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The dependence between interdisciplinarity and discipline concepts

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ABSTRACT
The conceptualization of interdisciplinarity's problem presupposes the concept of discipline, as to break this paradigm, as to understand that one cannot think of him without the knowledge of the various disciplines that contribute to the understanding of complex research's objects, like, for example, the environment and its diversified ecosystems. The goal is to present a synthetic concept of interdisciplinarity from a literature search by use of the argumentation dialectical method, being inexorable, for this, return to both concepts of discipline and multidisciplinary.

Keywords: Interdisciplinarit, Interdisciplinar, Multidisciplinar, Discipline, Concepts.

1 INTRODUCTION

It is difficult to characterize the epistemological assumptions whose presence, or absence, allow us to assess whether or not a given academic work can be considered *scientific*. At least there seems to be no consensus among epistemologists on this topic, varying from branch to branch of science.

The ways of seeing and judging scientific knowledge vary according to the philosophical framework of each epistemologist, which transforms the question, in the final analysis, into a problem of choice or construction of *a theoretical framework* by the researcher before intending to carry out a scientific work.

This choice or construction is a process of becoming aware of the absence of neutrality in any and all research, and should be made explicit by the researcher in the introductory part of his work, which allows him to be placed before the peers of his scientific community according to an explicit posture of *epistemological* loyalty.

In this context of intrinsic difficulties, there is also the recent discussion about the *concept* of *interdisciplinarity and* about which philosophical and epistemological foundations would be better constructed.

The importance of (re)constructing this concept stems from the need to *challenge* the *growing tightness* of scientific knowledge, observed from its disciplinarization. This challenge stemmed from the increasing complexity of the problems faced by contemporary modernity, whose solutions could not be well predicted from a single sphere of knowledge and not even from the mere gathering of

professionals from different areas, but with the effective interaction of the knowledge debated in these various areas, until then immune to reciprocal interpenetrations.

Notably in the Environmental Sciences, given the high order of complexity of their research object, which does not admit simplifications without enormous loss of precision, it is imperative to face the problems from an interdisciplinary posture, since even multidisciplinary action has been shown to be insufficient in the diagnosis and prognosis of the problems that are posed to them.

Thus, it is necessary to *propose* a concept or typical steps of an interdisciplinary intervention and *to determine* the different levels of integration of the disciplines, which should be done from a philosophical and epistemological option. Not forgetting to synthesize several issues that precede it, such as the idea of discipline, scientific knowledge, scientific method, and what science is.

For this, the bibliographic review that we take as a starting point comes from authors who have already dealt with the institute in the educational context, among which we can mention Jurjo Torres Santomé, Alice Ribeiro Casimiro Lopes, Ivani Catarina Arantes Fazenda and Ari Paulo Jantsch & Lucídio Bianchetti.

In the approach to the problem, the dialectical-argumentative method, advocated by Azevedo (2000) and Perelman (2000), who calls it topical, will be adopted at the level of language.

2 SCIENTIFIC KNOWLEDGE

Doing science is a human activity of producing knowledge that needs to be well characterized. In this context, it is debated which set of characteristics would be sufficient to assess a given knowledge as being scientific.

The specificities of scientific knowledge need, therefore, to be indicated in order to establish a criterion from which to differentiate scientific knowledge from other knowledge that is socially legitimized, such as, according to Lopes (1999, p. 138-9), *everyday knowledge*, *common sense* and *school knowledge*.

Scientific knowledge is marked by rigor, that is, as Demo (1997, p. 17) emphasizes, by systematic questioning. Historically, this was due *to the appeal to rationalization, to the sieve of the evidence,* carried out by the jury of the peers of the scientific community (the idea of legitimation by the measurement of the discourse, with its starting and ending points) and by the *rupture with common sense*.

This *measurement of discourse is an* epistemological stance that does not place knowledge centered only on the object of research or on the researcher, but on the relationship between one and the other, which is all *percolated* (leached*)* by a symbolic (language), argumentative and dialectical construction, which presents science as an interpretation of "truths".

2.1 DIFFERENT PHILOSOPHICAL-EPISTEMOLOGICAL VIEWS OF SCIENTIFIC KNOWLEDGE

The different ways of seeing knowledge or human knowledge stem from a philosophical and epistemological position.

Scientific *knowledge (of little concreteness and much abstraction), as a rational reconstruction of phenomena*, mediated by scientific culture, is thus presented in a position *of diversity with popular knowledge or common sense*, everyday (with a lot of concreteness and little abstraction) and still varies over time, as a historical-cultural product that they are.

This variability of the idea of what scientific knowledge is is intimately linked to the paradigmatic method predominant in each period of its historical evolution.

In the sixteenth century Descartes launched positivism based on the belief that the *inductive method – which* emerged at the end of the Middle Ages (Galileo, Newton) as a product of the secularization of knowledge, which leads to the need for the method, despite its reductionism, as a mechanism of separation between faith and reason – based on observation, reproduction and derived generalization. It would provide enough security for the construction of a knowledge that, because it was methodical, deserved the nickname of scientific.

At the end of the nineteenth century, according to Aranha and Martins (1986, p. 160-1), science went through a crisis with the proposition of non-eculidian geometries (Lobatscheviski and Riemann), non-Newtonian physics (Eistein) and the uncertainty principle (Heisenberg).

For Aranha and Martins (1986, p. 161-2), the Vienna Circle (1928), under the influence of the mathematical logic of Russel and Whitehead, presents neopositivism or *logical empiricism*, in which *experience and language complement each other*.

Karl Raimund Popper (1935) was the one who systematically broke with the paradigm of inductivism, who cast doubt on the fact that our observation is not safe (the case of countless white swans before the appearance of a single black swan) and for whom science begins with theory and not with experiment. He advocates the *hypothetical-deductive method* based on the elaboration of a hypothesis that is subsequently submitted to tests, whose primary attribute is the ability to refute it, that is, observation does not serve as a safe basis for the production of knowledge, by induction, but rather for the refutation of a theoretical hypothesis, gauging the conclusions drawn from the theory by deduction. It thus fails to resolve the internal contradiction of conferring on the experiment, fallible par excellence, the power to refute.

Those who break with Popper's internalism will be Lakatos and Kuhn, who are therefore called externalists. For them, *the construction of knowledge is mediated by a discourse* that will be *measured by peers* in the scientific community to which it is intended. Hence the extrapolation of scientific knowledge beyond the internalism of the subject-object relationship of research, highlighting the

importance of the social role in the production of scientific knowledge, which only becomes hegemonic after a considerable adhesion of peers from a given scientific community.

Lakatos contextualizes research with the idea of *vector* research projects, which direct the activities of researchers, giving the boundaries of what can (positive heuristic) and what cannot be done (negative heuristic), notably when it comes to applied research. The vision of a body of nuclear ideas (*hard core*), protected by a belt, combined with the idea of success, which should be aimed at by the researcher, reveal well the question of external influence in Science. To consider the error as inadmissible seems to mischaracterize an environment, thus conceived, as a true environment of scientific research.

For Thomas Kuhn (1960), the evolution of scientific knowledge does not always occur gradually and cumulatively, but is traced by *revolutions*, that is, there are periods in which it can be said *that evolution* proceeds according to a *normal science*, that is, without revealing doubts about the convergent hegemonic model, followed by periods of *crisis* marked by the clash between a new proposed model that diverged from the model that had been serving as a paradigm for the scientific community.

Consensus is, in Kuhn's view, the central hallmark of scientific knowledge. With its break in the periods of epistemological crisis, the new paradigms emerged, in a revolutionary way, that would serve to guide research in the periods of normal science that followed. Thus, the question of *the validation* of knowledge, an attempt at a rational and perennial search for truth, depends on scientific discourse.

There is also Feyerabend – who defines himself as an epistemological anarchist and, without discarding rigor, admits methodological pluralism and for whom nothing is ever definitive – and Bachelard, and for him *the error* is of the essence of the production of scientific knowledge, which presents itself as a *rational process* of *rupture* with *common sense* (utilitarian everyday life does not rationalize; religion is revealed and is based on faith), in a dialectical relationship of the empirical and the rational, which he calls the *philosophy of applied rationalism*. Bachelard (*apud* LOPES, 1999) traces a connection between empiricism and rationalism as strong as the one that unites the human person to pain and pleasure:

> ... Empiricism and rationalism are linked, in scientific thought, by a strange tie as strong as that which unites pleasure and pain. In fact, *one of them triumphs by proving the other right*: *empiricism must be understood; rationalism must be applied*. An empiricism without clear laws, without co-ordinate laws, without *deductive laws*, can neither be thought nor taught; A rationalism without *tangible proof*, without application to immediate reality, cannot fully convince. The real value of an empirical law is proved by making it the basis of reasoning. Reasoning is legitimized by making it the basis of an experience. (p. 131)

Following this same line, more conciliatory and less Manichean, Hodson (1982), after questioning whether there is a scientific method, ends up suggesting, in a dialectical synthesis built

from the various philosophies that seek to support the construction of scientific knowledge, six recommendations that should be considered in the presentation of this knowledge, namely:

> (i) Observation is theory-dependent and therefore fallible.
> (ii) Theories are complex structures produced by the human mind. But once produced, they have an objective existence, independent of individual minds. A scientific theory is something apart from the scientific activity that created it, but it is related to it, in the same way that a spider's web is distinct from its making by the spider but is related to it. Theory may have consequences not foreseen by its creator, or it may have conceptual relationships that remain undetected for some time.
> (iii) Theories can be preserved and elaborated in spite of refutable observations: they need *time* to develop before they are subjected to rigorous tests.
> (iv) ... The rejection of the (old) theory cannot be more definitive than the acceptance of the (new) theory.
> (v) The *scientific method*, as practiced by the community of scientists, is the way in which we gain knowledge about the physical world. In other words, *there is no single method* of science applicable at all historical moments. The current scientific method is *adequate* to the current situation...
> (vi) ... The individual scientist detects *a problem*, formulates a strategy to solve it, *invents hypotheses*, creates and manipulates concepts, *collects evidence*, etc., using his own *creative imagination* and the *techniques and* knowledge *that were* developed by his predecessors *in* the *game of science*. It is during this *creative stage* that Feyerabend's anarchy is an essential resource. The new one must stand up to criticism and its testing by the rest of the community. If it survives this stage, it may be admitted to the body of scientific knowledge, but it may later be rejected in the light of new evidence (...) or new theories. Thus, a new discovered theory is the product of *a complex social activity* that precedes and follows the individual act of discovery or creation. (p. 12-15)

Despite the strong weight of positivism, which we are glad we carry, it is necessary to challenge this and other models so that more advanced characteristics of what is capable of identifying and validating what is scientific can permeate our scientific production, but that we can do science without ever forgetting that "... it is one thing among others, which we use in the adventure of living, which is the only thing that matters" (ALVES, 1987, p. 17).

2.2 DIFFERENCES BETWEEN SCIENTIFIC KNOWLEDGE, COMMON SENSE KNOWLEDGE AND SCHOOL KNOWLEDGE

Everyday knowledge is a kind of knowing. The scientific is another kind.

None of us escapes the everyday, because we need to automate our actions based on an *instinctive and anonymous (non-original) way of living* . And it is good that it is so, because otherwise, to give a simple loop to the laces of a shoe, man would be called to reflection, which would end up taking up the space of things on which he effectively needs to reflect (LOPES, 1999, p. 139).

Breaking away from everyday life requires reflection. When the routine is no longer able to overcome an obstacle it faces, then a rational reflective activity is needed to turn to that same routine and to the problem in order to propose viable solutions for its overcoming.

From this need to break with everyday life (Bachelardian epistemology) it is possible to perceive a bipolarity-implication between everyday knowledge and another kind of knowledge (there

are different types of knowledge), which, because it is *reflective, questioning and provisional*, brings with it marks of scientificity, even when this process of rupture implies, in its evolution, a modified return to everyday life itself (LOPES, 1999, p. 141-3).

Within everyday knowledge, which is culturally transmitted, there is popular knowledge (aimed more at specificity and diversity) and common sense, the latter being a form of expression of that which shows itself to have a trans-individual character, that is, intersubjective and, thus, is endowed with a certain degree of universality, showing itself to be more resistant to change (it points more to universality and uniformity).

In addition to everyday and scientific knowledge, school knowledge is also identified, which is characterized by transmission with pedagogical mediation and modularly compartmentalized in the form of *disciplines*, which have gradually crystallized in Western *curricula*.

While in scientific research there is *the production* of knowledge, in the school, whose conception of a public place aiming at its accessibility by all took place after the French Revolution, the *reproduction* of knowledge that has already been validated occurs. Thus, school knowledge, with its pedagogical mediation, is not to be confused with scientific knowledge.

The classification presented here seeks more a plural identification of the different types of knowledge than the unworthiness of any of them, as if it legitimized that the popular could be despised by the scientific, nor "... to establish an epistemological equality between the different discourses, with a view to conferring on the former a scientificity that they do not possess" (LOPES, 1999, p. 152-3).

3 RELATIONS BETWEEN PRODUCTION PROCESSES AND SCHOOL CULTURE

School culture does not seem to be detached from the productive processes, but, on the contrary, it is clearly placed at their service, that is, much less as a driving activity of the possibilities of social changes and much more as a maintainer of social relations in the ways in which they were constituted in a society.

The question that arises is whether the fragmentation of the production process has any correlation with the fragmentation of school knowledge.

Taylorism and *Fordism,* with the establishment of the assembly line in modern times, represented a leap in productivity. However, it deprived the worker of the knowledge of the whole, further alienating him from the decision-making of the production process.

> The fragmentation of production activities has made them incomprehensible; only a salary was offered to the working class as a motivation to develop their work; he was denied the responsibility of intervening in such important and human issues as what should be produced, why, for what, how, when, etc. (SANTOMÉ, 1998, p. 13)

Contemporaneously, *Toyotism* (1960-70) emerges as a form of downsizing of mass production, which shows itself more as an intensification of this process of fragmentation of production than a revolution of this system. What is sought is to meet the need for "... producing small quantities of many product models (...), this system is fundamentally competitive in diversification (...) This represents the opposite of Henry Ford's proposals, which sought mass production, that is, a large number of identical products" (SANTOMÉ, 1998, p. 17).

In *Toyotism*, zero stock (*just in time*) and guarantees of total quality or zero defects *are sought, with intensive training of workers*, because the fluctuations of the market are very large*, opening the production lines for their participation*, but all this *without renouncing the real share of power* that decides what to produce, with which, how much and for whom.

There is "the rediscovery of the interest of the worker as a key element of the profitability and competitiveness of the company" (SANTOMÉ, 1998, p. 20).

In other words, there was no effective, but only apparent*, democratization of the production process*, with workers being invited to give their opinion only on the actions that can guarantee higher quality to the goods produced, while making efforts to make the company more competitive. All this without the *democratization of capital,* which could take place through profit sharing, challenging the *social function* that should guide property and, thus, capital as well (art. 5, XXIII, CF/1988).

As the process of school education is inserted in the social fabric, it ends up assuming the official role of labor trainer, suffering, reflexively, the same influences observed in the transformations of the production processes.

> Each model of production and distribution requires people with certain capacities, knowledge, skills and values; And education systems have a lot to say about this.
> (...)
> Consequently, the great importance that the official discourses of the Ministries and Secretariats of Education have been giving to some pedagogical languages can also be reread and interpreted from a certain philosophy close to ohnonism. (SANTOMÉ, 1998, p. 13)

Thus, the same fragmentation of production processes seems to be reflected in the school with the fragmentation of the *teaching process*. If the former distances the worker from the decision-making centers, the latter deals with them by distancing teachers and learners, in addition to distancing them from reflective practice and serving as a guarantee of the reproduction of the current political model, leaving them impervious to criticism and problematization.

> Institutionalized education seems to have been reduced exclusively to custodial tasks for the younger generations. Analyses of hidden curricula show that what is actually learned in classrooms are skills related to obedience and submission to authority.
> (...)
> In this way, the school betrayed its authentic raison d'être: to prepare citizens to understand, judge and intervene in their community in a responsible, fair, supportive and democratic way. (SANTOMÉ, 1998, p. 13-14)

Fragmented and disciplined, school knowledge is passed on in such a way that its recipients lose their autonomy and independence and the universality of ideas to submit to the destiny pre-established by the State, and the school's capacity for action is "... delimited by indicators of what they must achieve, to the definition of which they did not contribute" (SANTOMÉ, 1998, p. 22), which demonstrates, at least, *the absence of democracy* in the establishment of curricula, which results in the *cultural stabilization of the disciplines*.

For the sake of uniformity or curricular diversity in Brazil, what is certain is that the choice should be open to its recipients, the main ones affected by it, since the dismantling of the State, operated by liberalism, reduced national education to the condition of a mere reproducer of the inequalities present in the social environment and far from the "... utopian ideal that considers education as an engine of social transformations" (SANTOMÉ, 1998, p. 26).

4 THE DISCIPLINING OF KNOWLEDGE

Scientific knowledge has been disciplined to allow, through the procedure of its analysis, decomposition, fractionation or partitioning, to facilitate its understanding and to face its increasing complexity as a result of its historical-cultural evolution.

4.1 THE CONCEPT OF DISCIPLINE

Discipline is a term widely used in the academic world and means, first of all, *a coercible regulation of conduct,* something that is imposed on a person to be assimilated and, later, can serve as a parameter to monitor and punish their actions.

> In summary, it can be said that the discipline produces, from the bodies it controls, four types of individuality, or rather an individuality endowed with four characteristics: it is cellular (by the play of spatial distribution), it is organic (by the codification of activities), it is genetic (by the accumulation of time), it is combinatorial (by the composition of forces). And to do so, it uses four major techniques: it builds paintings; prescribes manoeuvres; imposes exercises; Finally, in order to carry out the combination of forces, it organizes 'tactics'. Tactics, the art of constructing, with the cups located, the activities codified, and the aptitudes formed, apparatuses in which the product of the different forces is magnified by their calculated combination, is undoubtedly the highest form of disciplinary practice. (FOUCAULT, 2001, p. 141)

This idea of control, order, surveillance, punishment and repression seems to permeate the structuring of curricula as a mechanism to pre-establish the boundaries between what can and cannot be taught, constituting, in the final analysis, a form of *control*.

The idea of control is based on the idea *of norms* (deontics of what is allowed, what is obligatory, and what is forbidden) and the establishment of curricula or curricular parameters centralizes these decisions about what is allowed to be taught. Then, the control is exercised in the

form of poor evaluation when it is found that the school institution deviates from the official teaching parameters, which can even culminate in the loss of the *concession of the right to teach* (Inep/MEC).

The relations of subordination of the disciple in relation to the master also reveal this idea of control, since he is usually only allowed to follow the captive teachings of the master, without the possibility of freedom to question their legitimacy or their validity.

The notion *of school discipline* is presented as an *organized portion* of a certain branch of science, which, once established, tends to be preserved, over time, in bodies of disciplines in a process that can be called the disciplinarization of scientific knowledge.

The deeper one delves into the level of knowledge of an increasingly delimited object of a given branch of science, the more one specializes.

It is the search for an ever broader scientific knowledge of an increasingly restricted portion of a previously delimited object.

This attitude leads to two paradoxes: first, of losing more and more the holistic view of the whole and, thus, prognosticating solutions that, although from the perspective of the specialty may seem the most appropriate, end up proving to be harmful to the conjunctural problem; secondly, because, in an infinitesimal induction, the final parameter would be the knowledge of everything about nothing, which would prove to be of doubtful efficacy.

The absence of this view on other factors that influence the solution of problems has put professionals in *crisis*, notably due to the difficulty in *building effective interfaces between specific disciplines*.

4.2 THE CONCEPT OF INTERDISCIPLINARITY

There is no consensus on the concepts of *interdisciplinarity*. From the concept of discipline it is possible to construct that of interdisciplinarity, which does not deny it, but rather reaffirms it, that is, interdisciplinarity does not *pass through the weakening of the discipline itself*.

To face the reality, which is multidimensional, the human dimension of *multidisciplinarity* is rescued, seeking to observe people and things as a whole in their endless interrelationships.

Faced with this need to reorganize knowledge, there are two poles: specialization and unification.

The intensification of specialization is a dynamic that may eventually lead to the establishment of a new, autonomous branch of science.

Another dynamic is *that of disciplines in different areas that share a common object of study* and, thus, allow a multidisciplinary dialogue between disciplines, such as, for example, Physics and Chemistry.

There is also the recent appearance of interdisciplinary research teams with the objective of "... to try to understand and solve significant problems, issues that require the joint effort of various fields of knowledge and research in order to be faced" (SANTOMÉ, 1998, p. 44).

A typical example is the problem of violence in large urban agglomerations in Brazil.

Science, as a problem-solving method par excellence, cannot solve such a complex issue from the isolated perception of one of its specialized branches.

For problems with this high degree of complexity, as they occur in environmental issues, only a group of people with an interdisciplinary approach is better able to diagnose the problem more accurately and predict more viable and effective solutions in the short and long term (SANTOMÉ, 1998, p. 52).

However, the conduct of each of the members of such groups will dictate the greater or lesser degree of capacity to present englobalizing solutions, that is, to take into account the various faces of the problem in their various interfaces and interpenetrations, because if a *conversation of the deaf* is established, under the carapace of *intolerance*, Then a *superficial dialogue will prevail*, which will not address common elements and will tend to turn into an *insurmountable cognitive conflict*.

Overcoming *intolerance and intellectual arrogance are indispensable for the possibility of group work*, not least because it is not credible that a single person is capable of mastering so many and so distinct specialized branches of scientific knowledge and thus can accomplish the herculean task of proposing solutions to problems that require the concurrence of many branches of modern science. with knowledge dispersed in its various disciplines, for its effective clash.

Thus, the concept of interdisciplinarity permeates the idea of the possibility of *dialoguing with other branches of scientific knowledge*, which requires*, from those who propose to do so, the need* to incur the *minimum sufficient* in these branches to *establish a dialogue with specialists* of the area that allows the negotiation of the solution that the case requires. It is clear that this dialogue presupposes the indispensable mastery of the specific branch of knowledge of each of the members of the group, that is, the idea of discipline is reinforced and not rejected.

The (re)construction of a concept of interdisciplinarity, as well as its own *praxis*, is a complex task. More than seeking an analytical concept, what is noted is the enumeration *of objectives* that, in general, are capable of indicating its search, an attempt.

> Although there is not just one process, much less a rigid line of actions to follow, there are some steps that, with flexibility, are usually present in any interdisciplinary intervention:
> 1. a) *Define* the problem (question, topic, question).
> b) *To determine* the necessary knowledge, including the representative *disciplines* and those in need of consultation, as well as the most relevant models, bibliography traditions.
> c) *Develop* an integrative framework and the issues to be researched.
> 2. a) *Specify* the specific studies and research to be undertaken.
> b) *Gather* all current knowledge and *search for* new information.
> c) *Resolve conflicts* between the *different disciplines involved*, trying to work with *a common vocabulary and in a team*.

d) *Build* and *maintain* communication through integrative techniques (meetings and exchanges, frequent interactions, etc.).
3. a) *Compare* all contributions and *assess* their appropriateness, relevance and adaptability.
b) Integrate the data obtained individually to determine a coherent and relevant model.
c) *Ratify or reject* the solution or response offered.
d) *Decide* on the future of the task as well as on the work team (Klein, J. T., 1990, pp. 188-189). (SANTOMÉ, 1998, p. 65)

However great interdisciplinarity may be, this *does not represent a movement in the totalitarian sense of integration*, that is, of the *disappearance of disciplines* with their own idiosyncrasies, concepts and methods.

It is necessary to admit *epistemological polytheism* and, thus, seek to overcome the paradox of the reunion of unity in multiplicity. Where there is only unity, there is no possibility of order due to the absence of heterogeneity, because there would be nothing to compare it with. Where multiplicity is total, there is also no possibility of order because it is not possible to promote the gathering of fellow men.

4.3 DIFFERENT LEVELS OF INTEGRATION OF DISCIPLINES: MULTIDISCIPLINARITY, INTERDISCIPLINARITY AND TRANSDISCIPLINARITY

Admitting the need for *interaction* and integration between the *various disciplines*, it can be seen that Jean Piaget proposes a *hierarchy of these* levels of integration between these disciplines, namely: multidisciplinarity, interdisciplinarity and even transdisciplinarity (SANTOMÉ, 1998, p. 70). It remains to be precise the scope of each.

Multidisciplinarity would be a mere simultaneous juxtaposition of different disciplines, with their flat interfaces cleaving the topical contact established between them, which does not violate the watertightness of each one, without clearly establishing the connecting links between them. There is no dialogue between them.

Interdisciplinarity itself is placed in a *context of collective study and* implies a willingness and commitment to elaborate a more general perspective, in which each *of the disciplines in contact are*, in turn, *modified* and clearly *dependent on each other*.

Thus*, these are not interface planes*, but reciprocal intrusions around which *a metamorphosis of contact develops*, with interactions and alterations in as many disciplines as there are intrusive interfaces.

There are dialogues between the disciplines involved, but, despite the border transformations, the destruction of these borders does not occur.

Transdisciplinarity or *metadisciplinarity* evokes a *relational transcendence between different disciplines capable of overcoming all of them*, making the limits that lay there disappear. From the

metamorphosis of all disciplines emerges a new macro-discipline, in an *ideal of epistemological unification*, as occurs with general systems theory, phenomenology or Marxism.

To a maximum degree, the possibility of unification of science is considered, which "... it will only make sense if it is able to grasp, at the same time, unity and diversity, continuity and ruptures" (SANTOMÉ, 1998, p. 75).

The current stage of Science leaves this abstraction of its unification in the realm *of the utopia of knowledge without borders*, which is *quite complicated within the rationalized model of the Western world*.

5 DIFFERENT VISIONS OF INTERDISCIPLINARITY

The way of seeing interdisciplinarity varies according to the philosophical option of the epistemologist.

It is possible to notice a duality of options, which oscillate between seeing it sometimes as a work posture, that is, a *subjective posture of the research subject*, or as a *necessity objectively imposed by the reality* that surrounds this same subject.

5.1 INTERDISCIPLINARITY AS A WORK POSTURE

For those who see interdisciplinarity as a work posture, such as Ivani Catarina Arantes Fazenda and Jurjo Torres Santomé, the foundation of this philosophical option lies in the fact that it depends on *a posture of the research subject,* that is, it is dependent on his or her will.

> Interdisiciplinari*edade (*sic*) is a philosophy that requires conviction and, what is more important, collaboration; it can never be supported by coercion and impositions (SANTOMÉ, 1998, p. 79).*

In other words, interdisciplinarity would be centered on the subject, dependent on his interiority, on his work posture, in a theoretical proposition that models the detached reality of the research subject of that same reality.

> ... The great dilemma that has been posed since the end of the Second World War would have, so to speak, the following simplified profile: science questioned in its objectivities does not find a homeland in the current subjectivities. The *paradigmatic truth of objectivity has been replaced* by *the error* and *transience* of science.
> (...)
> In this return to time that only memory allows, we try to find the common thread of the history of knowledge, and behold, a first *symbol* is announced to us: *Know thyself*. To know oneself is to know oneself in totality, interdisciplinarily. In Socrates, totality is only possible through the search for interiority. The more one goes within, the more certainties one acquires from *ignorance*, *limitation*, and *provisionality*. Interiority leads us to a *profound exercise of humility* (the greatest and first foundation of interdisciplinarity). *From inner doubt to outer doubt,* from the knowledge of myself in search of the other, of the world. *From the doubt that generates doubts*, the first great contradiction and in it the possibility of knowledge (...) From the knowledge of myself to the knowledge of the totality (FAZENDA, 1994, p. 15).

This superlative value of the subject in the production of knowledge attributed by these authors seems to result from the emphasis they place on the need for *teamwork, dialogue* and *negotiation* that should permeate *the production of interdisciplinary scientific knowledge*, looking at the subject as the great complicator of this dialogue, a barrier that can be overcome through their complicity.

5.2 INTERDISCIPLINARITY AS A NECESSITY OF REALITY: A CRITIQUE OF THE *PHILOSOPHY OF THE SUBJECT*

There are those, such as Ari Paulo Jantsch and Lucidio Bianchetti, who present a critique of the view of interdisciplinarity according to a philosophy of the subject, since it would derive from a necessity of reality, that is, it would be more an imposition resulting from the values, including the market ones, that surround the subject of the research than an option resulting from his will.

> ... Both disciplinarity and interdisciplinarity are historically imposed, both being, therefore, daughters of time (a necessary human construction).
> (...)
> In this aspect, talking today about the need for interdisciplinarity no longer *depends on the decision of the subject (*individual or of a group of individuals): *it is an imposition of the current moment* (JANTSCH; BIANCHETTI, 2001, p. 21).

It would be much less a process of choice by the researcher than an imposition of the social reality that is external to him.

In its favor is the argument that research funding institutions, which ultimately dictate its course and policy, only stimulate and finance projects with characteristics previously established in their guiding notices.

Another point that is favorable to him is that the labor market shows evident signs of demand for interdisciplinary professionals, especially with the change from *Fordism* to *Toyotism*.

Historically, when interdisciplinary work was necessary, it happened, as a rule, for political reasons, such as the *Manhattan Project* for the production of the atomic bomb.

5.3 THE CONCRETE PRACTICE OF INTERDISCIPLINARITY

Even in the face of a theoretical model that traces, to a certain extent, satisfactorily well the characteristics of what interdisciplinarity is, there are practical difficulties that certainly make it impossible to adopt research postures in this exact sense.

The first of these is the impossibility of mastery by *a single singular subject of research*, with very rare exceptions (such as Aristotle, for example), of a knowledge such that it can be considered universal.

Group work is then presented as the viable way out. However, as, as a rule, the various members of the group do not communicate beyond the interface of the various branches of knowledge involved, several obstacles arise to the accomplishment of a work that can be considered interdisciplinary.

The discipline, hermetically sealed around itself, with the simplification and cutting of its object, is not receptive when faced with a proposal of complexization and sewing of its object with others that, apparently, do not have any degree of correlation or compatibility with its own.

What can be noted is that the neologism *interdisciplinarity* has become a recurrent term in research circles much more as a result of a posture resulting from needs imposed by circumstances than from a voluntary posture of the subjects, which evokes the nickname inter, when in fact it is nothing more than an activity, at best, multidisciplinary.

In other words, most multidisciplinary research is often mistakenly labeled as interdisciplinary.

To overcome this epistemological error, creativity is necessary to conceive and *make explicit an interdisciplinary method,* performing this task as an integral part of the research itself, which must assume the condition of error as something immanent to human action and, thus, to the production of scientific knowledge (Bachelard).

6 CONCLUSION

In view of the challenge that the theme represents, the possibility of conceptualizing what interdisciplinarity *is* is still an open discussion, and the authors who address the theme are content to *enumerate the objectives* that must be observed in an attempt to achieve the production of scientific knowledge of this kind.

Thus, the issue of the philosophical posture in the face of this challenge of interdisciplinarity was also shown, oscillating between a posture focused on the subject and one arising from the necessity arising from social reality, raising the old subject-object dichotomy.

In this attempt to construct interdisciplinary scientific knowledge, one does not aspire to reduce oneself to a common denominator, since disciplinary knowledge is not denied, but rather reaffirmed.

Apprehending concepts from other areas in order to become better in the exercise of one's own area of knowledge through interdisciplinary dialogue with the knowledge of others, with the placement of the same object of knowledge under the eyes of different disciplinary branches of science, seems to be the key to intersubjective relations committed to the search for solutions to complex problems that are demanding equally complex approaches. that is, interdisciplinary.

An attempt at such an approach would be to admit a discursive dialectical discourse between the disciplines involved, which makes it essential to give up one's own certainties and assume that the search for consensus would be the key element in the construction of interdisciplinary knowledge.

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