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The holistic conception of knowdledge as a model for understanding sciences and their contribuitions to interdisciplinary teaching[1]

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ABSTRACT

This work aims to discuss an epistemological and pedagogical path for science teaching that includes the apprehension of scientific knowledge through the dialogue between two big areas of study: the history of science and interdisciplinarity. In addition to offering contributions to science teaching, this research resulted in the elaboration of a text to support the teacher, which aims to clarify how the mechanistic/reductionist conceptions of classical Physics, established in modernity, were accepted and adopted as a model of science; and to present the transition to a holistic approach to science, in a movement to enable the interface between science - in its holistic context - and teaching. Authors who discuss science in a historical, systemic, organic, holistic, evolutionary view, such as Fleck, Canguilhem, Mayr, Capra, have the potential to support the proposal to confront reductionism and the fragmentation of knowledge, in contrast to the pattern of science that has lasted since the modern era. From that, we believe that the promotion of interdisciplinary dialogues that consider a historical epistemology of science, with an emphasis on the holistic conception, deserves a prominent place in science classes in interaction with other disciplines. Relativizing the conception of truth and considering the historical, social, cultural context of the construction of knowledge, as in Fleck's epistemology, makes the understanding of scientific concepts less rigid, far from the objective truth of modern science that, in view of the above, hampers and weakens the process of apprehension of the scientific culture by the students.

KEYWORDS: Science teaching. History of science. Holism. Interdisciplinarity.

INTRODUCTION

In the current educational context, the influence of science products on society's life is easily noticeable, making it necessary to understand scientific knowledge's concepts, applications, risks, and benefits. This work aims to discuss an epistemological and pedagogical path for teaching science that addresses the apprehension of this knowledge through dialogue between two significant areas of study: the history of science and interdisciplinarity.

When arguing in favor of including the history of science in teacher training curricula, Scheid (2018) defends that scientific and technological education should enable citizens to participate in discussions on issues related to science and technology, with consequences for individual and collective quality of life. The author suggests that, to achieve this objective, “it is necessary to move from a fragmentary conception to a unitary conception of knowledge. This can be achieved through interdisciplinary projects” (SCHEID, 2018, p. 450).

Paniz and Muenchen (2020) also highlight the importance of collective and interdisciplinary work in science teaching in developing and implementing critical/transformative curricula. According to the authors, “curricular discussions are fundamental in initial and permanent training, referring to placing the teacher as a subject who can think and develop curricula in a dialogical, contextualized and interdisciplinary way” (PANIZ; MUENCHEN, 2020, p. 238).

The interdisciplinarity concept adopted in this research is aligned with Fazenda (2011), who states that interdisciplinarity is a term used to represent cooperation between different disciplines or areas of a given science. Mutual collaboration is evident in exchanges, with a focus on reciprocal improvement. According to the author, “it is not science, nor science of sciences, but it is the meeting point between the movement of renewing attitudes towards the problems of teaching and research and the acceleration of scientific knowledge” (FAZENDA, 2011, p. 73)

The research resulted in the elaboration of this article with a double function. In addition to offering contributions to science teaching, it can support the teacher with regard to brief content about conceptions of science. In items 2, 3 and 4, texts with potential to support teachers seeking to promote reflection on views of science during science classes will be presented, respectively: 'Science Models[2], a brief historical reconstruction', 'From machine metaphor to holistic thinking ' and 'Epistemological reflections on the holistic conception of knowledge'. These texts aim to clarify how the mechanistic/reductionist conceptions of classical physics, established in modernity, were accepted and adopted as a science model and to present the transition to the holistic[3] approach to science as a possibility of confronting and overcoming this universal scientific parameter, absolute and generic, considered an obstacle to scientific activity and science teaching.

Therefore, we consider this historical rescue a movement to facilitate the interface between sciences — in their holistic context — and teaching, taking as a starting point reflections on historical factors involved in the constitution of modern science and its implications for science teaching since teachers can significantly contribute to students' understanding of scientific culture. Thus, we used a qualitative, exploratory, and explanatory approach in this investigation (GIL, 2002).

The theoretical framework that supports the proposed correlation between the history of science and interdisciplinary teaching was obtained from Trindade's works (2008; 2011; 2013). In item 5, we seek to expand this author's collaboration to develop the idea that he defends the history of science as a unifying discipline, which corroborates his defense of the holistic conception of knowledge as a model for understanding science.

In this way, authors who discuss science from a historical, systemic, organic, holistic, and evolutionary view, such as Ludwik Fleck, Georges Canguilhem, Ernest Mayr, and Fritjof Capra, have the potential to support the proposal for communication between the history of science and interdisciplinarity, in contrast to the pattern of science that has persisted since the modern era - linear, fragmented, decontextualized. The first three authors chose the life sciences as a model of science, not only admitting biology as an autonomous science but also seeing biological processes as models for understanding the sciences.

Based on systemic thinking, which encompasses the holistic conception of knowledge, considered here from the perspective of the history of science, the physicist Fritjof Capra and others who share the same conception seem to propose a rupture in the existing boundaries between disciplines and, thus, promote interdisciplinary dialogues between phenomena studied separately by different areas of knowledge. It is interesting to highlight that we are talking about physicists and not biologists, which corroborates the defense that the holistic conception has excellent potential to be adopted as a model for understanding science and serve as a parameter for the practice of interdisciplinary teaching. In the work ‘The Point of Mutation,’ initially published in 1982, Capra presents several limitations of the Cartesian paradigm in natural and social sciences, with examples that can be adopted for study and reflection in the classroom.

Trindade (2013) argues that “the sociocultural and historical contextualization of science is associated with the human sciences and creates important interfaces with other areas of knowledge” (TRINDADE, 2013, p. 71). He adds:

> The interdisciplinary character of the history of science does not necessarily annihilate the disciplinary character of scientific knowledge. Still, it complements it, stimulating perception between phenomena, which is fundamental for most technologies, and developing an articulated vision of the human being in its natural environment as a builder and transformer of this environment (TRINDADE, 2013, p. 71).

The historical review of explanatory models for understanding science, exposed in the next section, shows science as a collective, collaborative, and dynamic activity, characteristics that are equally striking and necessary for the practice of interdisciplinarity in science teaching.

SCIENCE MODELS: A BRIEF HISTORICAL RECONSTRUCTION

We inevitably refer to the Greek philosopher Aristotle when discussing a holistic conception of knowledge. Mayr (2008) argues that **Aristotle's biology** could also be considered a science in specific characteristics, “but it lacked the methodological rigor and completeness of the science of biology as it would develop from the years 1830 to 1860” (MAYR, 2008, p. 50).

Capra (2021) clarifies that Aristotelian ideas of organic perception of the world, as well as his doctrine, remained throughout the Middle Ages. Only from the 16th and 17th centuries onwards can a transformation in Western scientific thought be seen with the so-called Scientific Revolution. Such a revolution marked Physics and Astronomy with mathematical foundations, which became exemplary science in the works of Copernicus, Galilei, Bacon, Descartes, and Newton (MAYR, 2005).

> Since the 17th century, Physics has been the shining example of an "exact" science, serving as a model for all other sciences. For two and a half centuries, physicists have used a mechanistic view of the world to develop and refine the conceptual framework of what is known as classical Physics. They based their ideas on the mathematical theory of Isaac Newton, the philosophy of René Descartes, and the scientific methodology defended by Francis Bacon. They developed them by the general conception of reality prevalent in the 17th, 18th, and 19th centuries (CAPRA, 2021, p. 45).

Capra (2021) adds that at that time, the material world was seen as a “profusion of separate objects, assembled into a gigantic machine” (CAPRA, 2021, p. 45-46), made up of elementary parts, just like machines built by man. Consequently, it was believed that complex phenomena would be understood by reducing them to their essential components and investigating their interaction mechanisms.

According to the author, this reductionist conception was “rooted in our Western culture in such an intense way that it has been repeatedly associated with the scientific method, " whose basic principles still characterize science today (MAYR, 2008). Capra (2021), therefore, endorses what several other scholars in the history of science found in their studies: “Other sciences accepted the mechanistic and reductionist points of view of classical physics as the correct description of reality, adopting them as models for their theories” (CAPRA, 2021, p. 46).

Regarding explanatory models to characterize scientific knowledge, Beltran, Saito, and Trindade (2014) emphasize the need to consider that the epistemologies that sought to clarify the development and foundations of science manifested themselves “at a time when modern science itself was consolidating as an area of knowledge” (BELTRAN, SAITO, TRINDADE, 2014, p. 51).

Despite establishing itself later than other sciences, around the 19th century, Biology maintained Cartesian remnants, such as animal mechanics and physicochemical reductionism. The latter is still very present today in studies related to biotechnology, genetics, and molecular biology. However, the model supported in the present work is close to the characteristics of evolutionary, historical biology, which is aligned with the epistemology of the authors mentioned in this article.

FROM THE MACHINE METAPHOR TO HOLISTIC THINKING

The metaphor of the machine, dominant in modernity, was not restricted to Physics and Mathematics. The study of the organism was also influenced. Canguilhem (2012) comments on the interpretation of animal functions in Descartes:

> When Descartes explained the functions of the animal organism in general and the human organism in particular, as he did with the movements of a machine, clock, or organ, he resorted to an analogy. In his scientific work, it was the only analogy that was not a simple didactic comparison. The automatism of animals was a radical rejection of animism [...]: the earth is a living being, it has entrails, it feels, it generates; the world has a soul, like plants, animals, man. The analogy that sustained animal mechanics reduced the marvelous, denied the spontaneity of the living being, and guaranteed the ambition of rational domination of the course of human life (CANGUILHEM, 2012, p. 235).

Mayr (2008) explains that the acceptance of this model as the ideal of science led to the belief that organisms are no different from inert matter in such a way that science aimed to reduce Biology to the laws of Physics and Chemistry. The change in biological thinking, with the decline from mechanism and vitalism to emerging scientific explanations and the establishment of organicism in the 20th century, impacted the position of Biology among the sciences, according to the biologist.

Naturally, this worldview significantly impacted the philosophical position of those who dedicated themselves to understanding science. Zaterka and Mocellin (2022) refer to this epistemological selectivity and state that in the first half of the 20th century, most philosophical discussions about science had Physics as a mirror, which became a model of what scientific knowledge would be. It was because it adapted better to mathematical language for other empirical sciences.

If, on the one hand, Biology has consolidated itself as a science, on the other, as Zaterka and Mocellin (2022) suggest, philosophical reflections and reflections on the context regarding the production of biological knowledge do not have a prominent place even today:

> [....] hegemonic epistemological systems privileged logical-mathematical and linguistic explanations of science, leaving aside not only the philosophical questions suggested by experimental investigation but also the entire social and cultural context underlying such knowledge. Although interest in the philosophy of other scientific disciplines has recently grown, notably the philosophy of Biology, the paradigmatic model for the philosophy of science among philosophers continues to be, in general, Physics (ZATERKA; MOCELLIN, 2022, p. 18).

Considering that biological knowledge has permeated the conception of the world at least since Aristotle, we can ask: How and why was the conceptual framework of the sciences restricted to Physics and Mathematics for more than three centuries, and why did Biology not emerge during this period as another possible model for understanding science?

The answer seems to be simple. Biology had not yet been consolidated as a science. During the 19th century, it developed its language, concepts, and methods very far from physicalist ideas, which did not apply to biological phenomena, which led some authors, such as Mayr (2005), to defend it as an autonomous science, an idea previously defended by Auguste Comte in the 19th century, based on his conception of organism, which made him reject the concept of cell and oppose cell theory, due to his socialist convictions.

Canguilhem (2012) presents an unusual idea about Comte's positivism, which suggests a biological heritage present in positivism, by stating "that it was in the domain of Biology that positive philosophy revealed itself to be newer and exerted a more real influence, to the point of one doubts whether sociology retains as deep a trace from Comte's work as Biology does" (CANGUILHEM (2012, p. 59-60). According to the author, the formation of the term Biology was, for Comte, proof of autonomy and independence, to the point of suggesting a scientific revolution in its domain:

> Comte's biological philosophy is the systematic justification of this testimony, the full acceptance and consolidation of the great scientific revolution that, under Bichat's impulse, takes the general presidency of natural philosophy from Astronomy to Biology. Comte is not precisely wrong in seeing, in the setbacks of his career, one of the consequences of the fact that, in the city of the wise men of the time, he placed himself, as a mathematician, on the side of the biological school fighting to maintain [according to him], against the irrational ascendant of the mathematical school, the independence, and dignity of organic studies (CANGUILHEM, 2012, p. 63).

The recognition of Biology sought by Comte seems to have been achieved only through the idea of biological evolution - initially proposed by Lamarck and later formulated by Darwin - contributing to the emergence of a new thought about living beings in opposition to the persistence of species, the which meant the beginning of a process of recognition of a new possible model of conceiving science, very different from the hegemonic model. According to Capra (2021), the theory of evolution forced scientists to admit that the world should be understood as a system in continuous change, where complex arrangements developed from more superficial structures, moving away from the Cartesian vision of the manufactured machine by the Creator.

However, the main concepts of the Cartesian worldview and Newtonian mechanics still resisted and were only challenged by the theory of relativity and quantum theory presented in the first decades of the 20th century. In an optimistic position in defense of the consolidation of this change, Capra (2021) states:

> In contrast to the Cartesian mechanistic conception, the worldview emerging from modern physics can be characterized by words such as organic, holistic, and ecological. It can also be called a systematic view in general systems theory. The universe is no longer seen as a machine composed of infinite objects, to be described as a dynamic, indivisible whole whose parts are essentially interrelated and can only be understood as models of a cosmic process (CAPRA, 2021, p. 75).

This new vision of the world of science had the potential to support new epistemological positions, as is the case of Ludwik Fleck's biological historiographical model. This model can be considered a way of confronting the monopoly of the reductionist Cartesian epistemological position, which is positivist, as we see below.

EPISTEMOLOGICAL REFLECTIONS ON THE HOLISTIC CONCEPTION OF KNOWLEDGE

In the literature, there are similarities between the ideas of two theorists who anchor them in the field of life sciences, in contrast to the epistemology of classical physics, Ludwik Fleck and Georges Canguilhem (CONDÉ, 2016; SOUTO, 2019). The first was a Polish doctor specializing in microbiology and was the author of 'Genesis and Development of a Scientific Fact,' originally published in 1935. The second is a French doctor recognized as one of the most influential historians of science in the 20th century, particularly in the history of life sciences and the history of medicine. Although there is no historical record of dialogue between the thinkers, something aligns with their ideas: looking at science in an evolutionary and holistic conception of knowledge instead of logical positivism. Condé (2016) highlights:

> Despite belonging to different traditions and not having suffered reciprocal or unilateral influences, in the 1930s/1940s, Fleck and Canguilhem reacted, each in their own way, against the old conception of the history of science legitimized by a positivist epistemology (CONDÉ, 2016, p. 52).

Regarding the similarities between the ideas of Fleck and Canguilhem in the context of life sciences, Condé (2016) calls the point of convergence between the two thinkers the biological matrix, opposing the traditional physical matrix and comments that, in addition to practical and discourse from the biological matrix, both understand the need to integrate it as an epistemological reference. Doctors would have thought of the history of science from the perspective of historical epistemology, biological or evolutionary.

Em 1948, na sua clássica obra ‘O normal e o patológico’, a partir de questões médicas e biológicas, Canguilhem apresentava uma concepção de história da ciência inovadora, alinhada à concepção pioneira desenvolvida por Ludwik Fleck, em 1935, na qual procurava mostrar, inspirado na biologia e medicina, um novo modelo epistemológico para a compreensão da história da ciência numa perspectiva social e histórica, ou seja, o entendimento do conhecimento como resultado de um coletivo e suas interações sociais situados no tempo (CONDÉ, 2016).

In addition to the theoretical approach between medical thinkers, signaled by the dynamic, holistic, and ecological vision that both have of the disease, Souto (2019) highlights the change of focus developed by Canguilhem about French historical epistemology “by preferring to leave no longer from the mathematical or mathematizable sciences, but life sciences, which are characterized precisely by the fact that they resist mathematization” (SOUTO, 2019, p. 392).

Would the holistic/organic perception of scientific knowledge mean a return to the Aristotelian conception of nature? Many centuries have passed from Aristotle's holism to mechanistic reductionism, and this last model of science proved to be increasingly less efficient in explaining the new phenomena that sought to be studied, both in Physics and Biology. According to Mayr (2008), since 1920, the terms holism and organicism have been used synonymously. However, as many inanimate systems are also holistic, this term is considered more appropriate for physical, chemical, biological, and other phenomena.

Therefore, we understood that not only biological phenomena can be examined from a holistic point of view, but also the different sciences can be explained based on this model. Ludwik Fleck and Georges Canguilhem, as doctors, understood the potential of biological ideas and integrated them into their epistemologies.

Biology now has the potential to serve as a model for scientific activity, not only one but a possible model, which offers scientific knowledge that produces the possibility of being understood through evolutionary, procedural, and nonrevolutionary epistemology. Because Fleck and Canguilhem use the biological model in their epistemologies, the holistic is associated with the biological, but not exclusively. It is believed that other sciences can also be analyzed from a holistic perspective of knowledge.

Fleck (2010) explains the gradual changes in knowledge through an analogy to the process of biological evolution, stating that the development of thought occurs dynamically "so that we constantly witness mutations in the style of thinking"[4] (FLECK, 2010, p. 67-68). Furthermore, Fleck relativizes the notion of truth - assumed within a style of thought - while in other epistemologies, which use classical physics as a standard of science, this notion appears to be rigid.

From a historical perspective, one cannot disregard the clarification of Beltran, Saito and Trindade (2014) that the different epistemologies propose explanatory models to characterize science and, therefore, need to be "contextualized and demonstrated according to the conception of knowledge of their respective since such proposals are anchored to certain discursive considerations specific to an era" (BELTRAN, SAITO, TRINDADE, 2014, p. 51-52).

From a historical-epistemological study on the concept of syphilis, in the 1930s, Fleck developed his theory of knowledge, in which scientific facts are taken as a social product. For Fleck (2010), "the knowledge process represents the human activity that most depends on social conditions, and knowledge is the social product par excellence" (FLECK, 2010, p. 85).

The author argues that scientific knowledge is constructed beyond the limits of the subject-object relationship, incorporating the 'state of knowledge,' that is, the historical, social, and cultural context of a given time. In the words of Fleck (2010):

> The comparative theory of knowledge should not consider learning as a binary relationship between subject and object, between the actor of expertise and something to be known. As a fundamental factor of each new knowledge, the respective state of knowledge must enter as the third element in this relationship (FLECK, 2010, p. 81).

When discussing the historical and social conditioning of knowledge, Fleck's view on the construction of knowledge constitutes a way of confronting the reductionist epistemological position. Capra (2014) clarifies that systems thinking "involves a shift from objective science to 'epistemic' science; for a framework in which epistemology becomes an integral part of scientific theories" (CAPRA, 2014, p. 115). The author emphasizes that:

> [...] In Cartesian science, it was believed that scientific descriptions were objective, independent of the human observer and the knowledge process. Systemic science, conversely, implies that epistemology – the understanding of the knowledge process – needs to be explicitly included in the description of natural phenomena (CAPRA, 2014, p. 115).

Capra (2021) comments that our thinking and scientific disciplines are fragmented due to too much emphasis given to the Cartesian method, a conception that "has led to the widespread attitude of reductionism in science — the belief that all aspects of complex phenomena can be understood if reduced to its constituent parts" (CAPRA, 2021, p. 56-57). This idea is reinforced by authors who research interdisciplinarity from the perspective of the history of science, being presented as an essential difficulty imposed on interdisciplinary practice in science teaching, as will be discussed in the next section.

CONCEPTIONS ABOUT HOLISTIC AND INTERDISCIPLINARY SCIENCE TEACHING

From the perspective of the dialogue proposed in this article between the history of science and interdisciplinarity, it is essential to recognize the profound differences between Cartesian, objective, neutral, fragmented, rigid, linear science and holistic science - dynamic, unified, procedural, contextual. Furthermore, correlating the compartmentalization of knowledge, which occurred in the modern era, with adopting this model in science teaching favors a broader view of interdisciplinarity in teaching, which requires adopting a holistic view as a parameter for understanding science.

Trindade (2013) highlights the excessive disciplinarization of scientific knowledge since knowledge during modern science developed through specialization so that the greater the delimitation of the object of study, the greater its scientific rigor. The author considers that “specialized, restricted and fragmented, knowledge became disciplined and segregated.” Furthermore, knowledge established and demarcated limits between disciplines “to later monitor them and create obstacles for those who tried to overcross them” (TRINDADE, 2013, p. 73).

Fazenda (1994) already indicated a solution to the much-discussed science crisis almost three decades ago, arguing that the practice of interdisciplinarity has the potential to make it possible to face this crisis as long as we understand where it comes from and what needs to be resolved.

Trindade (2013) compares the crisis of science with the crisis of humanity itself, “the result of fragmented and alienated knowledge and existence” (TRINDADE, 2013, p. 74) since specialized knowledge is not interesting for the essence of life. The author also highlights that doubts threatened the unshakable explanations of modern science based on some scientific theories emerging from the 20th century, such as Einstein's theory of relativity, Heisenberg's uncertainty principle, and Niels Bohr's principle of complementarity. Such theories show that “the deterministic and mechanistic universe, capable of being divided into parts, resulted from the human desire for control over nature and reflected only a personal belief, not an intrinsic characteristic of it” (TRINDADE, 2013, p. 74).

The author identifies an essential correlation between the belief in the Cartesian mechanistic conception and the origin of traditional teaching fragmented into disciplines.

> The limiting factor of the Cartesian conception, which is still widespread today, was believing in the scientific model as the only truth. His method, based on analytical reasoning, boosted the development of scientific thinking. However, it resulted in a profound split in our way of thinking, generating compartmentalized disciplinary teaching (TRINDADE, 2013, p. 82).

Contesting the traditional teaching structure does not mean disregarding the importance of individual scientific disciplines since each science has its particularities. Ivani Fazenda, the author most quoted as a theoretical reference for research on interdisciplinarity in Brazil (MOZENA; OSTERMANN, 2014), clarifies:

> As we have rehearsed in all our writings since 1979 and now deepened, the concept of interdisciplinarity is directly linked to the idea of disciplinary, in which interpenetration occurs without the elemental destruction conferred on the sciences. It is not possible to deny the evolution of knowledge by ignoring its history (FAZENDA, 2013, p. 25).

In this way, the history of science is classified as interdisciplinary (TRINDADE, 2013), and the concept of interdisciplinarity itself (FAZENDA, 2013) covers the typical specificities of the disciplines. We consider, therefore, that the promotion of interdisciplinary dialogues that lead to a historical epistemology of science, with an emphasis on a holistic view, deserves a prominent place in the planning and development of science classes in interaction with other disciplines. In the previous section, we recommended the Fleckian epistemology. In Fleck's model, the study of the origin and evolution of a scientific fact can contribute considerably to interdisciplinary dialogues.

Japiassu (2011) warns that one of the great benefits of a methodology anchored in interdisciplinary approaches to scientific disciplines refers to the implementation of a "pedagogy of *uncertainty*, in which educators and students would no longer believe in certain scientific truths as if they were a safe harbor" (JAPIASSU, 2011, p. 31). He adds:

> If we unquestioningly and uncritically shelter ourselves under the protective mantle of objective knowledge, of actual knowledge, of "scientific" knowledge, as if they were the expression of integration and interdisciplinarity in Brazilian education, a finished and absolute truth, we would easily fall into the temptation of living a parasitic intellectual life. Consequently, we would be preventing ourselves from reaping the best fruits of the relativity of life (JAPIASSU, 2011, p. 31-32).

Especially when seeking to clarify concepts, phenomena, and processes linked to scientific knowledge, we believe that rescuing the historical, social, and cultural context of the scientific fact studied, as well as its relationship with all the sciences involved, is a path rich in possibilities and potential in interdisciplinary science teaching. Relativizing the conception of truth, as in Fleckian epistemology, can make our understanding of scientific concepts less rigid, far from the objective truth of modern science, which, given the above, retards and weakens the process of apprehension of scientific culture by students.

Associated with this, we consider that presenting a vision of science with a Cartesian mechanical character, as opposed to the holistic one, also favors reflection on historically constructed science and has the potential to improve the quality of science classes, both in the epistemological and pedagogical aspects. This article also contributes specifically to this aspect and can be used as a reference for teachers seeking to promote this discussion.

FINAL CONSIDERATIONS

This study aimed to discuss an epistemological and pedagogical path for teaching science that encompasses the apprehension of scientific knowledge through dialogue between two major areas of study: the history of science and interdisciplinarity. Promoting the unification of scientific knowledge in science classes is a significant challenge for teachers since the process of building modern science has been fragmented, as has the school curriculum and its presentation in textbooks.

The results suggest pedagogical practices that are not restricted to the vision of science with a Cartesian mechanistic character but also seek to reflect on the historicity of its construction. They seek to conduct the study of concepts, phenomena, and processes in a holistic view, in its entirety, through understanding the interrelated parts, with the aim of interdisciplinary practice.

To achieve this, choosing a scientific theory as a guide is fundamental. As presented, Fleckian epistemology contemplates what seems to be an essential objective of the holistic and interdisciplinarity conception - confronting reductionism, of 'true and definitive' knowledge - when considering the historical, social, cultural context of the construction of knowledge, presenting the science in a broad, evolutionary and dynamic conception, as opposed to the simplistic, deterministic, linear view. In Fleck's model, the study of the origin and evolution of a scientific fact can be the starting point for interdisciplinary dialogues.

We understand that changes at the pedagogical and epistemological levels will never be simple, quick processes. However, the reflections and proposal presented here can constitute a viable path to improving the quality of science teaching based on two areas of study that are recognized as individually successful and potentially fruitful in interaction.

A CONCEPÇÃO HOLÍSTICA DO CONHECIMENTO COMO MODELO PARA A COMPREENSÃO DAS CIÊNCIAS E SUAS CONTRIBUIÇÕES PARA O ENSINO INTERDISCIPLINAR

RESUMO

Este trabalho tem como objetivo discutir um caminho epistemológico e pedagógico para o ensino de ciências que contemple a apreensão do conhecimento científico por meio do diálogo entre duas grandes áreas de estudo: a história da ciência e a interdisciplinaridade. Além de oferecer contribuições ao ensino de ciências, o desenvolvimento da pesquisa resultou na elaboração de um texto de apoio ao professor, o qual tem como finalidade esclarecer como as concepções mecanicista/reducionista da física clássica, estabelecidas na modernidade, foram aceitas e adotadas como modelo de ciência e apresentar a transição para a abordagem holística da ciência, num movimento para viabilizar a interface entre as ciências - no seu contexto holístico - e ensino. Autores que discorrem sobre a ciência numa visão histórica, sistêmica, orgânica, holística, evolutiva, tais como Fleck, Canguilhem, Mayr, Capra, têm o potencial de apoiar a proposta de enfrentamento ao reducionismo e a fragmentação do conhecimento, em contraposição ao padrão de ciência que perdura desde a era moderna. A partir disso, considera-se que a promoção de diálogos interdisciplinares que levem em consideração uma epistemologia histórica da ciência, com ênfase na concepção holística, merece lugar de destaque nas aulas de ciências em interação com outras disciplinas. Acredita-se que relativizar a concepção de verdade e considerar o contexto histórico, social, cultural da construção do conhecimento, como na epistemologia fleckiana, pode tornar menos rígida nossa compreensão dos conceitos científicos, distante da verdade objetiva da ciência moderna que, diante do exposto, engessa e fragiliza o processo de apreensão da cultura científica por parte dos estudantes

PALAVRAS-CHAVE: Ensino de ciências. História da ciência. Holismo. Interdisciplinaridade.

NOTES

1. The article refers to a revised and detailed version of the work presented at VII SINECT, which was promoted by the Postgraduate Program in Science and Technology Teaching at the Federal Technological University of Paraná in November 2022.

2. Although the authors prefer the term 'science,' which denotes the plurality of scientific knowledge, the reference to 'models of science' is made as an opposition between two historically constructed conceptions, and the term 'science' assumes a universal meaning in this context.

3. From the Greek holos, ‘totality’ is the Conception of the world as an ‘organized whole’, as opposed to analytical thinking. The properties of the parts can only be understood from the organization of the whole from a contextual perspective. In 20th-century science, the holistic view became known as ‘systemic’ (CAPRA, 2014).

4. In Fleck's definition (2010, p. 149), the thinking style corresponds to a directed perception and the corresponding processing on the mental and objective plane, marked by common characteristics of the problems that interest a thought collective.

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