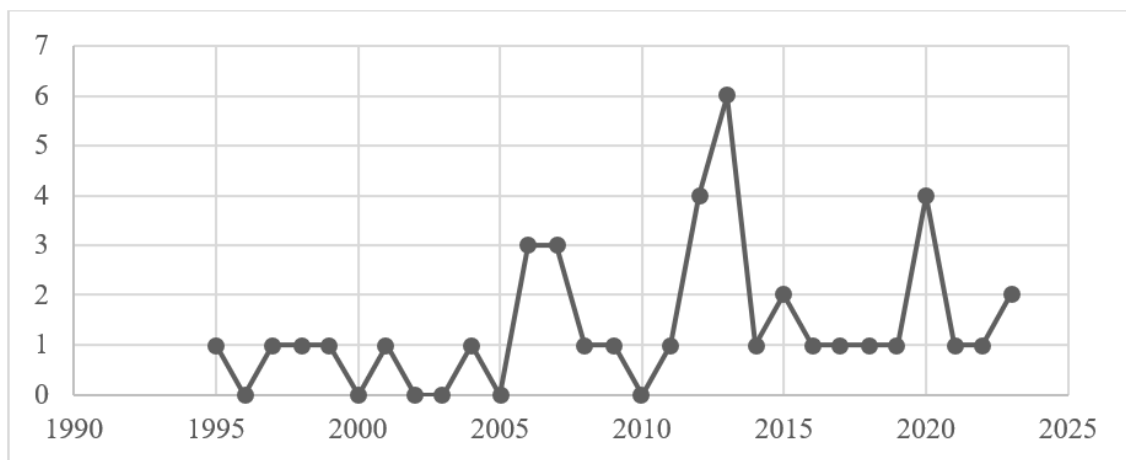
The selected texts were analyzed based on the objectives of identifying: (i) publication journals; (ii) years; (iii) most used keywords; (iv) authors of the texts; (v) languages; (vi) focus on the Epistemological Profile or Conceptual Profile; (vii) area; (viii) objective of the study. The analysis criteria of items i to vii represent the search for quantitative data, and item viii covers information with a qualitative basis.

Quantifying Research: Exploring Quantitative Text Analysis

The first quantitative information that we consider relevant to understanding the mapping of the use of both proposals refers to the journals where these publications occur, as shown in Figure 4. We emphasize that journals play an important role in advancing academic discussions since it is through them that many results, reviews, and analyses of relevant research are discussed and shared among experts. In this sense, the publication represents the conclusion of the research, constituting the author's social contribution and how the results and findings of the study can be disseminated (Trzesniak, 2009).

The journal that stood out with the largest number of publications, with a total of six papers, was *Ensaio Pesquisa em Educação em Ciências*. This is a refereed journal with continuous flow, dedicated to research reports, critical literature reviews, and fundamental discussions on topics related to natural science education. It covers all levels of education and diverse educational contexts. Six other journals published two articles each: *Caderno Brasileiro de Ensino de Física*; *Ciência & Educação*; *Enseñanza de las Ciencias*; *Revista Brasileira de Pesquisa em Educação em Ciências*; *Science & Education*; and *Tecné, Episteme y Didaxis: TED*. Although each of these journals has its focus and specific target audience, they all share the goal of promoting Science Teaching and scientific education by providing a space for exchanging ideas, research, and innovative practices in this ever-evolving field.

Regarding the language of the articles, we found that 65% were written in Portuguese, 22.5% in Spanish, and 7.5% in English. Based on these data, it is possible to infer that there is a predominance of texts that address these topics in Portuguese. This is largely due to the significant presence of Brazilian authors in this field or to the national origin of the proponent of the Conceptual Profile. We can also notice in Figure 3 a concentration of these publications between 2012 and 2015. In addition, we emphasize that the construction of the corpus of analysis of this research occurred in mid-2023. Therefore, there may be more than two articles published this year that are not included in the data of this investigation.

Figure 3*Identification of the annual distribution of publications in the corpus*

When we analyzed the keywords in quantitative terms, we identified more than 130 of them, many of which were not repeated. The three most frequently identified terms were: Science Teaching, Conceptual Profile, and Epistemological Profile. Editors of scientific journals usually ask authors to include keywords in their texts when submitting articles (Gonçalves, 2008). These keywords generally highlight the scope of a topic and its main concepts. In the context of scientific articles, this procedure can be beneficial for indexing in search engines and categorizing text (Ercan & Cicekli, 2007). In this sense, keywords increase accessibility to the content of documents beyond the information expressed in the title and abstract. This reflects the authors' thinking and maintains a connection with the reality of everyday practice, following scientific and technological development, as evidenced in the documents (Miguéis et al., 2013). Therefore, it was possible to observe the use of notions from both profiles strongly associated with Science Teaching.

Regarding the "authorship" aspect of the 40 articles, a total of 71 authors emerged, with a majority of contributions from multiple authors. Collaborative writing is a widespread practice in academia, as the writing of articles often emerges from research groups, mainly from partnerships between students and advisors. It is worth noting that most authors, together with their collaborators, had only one article published, and only three authors appeared in three or more different articles, as shown in Figure 4.

Figure 4*Presentation of authors that appear in different articles*

Name of the author	Article	Year of publication
Eduardo Fleury Mortimer	T7, T10, T12, T13, T15, T16, T20, T21, T24, T25, T26, T27	2012, 2001, 2011, 2013, 2013, 2012, 1997, 2004, 2020, 1995, 2008, 1998
Edenia Maria Ribeiro Amaral	T1, T10, T21	2020, 2001, 2004
Charbel Nino El-Hani	T12, T15, T26	2011, 2013, 2007

As we can see in the previous figure, the prominent role of the author Mortimer in the publications analyzed was notable. We believe such prominence arises from the previously discussed fact that the author is the proponent of the Conceptual Profile, and all these texts refer to this notion. Moreover, we emphasize that twenty-seven of the forty texts address the Conceptual Profile, while thirteen discuss the Epistemological Profile. We consider it likely that the greater recurrence of the first is associated with the pedagogical elements considered in this theory. Finally, the discussion field was Science Teaching/Education.

Qualifying Research: Using Studies With the Conceptual Profile and the Epistemological Profile

In recent years, as shown in Figures 1 and 2, several studies have been conducted on the Conceptual or Epistemological Profile models. These concepts have been considered in line with scientific issues. It is highlighted below, in each section, the texts identified with the Conceptual Profile and the Epistemological Profile.

To better organize the text, the following sub-items will initially address a descriptive approach to the research on the Conceptual and Epistemological profiles. In an integrative sense, the subsequent section will provide a critical discussion of the works, aiming to analyze the possible interactions and contradictions in the use of both profiles.

Conceptual Profile

Among the works analyzed, we observed that the author with the most productions was Mortimer (as shown in Figure 4), totaling twelve works and covering more than two decades of publications dedicated to the topic. Thus, we underscore that T25 represented the oldest among the documents in this research, being fundamental in the first discussions addressed by Mortimer when introducing the Conceptual Profile. Throughout the reading, the author's concern in highlighting and, at times, defending his proposal became evident. In this sense, the author discusses that:

I will use the notion of “conceptual profile” instead of “epistemological profile” to introduce some features in the profile that differ from Bachelard's philosophical notion since I intend to find a model to describe changes in individual thoughts as a result of the teaching process. The conceptual profile should have some similarities with the epistemological profile, such as hierarchies between the different zones, whereby each successive zone is characterized by having categories with more explanatory power than its antecedents (Mortimer, 1995, p. 272).

In this excerpt, the author made it clear that his Conceptual Profile proposal is directly concerned with issues involving teaching and learning processes.

In T20, the author emphasizes that, as discussed in article T25, his analyses shared with Bachelard's Epistemological Profile the conception that a single form of thought is inadequate to address a single concept. However, the author noted that each zone of a Conceptual Profile has specific ontological elements, in addition to its epistemological characteristics. He adds:

we are not looking for a way to understand primitive concepts solely to go beyond them, as in Bachelard's rationalism. We are more interested in describing the process of conceptualization in a way that is consistent with the idea that different worldviews can be complementary (Mortimer, 1997, p. 202).

This text (T20), one of the first published by the author on the ideas related to the Conceptual Profile, highlighted throughout its writing the reasons for adapting Bachelard's proposal. Furthermore, it became clear that the Conceptual Profile is a contribution developed within the scope of teaching and capable of helping to understand the evolutionary dynamics of chemical concepts. The application of this concept in Chemistry Teaching at all levels can be beneficial, according to the author, by providing students with a more comprehensive understanding and facilitating their contact with the frontiers of Chemistry itself.

Following the chronological order of publications, in T27, from 1998, the author continues defending the Conceptual Profile throughout the discussions. It is possible to notice similar characteristics in the first publications about this proposal. Therefore, when we analyze these texts from the end of the 20th century, we evidence not only a defense of the Conceptual Profile but also a search for a language and theoretical structure that better suits the understanding of the nuances and complexities involved in the development of concepts through teaching.

In these pioneering works, there is a clear emphasis on the choice of the terminology "Conceptual Profile", as opposed to "Epistemological Profile", revealing the deliberate intention of introducing specific characteristics that distinguish the proposed approach from Bachelard's philosophy. According to these studies, the use of this expression is not only semantic but brings fundamental implications for understanding the evolution of conceptual thought in the educational context.

This terminological choice suggests a conscious effort to develop a model that can more accurately capture the transformations in individual thoughts resulting from the teaching process. In this sense, the author sought not only a superficial differentiation but also a more refined conceptual approach that would allow a deeper and more contextualized analysis of the cognitive changes associated with education.

In contrast, Mortimer's own latest publications took on distinct characteristics. T12, although it does not mention Bachelard, established connections with the discussions related to the Conceptual Profile by aligning its ideas with Vygotsky's propositions. We highlight his statement that building a Conceptual Profile demands careful consideration of a wide range of meanings attributed to a concept, encompassing diverse contexts of meaning production. This included at least three of the four genetic domains explored

by Vygotsky in his investigations on the interrelations between thought, language, and concept formation, namely the sociocultural, ontogenetic, and microgenetic domains (Wertsch, 1988). Although it does not directly mention Bachelard, the text emphasizes the importance of integrating different perspectives and contexts for creating Conceptual Profiles, thus enriching the understanding of meanings around a concept.

T13 did not directly address Bachelard's ideas as contributions to Mortimer's proposal; however, it underscored the importance of understanding the construction of concepts. Mortimer (2000) proposed the creation of Conceptual Profiles as an approach to model the heterogeneity of thought and language. This model shares foundations with Vygotsky's theories (1979), considering the development of higher mental functions and the distinction between senses and meanings attributed by the individual to a word when it was used. The interconnection of these theories in a coherent synthesis established a set of shared assumptions that supported Mortimer's approach. This theoretical convergence offered a more comprehensive understanding of the construction of concepts, incorporating both the social-discursive dimension, as well as the cognitive-individual one, resulting in a more robust and holistic methodological proposal, explained in the article.

The purpose of T15 was to present an adaptation model for the Conceptual Profile, which served as a tool for discourse analysis in high school Biology classrooms. When defining this profile, which incorporates the same characteristics mentioned in other texts by the author, the importance of each individual developing a personal Conceptual Profile was highlighted. The text reiterated that Conceptual Profiles were understood as supra-individual systems of thought forms. Furthermore, when relating this idea to Vygotsky's (2001) approaches to the development of higher mental functions, it was underscored that individual thought was formed through the internalization of socioculturally constructed symbolic mediators, including language, provided by social interactions. This approach emphasized the interconnection between individual conceptual construction and the cultural contexts that contributed to the construction of knowledge and the development of higher cognitive abilities.

Although the presentation was concise in the context of T24, it was suggested that the understanding of chemical concepts varied substantially among students, highlighting the existence of heterogeneity in thinking. The central proposal emphasized the effectiveness of creating Conceptual Profiles as a valuable tool to capture this diversity. The core of the approach was the consideration of a wide range of meanings attributed to concepts, promoting a comprehensive exploration of different contexts in the production of meanings. In addition, the text underscored the influence of theories, notably from Vygotsky, underlining the need to integrate diverse perspectives and contexts to create these Conceptual Profiles. This theoretical and contextual integration aimed to provide a more holistic and refined understanding of the heterogeneity in students' thinking concerning chemical concepts, reinforcing the importance of the multifaceted approach in promoting more meaningful learning.

The texts mentioned above were reworked by Professor Eduardo Mortimer, which established a significant connection with Vygotsky's theories, evidencing the influence of Vygotskian thought in the elaboration of the Conceptual Profile. In T12, this influence was suggestive in the discussion on the theoretical bases that supported the approach, emphasizing the importance of the socio-historical dimension in the development of human thought. In T13, the methodological approach reflected Vygotskian understanding of the evolution of higher mental functions and the relevance of social interactions in the construction of meanings. T15 highlighted that Vygotsky's presence could be inferred in the discussion on the development of higher mental functions and the importance of social interactions in the formation of concepts. In T24, Vygotskian influence was observed in the analysis of the evolution of higher mental functions and in the internalization of symbolic mediators socioculturally constructed.

Eduardo Mortimer's most recent texts related to the concept of Conceptual Profile clearly reflect a strong influence of Vygotsky's theories in the theoretical and methodological approaches adopted. The reference to higher mental functions, sociocultural dimension, and social interactions demonstrates a convergence with the recognition of the importance of Vygotsky's contributions to the understanding of cognitive development and the formation of concepts. This convergence underscores a significant relationship between Mortimer's proposal and Vygotsky's ideas, highlighting the influence of the learning theorist in elaborating the Conceptual Profile.

Furthermore, although Mortimer also draws on Mikhail Bakhtin's ideas in developing the notion of Conceptual Profile, this influence is less explored in his writings. Even when Bakhtin is mentioned, the depth of his ascendancy on the proposal is not extensively discussed. Thus, while Vygotsky's influence is clearly articulated and integrated, Bakhtin's contributions are acknowledged but not explored in detail. The gap in the exploration of Bakhtin's influence may indicate a potential area for deepening and expanding the understanding of the Conceptual Profile.

Moreover, considering other texts by the most frequent authors in the articles that discussed the Conceptual Profile, only one was not in partnership with Mortimer. In T1, the authors suggested an interdisciplinary approach that integrated Chemistry with the daily practice related to acids and bases. The research explored the perspectives of undergraduate students in Chemistry and hairdressers about these concepts, aiming to understand how these groups approached and conceptualized acids and bases. The choice to compare undergraduate students in Chemistry, with more formal academic training, and hairdressers, with a more practical and applied perspective, highlighted divergences and convergences in the conceptions on these topics. The authors emphasized that for this analysis they mapped the Conceptual Profile, identifying patterns of thought and expression regarding acids and bases. An individual could express different ways of thinking about this concept, depending on the context, which indicates that each person could have a heterogeneity of thought. However, the authors also considered the profile zones as supra-individual and social, since they reflected ways of thinking and meaning the experience, which were imposed on individual cognition throughout their formation process (Silva & Amaral, 2020, p. 5).

Thus, cognition is constantly shaped and adjusted by social and cultural factors, resulting in a dynamic and multifaceted understanding of chemical concepts. This approach recognized the interconnection between individual formation and social influences, highlighting the complexity and fluidity of human comprehension of scientific concepts such as acids and bases.

Texts T2, T4, T7, T8, T10, T14, T16, T17, T19, T21, T22, and T23 mapped the Conceptual Profile, respectively, of the concepts of acid and base, equation, death, time, heat, heat, death, atomistics, magnetic force, entropy, biological evolution, and heat. The results of these studies indicated that the areas mobilized by the participants did not reveal a broad mastery over the understanding of the concepts, identifying weaknesses. These gaps can be attributed to a series of factors, such as the lack of familiarity with the concepts, or even difficulties inherent to the complexity of the topics in question, considering the emphasis on understanding these results from the perspective of the issues involving the teaching and learning processes.

On the other hand, texts T3, T5, T6, T9, T11, T18, and T26 focused on the theoretical part of the Conceptual Profile, for a better comprehension of the proposal. Among these works, T3, T5, T11, and T18 did not directly address the authors Bachelard and Vygotsky. In contrast, T6, T9, and T26 mentioned these authors, although without detailing how their theories contributed to the proposal of the Conceptual Profile. This absence of a more in-depth analysis can be considered a significant gap since a more detailed understanding of the contributions of Bachelard and Vygotsky could enrich the interpretation of the Conceptual Profile and provide a more solid theoretical basis for the discussions. By focusing on the theoretical part of the Conceptual Profile, these texts sought to establish a direct connection between the use of these notions and the understanding of the evolution of conceptual thinking in teaching, highlighting the objective of creating a robust theoretical basis that could be applied in educational practice to enhance the teaching and learning processes. However, the lack of reference to Bachelard, Vygotsky, or Bakhtin in some of these texts consisted of a limitation in understanding how the ideas of these theorists can complement and enrich the proposal of the Conceptual Profile and the comprehension of these notions.

Epistemological Profile

By examining texts focused on the notion of Epistemological Profile, we identified patterns and trends in the development of epistemological thought. These analyses allowed us to investigate the understanding of scientific concepts, as well as the philosophical and cultural influences that shape their perspectives.

Of the thirteen texts that make up the corpus of analysis regarding the Epistemological Profile, except for T34, the others brought discussions about the definitions of Bachelard's philosophical doctrines. Furthermore, T30, T31, T32, T33, T36, T37, T39, and T40 discussed mapping the Epistemological Profile of specific concepts. In their results, it is common to notice the mobilization of the first philosophical doctrines for the different concepts investigated.

The objective of T28 was to argue that Science Teaching should not be limited to the simple presentation of content, aiming at the accumulation of knowledge, but rather to overcome the obstacles that hinder the understanding of scientific thought and practice today. To achieve this objective, discussions around the Epistemological Profile were explored, highlighting its ability to identify an individual's level of maturity concerning certain scientific concepts. According to the authors, this allows the teacher to identify the means necessary to promote an effective teaching process, adapted to the student's level of understanding.

Text T29 addressed Bachelard, his contributions, and possible connections with Chemistry Teaching. The author's elements address current issues related to Chemistry Teaching and teacher training, with an emphasis on more autonomous, reflective and research-oriented teacher training. It was argued that the coexistence of different philosophical perspectives for the same scientific concept demonstrates the philosophical pluralism of scientific ideas, as described by Bachelard through the notion of Epistemological Profile. In this way, it showed how each scientific concept went through different philosophical perspectives until reaching a stage of maturity with the dialectical rationalism of contemporary Science.

In T30, according to the authors, the Epistemological Profile was considered a tool to measure the effective psychological influence of the various philosophies in the construction of knowledge. They highlighted that this profile is always related to a specific concept and that it is influenced by the culture and society of each individual. Moreover, the authors stated that the Epistemological Profile should be homogeneous to meet the educational needs of a group, as in the case of the undergraduate students interviewed, without hierarchy and sharing the same social representation. In the analysis, the authors observed that the social representation of the concept of time (a topic of specific interest) was strongly associated with common sense, without the presentation of traces of a systematized scientific approach. This indicated that the training of future teachers may be compromised with regard to the scientific understanding of this concept. Therefore, these future teachers may face difficulties when trying to teach this concept to their students, especially when adopting a scientific approach necessary for training citizens in today's world.

In T31, the authors outlined Mortimer's proposal in the theoretical foundation, which was based on Bachelard's discussions, emphasizing that:

another perspective that aimed to understand the construction of scientific concepts by students was the conceptual profile, suggested by Mortimer (1996). When proposing his model, the author explains that it derives from the notion of epistemological profile, but justifies the new nomenclature due to the insertion of some elements that, in his view, would not be present in Bachelard's notion. The author states that, in this perspective, each individual would present a distinct profile for each concept; however, the categories of the different zones of the conceptual profile would be independent of the context, being considered within the same culture.

Nevertheless, they did not address the existence or not of differences between the proposals. Furthermore, the results indicated that most of the students in the sample had scientific knowledge related to the empiricism zone. On the other hand, when presented with items involving complex empiricism, most students did not demonstrate having the necessary understanding to deal with the concept, which is similar to the difficulty faced with items from the traditional rationalism zone. This suggests that mathematical knowledge and the ability to establish necessary relationships increase the level of difficulty of the items, elevating them to a level corresponding to another knowledge zone. The difference is that this zone is more complex, as it encompasses and expands the comprehension of the previous zones, historically neglected in the schooling process, resulting in a higher level of difficulty. This result highlights the importance of discussing the instruments used to assess students' knowledge, especially in terms of their validity to achieve this objective.

T32 explored the relationship between the proposals about Bachelard, especially the issues related to the Epistemological Profile and Epistemological Obstacles. The authors argued that, according to Bachelard (1991), the philosophical evolution of specific scientific knowledge is a process that permeates all these doctrines in the order mentioned. They argued that we can relate the notions of Epistemological Obstacle and Epistemological Profile because the latter reflects the obstacles a culture needs to overcome. Hence, there is a relationship between the progress of knowledge, which depends on overcoming epistemological obstacles, and the philosophical evolution of knowledge, understood by Bachelard as a process that goes through different phases, that is, philosophical doctrines. The main objective of the study was to identify possible epistemological obstacles to the learning of concepts of time and space by students, in addition to inferring elements related to the evolution of Epistemological Profiles, within the categories used by Gaston Bachelard, based on the most striking characteristics in the conceptualization process. As a result, they observed a stronger tendency towards naive realism and empiricism, although manifestations emerged that could be related to traditional rationalism during the interaction with the groups and the teacher.

T33 addressed the introduction of the process of elaboration and validation of a taxonomy for the scientific concept of density, based on the notion of Epistemological Profile. The results of this investigation identified the mobilization of the zones of empiricism and traditional rationalism of the Epistemological Profile. Bachelard, in the relationship between empiricism and rationalism, writes: "empiricism needs to be understood; rationalism needs to be applied. The value of an empirical law is proven by making it the basis of reasoning. Reasoning is legitimized by making it the basis for an experiment" (Bachelard, 1991, p. 5). The importance of transforming empirical data into usable knowledge is emphasized, indicating that the simple observation of phenomena is not enough; it is necessary to analyze these data empirically to build theories. In addition, he highlights the significance of empirically testing theories generated from reasoning, suggesting that they cannot be accepted as true based solely on rational deduction; they need to be subjected to practical testing to justify their validity.

T34 did not aim to map the profile of a specific concept, nor to describe the notions proposed by the French author. Instead, it discussed certain areas of the Epistemological Profile and its relations with other authors, such as:

in the essay *Eureka*, his last book published during his lifetime, written in 1847–1848, Poe presented a long study on the scientific method and Isaac Newton's gravitational theory, among other topics. He considered this essay-poem to be a metaphysical text and not a scientific text. This essay presented a statement on Kepler's methodological contributions, significant in the free interpretation I make of Bachelard's conceptualization of epistemological profile (Zanetic, 2006 p. 60).

Thus, analyzing the free interpretation of Bachelard's concept of Epistemological Profile in relation to the essay "*Eureka*", by Edgar Allan Poe, writer, poet, and essayist, we identify the importance attributed to critical thinking, the willingness to change, and the incessant search for truth as fundamental elements for the advancement of both scientific and metaphysical knowledge.

The objective of T35 was to deepen the concept of model, aiming to extract new conclusions that allowed not only to understand its scope but also to evaluate the transposition resulting from its application: the epistemological transfer. This investigation proposed that every didactic model has an Epistemological Profile, which results from its operation on its conceptual structure. According to the authors, the measurement of the epistemological transfer enables the evaluation of the result of the application in the classroom of a didactic model concerning the Epistemological Profile acquired by the students. Therefore, it was suggested that the design of a didactic model can result in an epistemological transfer as a product of its didacticization.

Article T36 analyzed the conceptions of time of three students enrolled in different levels of education at a higher education institution. Using Bachelard's notion of Epistemological Profile as a reference, the study identified the relationships of these conceptions with each student's culture. The analysis proposed a productive connection between these elements, allowing the identification of individual behaviors that influenced the formation of the profiles. The absence of rationalist conceptions in the Epistemological Profile, as well as the lack of a scientific culture in the cultural profile, raises questions about the depth and influence of school, especially Science Education, on students' worldviews.

In T37, an Epistemological Profile model was developed for the concept of transformations, using first-year high school Chemistry textbooks approved in the National Textbook Program of 2018 as a basis. Comparatively, we observed that the most mobilized Epistemological Profile zone in this case was traditional rationalism. This may result from trying to stimulate reflection and develop the scientific spirit of students based on their preexisting ideas.

T38 sought to identify the areas mobilized for the concept of electromagnetism. We observed that the students' Epistemological Profile, heavily based on common sense and empiricism initially, began to fit into the region of traditional rationalism. This conclusion was inferred from the questionnaires applied at the end of the modules, indicating an acquisition of a region with greater rational coherence within the hierarchy of thought. This suggested progress in the learning of scientific concepts.

The authors of text T39 emphasized that the outline of the Epistemological Profile plays an important role not only in identifying the different philosophical conceptions but also in presenting students with a historical and philosophical framework. This framework served as a basis for the new conceptions of the nature of light and helped to deal with the conceptual conflict between the spontaneous conceptions and the diverse interpretations of formalism in Classical and Modern Physics. Therefore, educators had the opportunity to situate scientific theories in the historical and philosophical context in which they were developed. This allowed students to understand the scientific foundations of the theories and also the cultural, social, and philosophical influences that shaped these conceptions.

In T40, when examining the evolution of chemical bonding concepts among high school students, the authors noted that knowledge construction occurred by overcoming epistemological obstacles associated with the realist and empiricist philosophical zones. This result highlighted the importance of a careful approach to these issues, as it emphasized the need to advance in philosophical zones for a deeper understanding. An example was the observation of the indiscriminate and irrational use of rules such as "electron transfer" or "metal and nonmetal", indicating a superficial understanding that did not consider the underlying conceptual foundations. These findings underscore the importance of an education that not only teaches concepts but also promotes reflective and critical knowledge, allowing students to overcome epistemological obstacles and develop a more solid and contextualized understanding of scientific principles.

Noise in the Use of Profiles: Abuses and Confusion

The discussion in this text about the "noise" in the use of profiles is associated with the evidence that there is, at times, an "incorrect or illegitimate use; excessive or immoderate use of powers" (Aurélio, 2019) of the very ideas of profile. This definition is precisely the one that accompanies the term "abuse" in dictionaries. Likewise, when we highlight that there are possible "mistakes, misconceptions" (Aurélio, 2019) regarding these uses, we also have the approximation of the term "confusion". In this sense, assuming the use of profiles by the Science Education community, such elements contribute to the "noise" that we identify here, which emphasizes the importance of explaining the theoretical bases that underpin the studies developed, since these proposals are used in the field of Science Education without adequate clarity about their characteristics and limits, sometimes being operated almost synonymously.

In several texts analyzed, we observed the use of the Epistemological Profile in a didactic sense, which may deviate from its original purpose. For example, in T28 the Epistemological Profile was related to teaching processes; in T31 it was used intrinsically to assess students' knowledge; in T35 it was associated with the didactic transposition process; and mainly in T36, a relationship was made with the cultural issues of each student, since this discussion is one of the pillar notions involving the Conceptual Profile.

Thus, we underscore the importance of clarity for the author who will use this proposal. The Epistemological Profile can be understood and applied within its epistemological scope, as its name suggests. The notions that sustain the ideas of the profile are epistemological, that is, they refer to how certain knowledge is produced and validated, which is fundamental for scientific production. In the examples explored, we note that, on some occasions, the Epistemological Profile is used almost in a didactic sense, extrapolating the limits of epistemology. This approach can create confusion and deviate from the main objective of understanding and analyzing the nature and production of knowledge, whether scientific or didactic in the context of teaching.

Considering research using the Conceptual Profile, no limitations were observed that would weaken the direction of discussions from their basic proposals. This is probably because all the studies analyzed are in the field of Education and Science Teaching. In this case, they already start from the didactic focus as a premise for their discussion, thus not having, in general, the similar inconsistencies observed in the epistemological proposal, which does not eliminate the possible confusion between both terms and/or the possibilities of reinterpretation that need to be explained.

Analysis of the texts suggests that, in some cases, depending on the objectives, it could be more effective to use the Conceptual Profile than the Epistemological Profile. The Conceptual Profile, by focusing on individuals' mental representations and knowledge construction processes, can offer a more appropriate perspective for analyzing didactic and cultural aspects of teaching and learning. Therefore, when considering the specific objective of each study or application, it is important to choose and justify, in a more explicit way, the theoretical bases of the Epistemological Profile and/or the Conceptual Profile to ensure a more precise and relevant approach.

Final Considerations

In light of the review study of the theoretical propositions for the Conceptual Profile, the Epistemological Profile, and the works that mobilize them, it became clear that their similarities and divergences were understood. Both proposals revealed significant potential. However, in order to explore them in the best possible way, we recommend that researchers, when choosing to use the Epistemological Profile or the Conceptual Profile, identify their differences and make an informed and justified choice.

Regarding the Conceptual Profile, we observed the evolution of discussions on the proposal over time, especially the influence of Vygotsky's theories on Mortimer's later works. This theoretical convergence indicates a significant relationship between the

authors' approaches, enriching the understanding of cognitive development and concept formation in the educational context. In addition, the need for an interdisciplinary and holistic approach to chemical concepts, integrating different theoretical perspectives and cultural contexts, emerges as an important point for a more comprehensive and refined understanding of the construction of meanings around concepts. These considerations underscore the relevance of an in-depth and multifaceted analysis of teaching and learning processes.

When reviewing the texts that explore the concept of Epistemological Profile, it became evident that there was some “noise” in its application, especially when it went beyond its epistemological limits to adopt a more didactic approach. Although the Epistemological Profile is designed to map the evolution of scientific thought and understand the philosophical influences on concepts, its use in some texts focuses excessively on pedagogical aspects, deviating from its original purpose. This distortion indicates the need for a clear and precise comprehension, as well as careful consideration of its application to avoid confusion and misinterpretations and ensure a more appropriate analysis.

Within the scope of the texts used in this research, we observed that 40% of them mention the existence of both proposals. However, no text discusses the differences in a way that highlights that both are, in fact, distinct proposals, each with its specific purpose.

Finally, with this study, we have shown that the choice between the Epistemological Profile and the Conceptual Profile must be made based on a cautious analysis of the specific needs and objectives of the educational or research context. Paying attention to how the theoretical foundations of the research are used enables the best fulfillment of its intentions and reduces possible abuses or confusion between objectives, foundations, analyses, and results.

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