Science as an interdisciplinary instrument for learning in high school - for a freirean epistemology (a curricular analysis of the high school classes of the College of Imaculada Conceição)

A ciência enquanto instrumento interdisciplinar para a aprendizagem no ensino médio – por uma epistemologia freireana (uma análise curricular das turmas do ensinomédio do Colégio da Imaculada Conceição)

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ABSTRACT
Science (from Latin scientia, "knowledge") or systematic practice. It is a product derived from systematized searches, so a method is required. For Lakatos (2011), it is the systematization of knowledge, a grouping of logically related prepositions on the behavior of certain phenomena that one intends to study. Interdisciplinarity serves as a link between the curricular components of a school institution, so it is a model with a new division of knowledge, allows interaction, communication between disciplines seeking to integrate knowledge in a harmonious and meaningful way. Therefore, with this fusion of curricular knowledge, an important, scientific community is formed that provides high school with a quality in the learning process and, finally, the production of knowledge. By epistemology (it is the right knowledge, science. Logos: speech, study. It's the philosophy of science.) freirean, it is critical, of interactionist basis, in which knowledge results from constructions of the subject with interaction with the world, society or culture. It is in this epistemology that dialogicity occurs, there is a process of constant construction in which the epistemic subject teaches and learns, learns and teaches. It is in high school, this school stage in which adolescents study, the presence of science permeating, instrumentalizing and boosting knowledge in classes and causing learning within the curriculum.

Keywords: Science, Knowledge, Curriculum, Dialogicity, Epistemology and Interdisciplinarity.
RESUMO
A Ciência (do latim scientia, “conhecimento”) ou prática sistemática. É produto derivado de pesquisas sistematizadas, portanto é necessário um método. Para Lakatos (2011), é a sistematização de conhecimentos, um agrupamento de preposições logicamente relacionadas sobre o comportamento de determinados fenômenos que se pretende estudar. A interdisciplinaridade, serve de entrelace entre os componentes curriculares de uma instituição escolar, assim sendo, é um modelo com nova divisão do saber, permite a interação, comunicação existentes entre as disciplinas buscando integrar os conhecimentos de maneira harmônica e significativa. Portanto, com esta fusão de saberes curriculares, está formada uma teia importante, científica que proporciona ao Ensino Médio uma qualidade no processo de aprendizagem e, por fim a produção de conhecimento. Por epistemologia (é o conhecimento certo, ciência. Logos: discurso, estudo. É a filosofia da ciência.) freireana, ela é crítica, de base interacionista, em que o conhecimento resulta de construções do sujeito com interação com o mundo, asociedade ou a cultura. É nesta epistemologia que ocorre a dialogicidade, há um processo de construção constante em que o sujeito epistêmico ensina e aprende, aprende e ensina. É no Ensino Médio, esta etapa escolar em que adolescentes estudam, observar-se a presença da ciência permeando, instrumentalizando e impulsionando o conhecimento nas aulas e causando aprendizagem dentro da grade curricular.

Palavras-chaves: Ciência, Conhecimento, Currículo, Dialogicidade, Epistemologia e Interdisciplinaridade.

1 INTRODUCTION
Research problem – The present work has as its problem science as an interdisciplinary instrument for learning in high school, observing freirean epistemology and analyzing the curriculum of high school class of the College of the Immaculate Conception. Guide question - How does the presence of science occur in an interdisciplinary way for learning to occur in high school, having as reference the epistemology of Paulo Freire?

Hypothesis – Science follows a path of curricular interlaces in various human fields, including education. And in this, there is a fusion in which it is clear the comprehensive, interdisciplinary knowledge and should lead to learning. In this case, in a dialectical way between learner and teacher and, teaching and learning, "there is a process of construction of the epistemic subject, of his abilities, not getting lost in content without horizon. That is why, in the learning process, only one who appropriates the learned, transforming it into seized, with which can therefore reinvent it, truly learns. Justifications – Science is justified in this research as an interdisciplinary instrument for learning in high school, having as reference the Freirean epistemology and the curricular analysis of high school class of the immaculate conception school.
Objective – To show the interlace through which science passes, in an interdisciplinary practice, having as reference the epistemology of Paulo Freire, in high school in the school of the immaculate conception.

2 METHODOLOGY

For the present research will be used literary review whose sources are books, dissertations, theses, monographs and website of the Ministry of Education, exploration on sites such as Scielo, Springer Link and Refseek and texts with thematic relevance and published in the last five years.

3 THEORETICAL FOUNDATION

Amid the difficulties of remote or hybrid education, because of the pandemic, teachers from public or private schools currently have an extra challenge: preparing to apply in the 2022 school year the changes brought by the New High School, which provides a series of changes to the stage. One of the most important points is that the organization becomes interdisciplinary, with the curricular components divided by areas of knowledge.

With teachers mostly based in specific areas, this broad approach has been causing concerns. However, teachers need to understand that their subjects will continue to exist within the new configuration of high school, says professor Maria Luiza Abaurre, author of textbooks. "What we are looking for is to break compartmentalization, not to explode the disciplines," he said during the Seminar Jornada Digital da Educação, from Moderna. Interdisciplinarity can only be found if there are disciplines, abaurre explains: "the identity of each teacher ensures that the student builds his knowledge. The concepts of the disciplines need to be called and articulated." What we are looking for is to break compartmentalization, not blow up disciplines. During the seminar, the expert also stressed that interdisciplinarity is not an end in itself, but a way to reach a more
meaningful learning. "The goal is for students to understand that because reality is complex, you can't interact with it from a unique perspective," he said.

A biologist and also author of textbooks, Sônia Lopes made an analogy about the work of disciplinary teachers from next year. "We will move to a new house, with another architecture, where we will no longer be alone. They're moving in, neighbors, with their objects, their routines. We're going to have to establish new routines together. Our students are the visitors and everything will have to make sense," he said during the event. For her, this form of work will give teachers plenty of space to choose what to do, how to do it. "THE BNCC (National Common Curriculum Base) is not a curriculum: it is just the architecture of the new house."

Overcoming fragmentation entails a different view on the didactic objectives, which should go beyond repeating the contents of each subject. "The center is no longer the discipline and becomes the skills and abilities that I want my students to achieve."

Although the excess of specialization of teacher education and previous school curricula ended up making people "half blind" for the whole, it is possible to switch to a comprehensive view without major upheav, argues Maíra Carnevalle, author of textbooks and executive editor of Moderna. "Change always scares a little. If we accept that it is a transition phase, we become calmer. You have to watch the student a lot," he advises.

She recognizes that the reality in most of Brazil will be to maintain the school organization, with the same teachers, times and bars, but calls on all educators to promote the necessary changes. "It's a process that's going to start. Inside the school, we need to find loopholes. You can't just get together in the coffee," he said.

The choice of educational materials appropriate to reality can be a decisive factor for the transition to be indeed smooth. "The book is an important subsidy for the teacher's work. You have to offer guidance, tips, and present the assumptions and objectives of each activity, indicate how they can be expanded or adapted.

Interdisciplinarity does not dilute disciplines, on the contrary, it maintains its individuality. But it integrates the disciplines from the understanding of the multiple causes or factors that intervene on reality and works all the languages necessary for the constitution of knowledge, communication and negotiation of meanings and systematic recording of results.

Teaching and learning from an interdisciplinary perspective aim to deepen knowledge from what aggregates the areas of knowledge, despite its peculiarities. It is not aimed at eliminating them, but at resizing and expanding their function and
understanding, because the economic, political, social, common sense facts, the field of education, science, the arts and many others can occur primarily without disciplinary formulation and only after being led to systematization, that is, life underlies all knowledge. The events occur according to the dynamics of existence and only then are problematized. Discipline is important because it makes didactic and organized the information that scientists, researchers, teachers and other social actors reap from reality; interdisciplinary work helps to resumethis dynamic origin of knowledge.

The noun discipline comes from the Latin concept of learning. This is the meaning of the verb discere, whose participle present in one of the declined forms [...] is a student, what he learns. From the same root appear to the words disciple (the follower who learns from whom he teaches – the teacher), and discipline, object of assimilated knowledge, what is learned and becomes part of life. Discipline, therefore, is not the mere knowledge or information received; it is assimilated knowledge that informs the life of the disciple (2000, p. 54-55).

According to the author, primarily the word does not refer to control or submission, but to healthy and vital assimilation with knowledge; however, the appropriation of the word for the elaboration of school curricula, even if integrated, impoverished semantics and reduced the strength of the radical meaning of the word. This partial emptying of the sense of learning was aggravated by the fragmentation of culture and school education (2000, p. 55). The author involves the appropriation by the school of the concept and the fragmentation present in society itself as factors that undermined the positive meaning inherent to the term. We understand that the effort and the emergence of interdisciplinarity took place exactly as if to combat the negative meaning that the term discipline incorporated, because it dissolved the genuine sense of learning from life itself. Continuing the explanation about what is interdisciplinarity: the term comes from two fields, basically: epistemology, that is, the way knowledge relates to each other and to the research subject, and from the field of education, with its diverse expressions.

For Juares da Silva Thiesen (2008), the discussion on the theme of interdisciplinarity has been addressed by two major approaches: epistemological and pedagogical, both of which include diverse and often complementary concepts. In the field of Epistemology, knowledge in its aspects of production, reconstruction and socialization is used as categories for its study; science and its paradigms; and the method
as mediation between the subject and reality. From the pedagogical approach, questions of curricular, teaching and school learning are fundamentally discussed.

Let us look at the fact that the pedagogical aspects, those that interest us more directly in this text, are not dissociated from the epistemological, because the perspectives on the general reality focus on the way the school and its organization are thought. If we still have today a pedagogical model in which the disciplinary perspective predominates, this is due to a worldview underlying it and that is predominant. The concern with interdisciplinarity emerged as a criticism of a certain dichotomous relationship that has existed in the field of knowledge since the beginning of modernity, but, if we want, it is possible to take a step back and see that the way the "sciences" were divided in antiquity, already with Aristotle, indicated the germ of this world perspective; although still wrapped in a conception of reality more integrated into Greek culture, the path was open to the radicalization of the rationalization of the world and the division of sciences.

In book IV of Metaphysics (1969), Aristotle makes a division of the sciences: knowledge can be practical, productive and theoretic. Theoretics is what deals with the study of the Being and its determinations. It is contemplative and aims neither to action nor to production. Mathematics and theology are examples. Productive knowledge refers to practical sciences, which are concerned with the production of something. Practical knowledge deals with action, how human beings act in various situations. Ethics and politics are in this field. In the Middle Ages, we tried to resume, with different epistemological bases, in which theocentrism prevailed, a model of division of knowledge from the classical world. The areas of knowledge were divided into Trivium and Quadrivium. It was the joint, respectively, of three and four branches.

In the first, grammar, logic and rhetoric were dominated, and the study of language prevailed in this case. In the second they mastered Arithmetics, Geometry, Music and Astronomy; in these, the numbers prevailed (Joseph, 2008). We do not intend to deepen this division and its characteristics, which are different from those that have ascended in modernity; we just wanted to observe that among the ancient and medieval there was already division of knowledge. Safeguarding their epistemological and cultural differences, it is possible to shift this process of disciplinarization of knowledge and life in our culture to before the influence of Descartes and Galileo and other modern ones.

Disciplinarization, in the sense of the constitution of a divided, non-integrated view of reality, is a characteristic of the Western world, extrapolates the field of science and other areas of knowledge and permeates a way of thinking the world that has become
hegemonic. In our perspective, Descartes and Galileo are not only the initiators of a new worldview inaugurated by Modernity; are also the synthesis of a way of interpreting life that has been developing since the philosophical rationalization of Greek post-mythology, formerly much more associated with life.

The process of disciplinarization may have been accentuated in modernity, but it was already a much older power that ended up becoming culture assimilated by the Western modus vivendi and, exactly for that, a problem so difficult to face. In the opinion of Edgar Morin (2002, p. 105), to understand interdisciplinarity, it is necessary to situate what is discipline and observe that it has context and origin: The disciplinary organization was instituted in the nineteenth century, nod. it then developed in the 20th century, with the impetus given to scientific research; this means that disciplines have a history: birth, institutionalization, evolution, exhaustion, etc.; this history is inscribed in that of the university, which, in turn, is inscribed in the history of society.

Given these preliminary analyses, we highlight that the origin of the concern with interdisciplinarity dates back to the last century, having as one of the main references the interest on the theme that emerged in Europe in the 1960s. As Anabela Mateus (2015b) comments, he pioneered Georges Gusdorf (1912-2000), with an interdisciplinary research project that he presented to UNESCO in 1961 for the Humanities. This project included scholars from European and North American universities from different areas of knowledge.

Coimbra (2000, p. 52) highlights the holding of the International Seminar held at the University of Nice, France, from 7 to 12 December 1970; "in addition to elucidating the interdisciplinary concept, the scope of the event was to discuss the real usefulness of the process for advancing teaching and research in the construction of knowledge." The origin of the discourse on interdisciplinarity occurred, above all, as a way of reacting to the rigid division of the sciences inaugurated by the positivism of Augusto Conte and that had its bases at the beginning of modern thought.

The criticism was directed at the too much fragmentation of the knowledge present in the sciences. Especially by the influence of the works of great modern thinkers such as Galileo, Bacon, Descartes, Newton, Darwin and others, the sciences were being divided and therefore specializing. Organized, in general, under the influence of the currents of naturalistic and mechanistic thought, they sought, already from the Renaissance, to build a more scientific conception of the world. Interdisciplinarity, as a contemporary movement that emerges from the perspective of dialogicity and the integration of science
and knowledge, has been seeking to break with the character of hyperspecialization and with the fragmentation of knowledge (Thiesen, 2008).

In the specific field of Education, there was a radical division of the areas of knowledge and each discipline was restricted to a given field of study. It is not an exaggeration to state that there is currently a superdivision of knowledge, because for each area there is a subarea that may have a specific object of study: medicine is a field that evidences this division very vehemently. The fragmentation of knowledge and, consequently, from the perspective of life, is something still very latent. In this context, interdisciplinary study consists primarily of launching a bridge to connect the boundaries that had previously been established between disciplines with the precise objective of ensuring their positive character, according to particular ways and with specific results (Japiassu, 1976, p. 75).

This is an efficient way of demonstrating to students that topics involving knowledge and life itself are not exclusive facts of the interpretation of a specific field, but can and usually permeate or traverse various knowledge. Interdisciplinary work is a way of contributing to overcome a model of society and way of thinking about the world that has been "didactically" disintegrated. The exaggerated distribution of disciplines, as we have already nodded, is the result of a millenary way of thinking about the life prevalent in our culture, which, in a way, has been framing our behavior and paradigms in the creation of perspectives before existence.

In Brazil, the two theorists who brought the problematization about interdisciplinarity were Ilton Japiassu and Ivani Fazenda, influenced by the studies of Georges Gurdorf and Jean Piaget. Studies were carried out in the 1970s that influenced several further studies on the subject. For Japiassu, for example, "interdisciplinarity is characterized by the intensity of exchanges between specialists and by the degree of real interaction of disciplines within the same research project" (1976, p. 74). Among the dense and complex tasks on which these authors had to focus is the definition of what interdisciplinarity is.

For Fazenda (1993), interdisciplinary thinking assumes that no form of knowledge is in itself rational. It therefore tries to dialogue with other forms of knowledge, letting itself be interpenetrated by them. Thus, for example, it accepts the knowledge of common sense as valid, because it is through everyday life that we give meaning to our lives. Expanded by dialogue with scientific knowledge, it tends to be a utopian and liberating dimension, because it allows enriching our relationship with the other and with the world.
But, according to Ferreira, there is no uniform definition on the subject; several authors assume it according to their perspective of thought, but there is a certain proximity in each of these visions, although flexibilization is one of its most decisive points.

In order to have interdisciplinarity, there must also be intentionality. Although it has no watertight definition, interdisciplinarity needs to be understood so that there is no deviation in its practice. The idea is led by basic axes such as: intention, humility, totality, respect for the other, etc. What characterizes an interdisciplinary practice is the intentional feeling it carries. There is no interdisciplinarity if there is no conscious, clear and objective intention on the part of those who practice it. If there is no intention of a project, we can dialogue, interrelate and integrate without, however, working interdisciplinary (Ferreira, 1993).

Another fundamental highlight was the absorption and interest in the importance of interdisciplinarity by the official discourse, that is, of the State as an organ that organizes the education system in the country. It was from the Law of Guidelines and Bases (Law No. 5,692/71) that this debate became fruitful from the institutional point of view. And especially with the new LDB (no. 9,394/96) and the National Curriculum Parameters. According to the latter, "interdisciplinarity has an instrumental function. It is a question of using directly useful and usable knowledge to solve contemporary social problems and problems" (Brasil, 2002, p. 34).

There is a concern with a more integrated perception of knowledge, because the disintegration arising from positivism in the field of science, education and existence requires revision. However, what is proposed is not the elimination of the regular disciplines that exist, but that they are addressed in a more holistic way, contributing to a less bipartisan worldview. From the school perspective, interdisciplinarity does not claim to create new disciplines or knowledge, but to use the knowledge of various disciplines to solve a problem or understand a particular phenomenon from different points of view (Brasil, 2002, p. 34).

The school should not be treated as a saving element of a society that many call decadent. Its restructuring goes through several factors, but certainly it can be an appropriate space where relevant debates about how we understand life, how our cultural constructions were and are elaborated should be confronted. Interdisciplinarity is certainly a way not only to treat school contents through differentiated methodologies, valuing the various fields of knowledge and leading to the understanding that they are not as distant as they seem, but is a possibility to rethink the model of social organization
present in most of today's society, the result of conceptions arising from too much industrialization and "commodification of life".

The "disciplinarization of the day-to-day" can be rethought from the school, when it strives to integrate the contents of school subjects and, above all, when it associates them with concrete life. One of the most damaging relationships in the relationship with knowledge is exactly to treat knowledge as something extreme theoretical and distant from existence. All kinds of knowledge, in thesis, should exist to dignify existence. In this sense, it helps to reflect on interdisciplinarity what is stated in the NCP: It must start from the need felt by schools, teachers and students to explain, understand, intervene, change, predict, something that challenges an isolated discipline and attracts the attention of more than one look, perhaps several. Explanation, understanding, intervention are processes that require knowledge that goes beyond the description of reality, mobilizes cognitive skills to deduce, draw inferences or make predictions from the observed fact (Brasil, 2002, p. 88-89).

It is a great challenge to face something that is already naturalized, and perhaps our generation still does not contemplate the prevalence of a non-disciplinary school model, because the conception that this model is correct is predominant in the minds of many teachers, students, parents of students and political and pedagogical organizations. In our understanding, this change depends on a transformation in the way of thinking about life, because society is organized under the aegis of an exaggeratedly disciplinary model, in the worst sense that this word absorbed, which is that of dominion over the human being. Therefore, the school reflects this situation. So can we say that this is a lost, unnecessary struggle, because nothing or little will change, at least in our generation? We understand that some practical attempts already occur to minimize this prevalence of disciplinarization in education, and this is already an important symptom. Another important aspect is that teachers, students, parents, institutions that defend and believe in a model of education that goes beyond the traditional can and should elaborate means to minimize the predominance of this hegemonic system.

About the possibility of interdisciplinary work in Integral High School The first aspect we need to highlight is that interdisciplinarity is possible in any teaching model, that is, in Regular Education, Youth and Adult Education, Elementary School, Higher Education and graduate studies; however, we want to nod to the peculiarity, a model instituted in some schools of the State. This model, as we have already nodded, works in the morning and early morning period, and this extension of time, that is, a greater
presence of the student within the school, is a concrete factor that indicates the possibility of interdisciplinarity.

Another is the motivation to work with projects, which brings some autonomy of teachers to elaborate diversified classes and not only from the curriculum or its characteristic of action, but also welcoming expectations of students and relevant themes that involve contemporary life. There is also a weekly pedagogical meeting, in which teachers articulate paths and procedures to exercise their pedagogical actions; in many moments, objective conditions emerge to exercise joint actions.

Certainly, many possibilities of interdisciplinary action spring up according to the affinity, interest and connection of teachers and disciplines in the face of a given theme or situation that requires more intense reflection, through the various fields of knowledge. Given these brief observations, we will highlight, briefly, some interdisciplinary actions that have already occurred effectively and some other ideas that are being thought of as achievable, which demonstrates that it is not utopian the opportunity to act jointly in Integral High School. One of the first activities performed was the Historical Walk. In it, an important historian of the city of Nova Friburgo, a teacher and researcher already retired, walked along with students and teachers and students from other schools through the city center.

The action, in the free space, provoked the curiosity and participation of people who passed through the street and at least at that moment, even if on a small scale, school and formal knowledge expanded beyond the school walls. It was a way to get students out of the restricted context of the school and help them realize that knowledge is in the world; behind squares, monuments, vegetation, people, there are historical foundations that we often do not realize and many of them were fundamental to the formation of a city.

Another important proposal was that, within an activity that would involve the various disciplines, each teacher worked facts from his area occurred within a certain century. The goal is to generate a linear and didactic view of the events and highlight how they still affect our lives. We thought about the 20th century and the suggestion of one of the Portuguese language teachers was to work on the role of women in this period. The general theme would be "Female protagonism in the twentieth century", and some disciplines would try to highlight such facts, ask students for research, promote lectures; activity should take place for one week.
In the specific case of Philosophy, an area of knowledge historically and still with a predominantly male presence, it was thought to work the female presence in the formation of Western thought, presenting thinkers such as Rosa Luxemburg, Hannah Arendt, Simone de Beauvoir, Marilena Chauí, Viviane Mosé, Márcia Tiburi and other important women who dignify the philosophical debate with their reflection. The same can happen with women in literature, the arts, science and all other fields. These brief citations of possibilities of actions in Integral High School in an interdisciplinary way, of which some were performed and others have the potential to take effect, were not the only ones that occurred; many actions were thought and were not mentioned here. We wanted to show only actions that are feasible in this teaching model and, as we indicate, this is a peculiarity of any modality, but due to its characteristics, interdisciplinarity is practically a pedagogical "requirement".

4 FINAL CONSIDERATIONS

There is a lot of discussion about the need for interdisciplinary work, but... Why interdisciplinary work? So that? What are the possibilities of developing interdisciplinary work in my school? This article investigated the theoretical debate on the subject, and then analyzed how teachers see it. It relates the perceptions of teachers to the administrative organization of the school unit (bureaucratic and pedagogical) to define the school context and, thus, create a reference to predict difficulties and potentialities of interdisciplinary work in the school unit. Finally, it highlights that interdisciplinary work should be a tool for some educational objective placed by the school community and, in this sense, proposes a set of actions for this.
REFERENCES


