



## INTERDISCIPLINARES METHODOLOGIES FOR HIGHER EDUCATION AND RESEARCH - FROM UNDERGRADUATE TO GRADUATE SOME POSSIBLE PATHS

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### ABSTRACT

The paper presents some methodological strategies indicated for the realization of interdisciplinarity in teaching and research. It includes bibliographical review of scientific articles published between 1994 and 2017 and available in Scielo database. br, in Scientific Open Access Repositories of Portugal - Rcaap and in Brazilian Journal of Graduation - RBPG in the period from 2004 to 2017. It is considered that the strategies presented in these articles bring significant contributions to the interdisciplinary practice in teaching and in research and by reference authors with significant studies on the theme.

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### INTRODUCTION

The interdisciplinarity has occupied the Brazilian educational scenario since the decade of 1970 from the publications of Hilton Japiassu and Ivani Fazenda, theorists who started this discussion in Brazil. From there to here, it is realized that not only interdisciplinary but transdisciplinarity are present in discussions and in educational practices in the educational institutions from basic to higher education. As to the origin of the discussions about interdisciplinarity, the first questions were released by Georges Gusdorf, in 1961 to UNESCO, that presented a project of interdisciplinary research in the humanities, in which some scholars of European and American universities took part, in different areas of knowledge and the first reference for the construction of category interdisciplinarity is the report of the Center for Research and Innovation of Education (Dec/1969), affiliated to the Organization for Economic Cooperation and Development (OECD). Also important was the Seminar on interdisciplinarity and transdisciplinarity which was held on February 1970 which has contributed to the conceptual

construction of the term and gathered 21 (twenty-one) representatives of countries of the OECD, integrating the theoretical discussion, such as: Heinz Hechhausen, Jean Piaget, Erich Jantsch, Marcel Boisot, Georg Gusdorf, Andre Lichnerowicz, Asa Briggs and Leo Apostel (MANGINI; MIOTO, 2009). But it was from the crisis of the capitalism of the decade of 1970, upon causing a change of the taylorist-fordist model of production for the model Toyota, that the necessity to better prepare the workforce for the world of work more complex and demanding presents itself and from there, the category of interdisciplinarity, according to Mangini and Mioto (2009), appears as a demand of the working world and offers itself in education and training as one more aspect in the teaching-learning process to be considered. In the Brazilian undergraduate education, the creation of a multidisciplinary area in Capes (CAM), in 1999, called interdisciplinary area (CAInter), enabled the emergence of several proposals for programs of academic master's and doctoral programs and interdisciplinary professionals. Currently there are 348 interdisciplinary programs with 449 courses, which in total are 6459 recognized courses, which are divided into: 3489 academic master's degree courses, 2198 Phd and 772 professionals master's degree. In this article it is presented therefore, discussion on methodologies used in higher

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education for the achievement of interdisciplinarity in teaching and research. The text is based on research on interdisciplinarity and interprofessionality in *stricto sensu* graduation and presents the results of the literature review on interdisciplinary methodology in higher education. The article structure comprises three parts distributed as follows: The first is a conceptual demarcation in order to clarify that the concept of interdisciplinarity orientates research and presents some discussions about the importance of interdisciplinary approaches to teaching and research; in the second some methodological strategies are presented for *stricto sensu* graduation and in the third part strategies indicated for under graduation are presented. 62 articles were analyzed (sixty-two), being 45 (forty five) published in Brazilian scientific journals included in Scielo.br and the Scientific repositories of Open Access in Portugal - RCAAP in the period from 1994 to 2017 and 17(seventeen) articles published in Revista Brasileira de Pós-graduação – RBPG in the period from 2004 to 2017. In the set of 45 (forty five) articles 41(forty-one) deal specifically with interdisciplinarity in under graduation and 4(four) in graduation and 4(four) in post-graduate programs. The articles of RBPG are all about graduation program. This set of 41(forty-one) Articles is classified so in relation to the areas of knowledge: Environment; Information Science; Health; Administration; Nursing; Social Sciences; Law, Interdisciplinarity in Higher Education, Education, Health, Medicine, Humanities, Language, Natural Sciences, Information and Communication Technology, Communication, Accounting Science and Dentistry. The 17 (seventeen) articles published in the period from 2004 to 2017 by the Revista Brasileira de Pós-graduação - RBPG about interdisciplinarity, are distributed like that with a view to classification that makes magazine articles in three categories: study, discussion and experiences, i.e., in the whole of the analyzed articles 08(eight) are reports of experiences, 08(eight) are studies and 1(one) Debates. The articles were numbered in ascending order of publication year in view of the identification, archiving and subsequent consultations. There are several themes developed in articles that could be explored, but in view of the focus of this article, the central theme are the methodological strategies for the achievement of interdisciplinarity in undergraduate and graduate courses. It is considered that the strategies presented in these articles bring significant contributions to the interdisciplinary practice in teaching and in research and by reference authors with significant studies on the theme.

### **A CONCEPTUAL DEMARCATION TO GUIDE AND THE IMPORTANCE OF INTERDISCIPLINARITY IN TEACHING AND RESEARCH**

Initially, it is necessary to point out that the concept of interdisciplinarity guides the research. In this sense, it is based on discussion of Sommerman (2012) about interdisciplinarity, in which the author brings a common concept of interdisciplinarity after analysis of articles in three areas of knowledge, i.e., according to Sommerman (2012, p.491-492), there is a common concept of interdisciplinarity in three areas:

Prolonged and coordinated interaction among academic disciplines for the understanding of a given topic or the resolution of a problem that cannot be adequately treated by monodisciplinary approaches; this interaction taking many times the integration of different discourses of disciplines through the creation of a language or a common conceptual

framework, thus formulating a common methodology, transcending or at the interface of the epistemologies of different disciplines and generating new knowledge. This common concept brings the idea of interaction, understanding and search for a solution to a problem, the creation of language or common methodological and conceptual framework, as well as the production of new knowledge. In terms of the appearance of the expression "Criticism to the subjects" and "Complexity" in three areas, it should be pointed out here, for example, some excerpts from articles that Sommerman (2012) presented on the meanings of these to the education area, i.e.: Here are some passages of articles in the area of education that relate interdisciplinarity with a criticism of the subjects: "interdisciplinarity is a combination of knowledge, methods or paradigms of various disciplines that together help to explain some of the systemic phenomena that cannot be understood by purely disciplinary approaches of knowledge or help to solve a real problem" (Article 1), "the interdisciplinary curriculum is holistic, driven by values, contextualized locally, prioritizes the critical thinking" (Article 1), "should reflect the concepts of democracy, human dignity, social justice, sustainability; it must be based on relevant themes and values (Paulo Freire)" (Article 1), "The new interdisciplinarity must not only put the disciplines together to seek connections among them and interesting differences among them, with the goal of forging a new field of thought, but also question the current subjects that were placed in dialog with one another" (Article 3), "must not reify and accept the idea of subject without questioning if any set of practices and structures is adequate to explain the word" (Article 3), "must recognize the limits of the set of practices, traditions and ideologies which receive the name of an academic established subject" (Article 3), "the interdisciplinary work, particularly of the transdisciplinary type exemplified here, starts with a sense of accessible questions, but with a commitment to the notion that the understandings, whatever their origin, are always incomplete" (Article 6) (SOMMERMAN, 2012, p.492-493).

That is, interdisciplinarity is associated to the criticism to the subjects; the integration, interaction and articulation of knowledge, methods and paradigms of various subjects; a holistic vision of reality; the values such as democracy, dignity, justice; to sustainable attitude in the face of nature, as well as to the incompleteness of knowledge, of the subjects, science and of reality itself. To Sommerman (2012, p.493) "One possible explanation for its strong presence in the area of education is that interdisciplinarity is normally associated with the awareness of the necessity to contextualize the education through an organization of knowledge centered on the student life - therefore, centered on the subject and not on disciplinary content." For interdisciplinarity, the starting point is the subject and the reality, whereas, especially, the problems they face. According to Sommerman (2012, p 495) "In the area of education, interdisciplinarity almost always appears in the articles analyzed in a relationship with a pedagogy centered on the student and not on the subjects". It appears much more as an instrument of its formation as a critical individual and socially engaged than as an instrument of its professional formation.

It seems correct that in education interdisciplinary focus on individual learner and not on the subjects, since it is the student who grasps the knowledge so that originating in the understand and transform the reality. In relation to the "Complexity", Sommerman (2012) says that this concept is

present in almost all the articles of the "Inter universe " and the "trans universe" selected for their qualitative research and introduces the concept of complexity from Neil Johnson, professor of physics of the University of Oxford, for whom complexity comprises:

Much of the traditional physics was dedicated to attempting to understand the microscopic details in the interior of what we see. This led the physicists to break atoms to look at the particles inside them possibly down to the quarks. This is undoubtedly complicated, but this reductionist approach is in a certain sense the opposite of that of Complexity. Instead of breaking things to find out what their components are made of, the complexity focuses on the new phenomena that may emerge from a series of relatively simple components. In other words, the complexity looks for complicated and surprising things that can emerge from the interaction of a number of objects that they can be so simple. (...) Going further, the underlying philosophy behind the search for a quantitative theory of complexity is that we do not need a full understanding of the constituent objects to understand what a series of them can do. Simple particles interacting in a simple manner can lead to a rich variety of actual results and this is the essence of complexity. (JOHNSON, 2009, p. 17 apud SOMMERMAN, 2012, p.572).

The complexity looks to what lies between, or that does not show explicitly; look for the different, divergent, diversity, illogical, chance, the stranger, the abnormal, the impossible, and the other, indecipherable, but that somehow contains in itself something, some knowledge, some sense of being, any possibility, some other way to exist or try to exist, or trying to be.

In relation to the importance or the needs that put the interdisciplinarity as an important methodological strategy in the production of knowledge and research, Philippi Jr. *et al* say that:

Hence arises with naturalness the effervescence of interdisciplinarity, such as design, process and how to produce knowledge, driven by the need to link knowledge and broaden the technical-scientific cooperation, something that professors and researchers who act in an interdisciplinary way pass to incorporate in their practices. Sharing information passes to be something inherent to the process in which there is not a way forward without sharing them mutually among the various disciplinary approaches, such as basic elements for which there is an interdisciplinarity (PHILIPPI JR. *ET AL*, 2013, p.522). That is, interdisciplinarity meets the need to link knowledge and broaden the technical-scientific cooperation, as well as share information for the interdisciplinary construction. To Oliveira and Almeida (2011), the interdisciplinary brings the possibility of difference, of the diversity and creativity, i.e.: The interdisciplinary nature, while principle mediator among the different subjects, there can never be an element of reduction to a common denominator, but theoretical-methodological element of difference and creativity. Interdisciplinarity is the principle of science, the understanding of its limits, but above all, it is the principle of diversity and creativity (OLIVEIRA AND ALMEIDA, 2011, p.48). Oliveira and Almeida (2011, p.48), regarding the possibility that the interdisciplinarity has to understand the reality, supported in Durand (1991, apud POMBO, 2004), say: "In the interdisciplinarity is not to unify the subject by reducing their

differences, but a process of mutual fecundation, transfer of concepts and methods with a view to a more detailed reading of reality" and they add that:

This notion of interdisciplinarity seems to be shared by CAInter (CAPES, 2008b), because in their documents, it is possible to observe the yearning so that programs and courses share methodologies, perform theoretical exchanges, to contribute to the advancement of the frontiers of science and technology, emphasizing the search "by professionals with distinct profile of existing ones, with solid basic and inclusive formation" (CAPES, 2008b, p. 2) (OLIVEIRA AND ALMEIDA, 2011, p.48). Thus, in addition to the integration of areas, the sharing of knowledge and information to interdisciplinarity, contributes to a "solid basic and inclusive formation". According to Pacheco, Tosta and Freire (2010, p.137), "What would be the interdisciplinary if not the construction of a complex system which aims to integrate the truths of each subject as single units, but by accepting their differences and respecting the complexity of their own formation, restoring each subject as a whole that has already been a day naturally united". This concept integrates the interdisciplinary approach to the discussion of the complex thinking, one of the strands of the interdisciplinary approach. For Musse, Ohira and Cislighi (2008, p.154), "interdisciplinarity emerges from the convergence of two or more areas of knowledge, which contributes to the advancement of the frontiers of science or technology, generating new knowledge, new occupational profiles and new subjects." In this sense given to interdisciplinary there is a prospect of the formation of new professionals, which refers to the interprofessionality, category already present in some courses in the area of health and which comprises the preparation of health professionals to integrate with different professionals in this area, as well as other areas, once the approach in health understands the concept of integral health. For Hoff *et al* (2007.p.44), "Klein (1990) identified that the interdisciplinary approach has been used to achieve responses to complex issues, addressing large initiatives, explore disciplinary and professional relationships, resolve problems that are beyond the scope of any individual subject and seek unity of knowledge." Here, again, the interdisciplinarity in vocational formation.

## **SOME METHODOLOGICAL STRATEGIES FOR INTERDISCIPLINARY TEACHING AND RESEARCH**

The discussion about the construction of interdisciplinary practice indicates several steps. According to Hoff *et al* (2007, p.44), Klein (1990) presents three steps: [...] "bridge building", which is a new subject between the boundaries of existing and consolidated subjects; "Restructuring", in which restructuring a new discipline from the fusion of existing subjects, requiring the creation of methods and specific skills; and "transdisciplinarity," stage in which they would be getting the unification of knowledge." Thus, it is posed to professors and researchers the need for change of posture in relation to knowledge and to its production. For Almeida *et al* (2004.p.124):

From this discussion, it is possible to apprehend that the practice of the construction of interdisciplinary knowledge requires the researcher a different posture from that of what is traditionally adopted. The need to develop new paradigms and methods, which are essential to ensure the accuracy and

reliability of the generated knowledge, will require the resignation of paradigms and methods already consolidated in several disciplinary fields, as well as the establishment of multidisciplinary teams. Below are, therefore, some methodological strategies for the achievement of interdisciplinarity in graduation and under graduation degrees.

### **Interdisciplinary methodologies for stricto sensu graduation degree**

The methodological strategies indicated in the texts analyzed for stricto sensu graduation degree were:

#### **1. Define common problems**

In relation to the interdisciplinary practices, according to Almeida *et al* (2004,p.124):"Building problems of joint research, sharing methodologies, seems to be the way to summaries that seek to confront the problems brought with the fragmentation and duality", i.e., from a common problem with sharing of methodology can reach the exchange, integration and the construction of both new knowledge and new methodologies.

#### **2. Having a good coordination, organization and tuned collective**

For the interdisciplinary practice in teaching and research, the organization and coordination are considered strategic. With regard to organization and coordination, a challenge according to Teixeira is "[...] the organization and coordination of a collective of researchers who are bound, many times, to teams or different institutional structures." For this task "the planning of operations research, then, is a crucial element of the interdisciplinary work". Firstly, the time factor is crucial (TEIXEIRA, 2004, p.60). In this sense, Teixeira (2004, p.60), indicates important aspects in this organization, the establishment of a timetable of research activities and collective visits; the perfect circulation of information among the different instances; the establishment of a research team with the following characteristics: "openness of spirit, intellectual curiosity, voluntarism, indiscipline (willingness to transgress borders), etc.". Concerning the departmental organization of Higher Education Institutions - IES, according to Oliveira and Franco (2015, p. 30) "the departmental structure legislation represents a barrier to achieving this goal [to form researchers focused on the environmental theme]."

In Quaresma (2015) the departmental structure, such as difficulty for the practice of interdisciplinary research and teaching, is also presented by articles on the theme published in several journals. So, what is posed herein is the need for revision of the departmental structure or the creation of mechanisms for interdisciplinary research even with it. The problem is that the departmental structure ends up imposing, from itself, the entire organization of the academic activities of the IES. According to Hoff *et al* (2007), the organization of the teaching staff and students of heterogeneous way promotes interdisciplinarity through interaction among diverse areas of knowledge. For Pacheco, Tosta and Freire (2010, p.145), "Fazenda (2002) exposes, at least, strong assumptions already defined by Gusdorf (apud FAZENDA, 2002, p. 24-26) for the deployment of a truly interdisciplinary program, being the researcher's personal identity defined by the new collective identity", i.e., the collective has an important role in interdisciplinary practice, mainly because the teams are

assembled with professors of various areas. It is perceived, by the experience of one of the authors in an interdisciplinary program, with professors and students of various areas, that this diversity helps in building interdisciplinary. However, the attitudes of professors and students and academic activities should contribute to the integration and exchange. Another aspect pointed out by Teixeira (2004, p.61) is the role of the coordinator for which provides the following functions:

[...] the centralization and finalizing of Collective Project writing; continuous monitoring of the interdisciplinary methodology; the training of researchers to the collective work, the intersection in conflicts and the clarification of controversies among the subjects the animation and a summary of the papers." These "functions" outline very specific characteristics for its postulant. One characteristic is, however, clear: the ability to perform summaries and assessments of the path travelled. Almeida *et al* (2004, p.116), also refers to the coordinator, that is: "This experience showed that the coordination of an interdisciplinary program bringing together researchers from different institutions and of various nationalities should correspond to an experienced researcher academically and in the field of negotiation, with a large capacity of articulation."

In this sense, for both the coordinator and to the researcher/interdisciplinary faculty, as regards the characteristics to develop, Pacheco, Tosta and Freire (2010, p.147), quoting Greco (1994) say the following: "Opening to the values of other subjects is, from the dialog, being able to collaborate with a new construction, requiring people able to be humble, to have a sense of sharing, cooperation and awareness of interdependence (GRECO, 1994)."

It is considered that the organization of space and the actions of the program, as well as the characteristics of the coordination and of researchers/professors identified above are fundamental to the success of the experiences of research and interdisciplinary teaching.

#### **3. Communication and common and clear language by the "loan of terms"**

Regarding Communication and Language, according to Teixeira (2004, p.61) the difficulties are: "The different understandings and concepts that are mobilized and differences of scale of analysis on the observation of natural and social phenomena, from the point of view of time and space" and offers two ways to solve this problem, "[...] The "loan of terms" that are themselves a subject for another; and the "employment policy" of the same term by various subjects. In addition to the above aspects presented by Teixeira (2004), there are also has the differences in styles of teaching and researcher, i.e., what constitutes the identity of the professor and researcher, as well as the personal characteristics which, in the collective, need to be revised or upgraded. Almeida *et al* (2004, p.122) shows the initial difficulty of some professors to "[...] apply their methods and theories, as well as elaborate their specific problems in the interdisciplinary approach to rural development," for example. So, choosing "common terms" or the "methodological option for the systemic" as points Teixeira (2004) or "applying your methods and theories" 'interdisciplinary issues, can facilitate the process of teaching and interdisciplinary research, but it can be a way of uncertainties, insecurities and that some professor may not

want to follow, but it can also be a path of potential constructions and challenges in the pursuit of knowledge and interdisciplinary methodology, i.e., the great challenge of interdisciplinarity is this constant construction, joint and without many certainties. Pacheco, Tosta and Freire (2010, p. 145), citing Fazenda (2002) say that "[...] the researcher, besides the excellent field of object and field of studies of their discipline", needs to know the intention of the generic theoretical approach of other sciences" involved in the program and build a vocabulary paradigm that embraces the key concepts to be decoded by all."

The integration of professors/researchers from different areas of knowledge requires language and communication strategies that respect differences, but build common points of dialog and exchange. In this sense, the authors cited above exhibit as strategies: the "loan of terms"; the "employment policy" of terms; "methodological option for systemic " and "paradigm vocabulary that embraces key concepts".

#### 4. Construction of common problems

In relation to the scientific and epistemological challenge, Teixeira (2004, p.63) starts by saying that from the moment in which "in practice, the interdisciplinary research became a requirement when researchers see themselves obliged to represent the bindings and/or relationships that certain events or certain developments lay among different fields of the real, which until then had been approached by different disciplines" and that "it is precisely this kind of situations that demonstrates the limits of the methods that the disciplines have to address the hybrid objects with dimensions that are not circumscribed to the standards and customary cutouts", the question that arises is: how to build interdisciplinary scientific objects?

In this direction, Teixeira (2004), supported by other authors, indicates the construction of common and progressive problems and the understanding that "interdisciplinarity is much more a point of departure rather than arrival", i.e.,

It is not given in advance, by means of rules, formulas or models, it is built to multiple hands, with a time of work and a dynamic research essentially different from disciplinary research. It starts at the time that the researchers define a common problem, a common research strategy and a common geographic area. Furthermore, the collective construction of certain instruments of analysis is fundamental for the construction of a common problem (database of relational data, maps, explanatory models, even questionnaires, etc.) (TEIXEIRA, 2004, p.64).

Still on this point, on the epistemology of interdisciplinarity, Teixeira (2004, p.64) says that "[...] you are faced with a bifurcation and that one should discuss interdisciplinarity or as a "research practice" or as a research methodology". For him if the option is the "practice of research", the path is the "Sociology of Science and the functioning of social groups and the reflection would be reduced to the study of the social behavior of a collective: their operation, their practice, their experience, etc." But if the option is for interdisciplinarity as "search method", it would be in the face of a philosophy or epistemology and study would be the propositions of notions, how the general problem was cut out, the development of tools and methods, etc.

But for him, perhaps this bifurcation does not exist and quoting Latour (1994), indicates that the construction of scientific facts is the product of the conjunction of several elements: the scientific instruments, the scientific community and colleagues, the social-institutional alliances, the political dimensions of the researched issue and its internal and external influences to study; and, mainly, the scientific content (TEIXEIRA, 2004).

It is considered that this bifurcation does not exist but a path that combines the two perspectives, i.e., the practice of interdisciplinarity as "research practice" and as "research method". And for the two the review and change of which constitutes the production of disciplinary knowledge are worthwhile. Another discussion in this direction, is presented by Pacheco, Tosta and Freire (2010, p.144), citing Paviani (2008) on:

The concept of Unity and multiplicity, in which the approximation among subjects provokes a creative tension, which awakens the investigation of the intrinsic logic, the disciplinary paradigmatic certainties and, as a form of defense", paradoxically seek the differences to find the similarities, not getting lost and nor is it void on the other. Including, when searching for the hard core that involves a fundamental unity among the several subjects, the distinctive cut-off point is found that points to the multiplicity of levels and degrees of knowledge. And the concept of continuity and discontinuity, in which the construction of scientific knowledge is not in essence a continuous process for its object of study, the reality, to be discontinuous, thus passing to require interdisciplinary competences to take account of natural contextualized problems" (PAVIANI, 2008, p. 41 apud PACHECO, TOSTA and FREIRE, 2010, p.144). That is, interdisciplinarity entails the unity and multiplicity, as well as the continuity and discontinuity, categories stemming from the theory of complexity (MORIN, 2005), indicate the existence of aspects that the tradition of production of disciplinary knowledge are contradictory, but in the interdisciplinary perspective converge, integrate and articulate themselves.

Thus, according to Pacheco, Tosta and Freire (2010, p. 145): "To promote interdisciplinary methodological procedures, one must initially comply with the methodological guidelines as complex phenomena, differentiating the lines of research by the Incommensurability of their ways of seeing the world and practice in it their science", i.e., to the interdisciplinary research the methodological procedures may need to be interdisciplinary.

#### 5. Collaborative learning

Another aspect is the collaborative learning that is present in the production of knowledge and interdisciplinary research. According to Athayde *et al* (2013, p.737). Knowledge is not transferred from the professor to the student or from the technician to the social actor, but generated through a process of collaborative learning, integrating theoretical and practical knowledge, directed to the resolution of problems. Although there are many approaches and perceptions about the participatory development, one of the precepts of this approach is the focus on the right to participation and collaborative learning, leading to the empowerment of local communities to make decisions autonomously.

That is, the interdisciplinary knowledge is the result of a process that requires collaboration for the integration of theoretical and practical knowledge, experiences, knowledge, as well as aid for coping with the difficulties involved in interdisciplinary construction. Without collaboration and a degree of patience, it is difficult the interdisciplinary construction.

### **Interdisciplinary methodology in the under graduation**

Follow the strategies indicated for under graduation:

#### **1. Identification of themes and concepts common to several disciplines and collective discussion of professors of the same for common understanding of concepts and the integration of subjects.**

This strategy allows to identify the themes and concepts common to several disciplines and build the pedagogical work around them, which facilitates the integration. Upon identifying the concepts and/or themes common to the various subjects, it is possible to articulate the specific discussions to a thematic or problematic more generally, giving a broader meaning to the concept. It also allows to create activities, for example, interdisciplinary thematic seminars around a problem/issue result of integration.

#### **2. Pedagogical meetings of professors who ministered lessons in semesters in progress, under the coordination of one of the professors and the student participation.**

These meetings allow the discussion of alternatives of interdisciplinarity from the verification of the contents of the subjects of the adopted methodologies, forms of assessment and bibliographies worked in the semester. In one of the analyzed articles, the attitudinal and behavioral strategies were also discussed (AMBONI *et al*, 2012). In addition to enabling the monitoring of pedagogical work done during the semester, in what concerns the development of subjects, these meetings enable the construction of disciplinary actions and activities. It is considered that no pedagogical work can happen with quality and, especially with interdisciplinarity, without a moment during the week for the encounter among the professors, in view of this common planning.

#### **3. Curricular reorganization in an integrative and interdisciplinary perspective**

Some undergraduate courses in health organize their curricula in thematic areas, modules or projects that can provide the interdisciplinary work (BAGNATO; MONTEIRO, 2006). This strategy includes the reorganization of the curricular proposal of the course on themes, modules, problems or projects that integrate and articulate content and subjects. The reference becomes the theme, project or module and their definitions in relation to the skills to be developed and no longer fragmented content of each subject. The possibilities of interdisciplinarity are more comprehensive and might materialize from several common activities, because the starting point is the theme/project or module. For example, in two courses the subjects Integrative Project and Problem Resolution were created and contents were gathered in various areas of knowledge around a project or problem, respectively.

#### **4. Building the pedagogical process on the basis of the collective work**

The collective discussion on the problems and on all the pedagogical process is fundamental to the quality of the course and allows the exchange of experiences and a more consensual construction of pedagogical work. Regarding the interdisciplinary practice, it is essential that the collective work constitutes itself as the basis of interdisciplinary pedagogical process.

#### **5 Constitution of faculty with formation and professional experience in various areas and institutions**

A faculty with formation and professional practice in various branches facilitates dialogs and interactions of different looks on co-tutorships, development projects, research and classes, production of articles, for example.

#### **6 The didactic case as interdisciplinary strategy**

The article of Badin, Giannattasio and Castro (2017) presents the "Didactic Case" as pedagogical strategy for the promotion of interdisciplinarity in International Law. One of the justifications of authors for the insertion of interdisciplinarity in International Law is that it is necessary by the breadth of knowledge and of issues that involve international relationships, which requires the integration of knowledge areas for the full and wide apprehension of problems. In this sense, they present the "Didactic Case" as pedagogical strategy for the construction of interdisciplinarity. But what is the "Didactic Case"?

The didactic case is understood as the story of a real situation-problem, which is translated and confined to the classroom environment. The recipients of the didactic case are students and this tool aims to improve skills and allow the acquisition of contents of a given area of knowledge from the intellectual effort of the student body in finding the repertoire necessary to apply the theory to a concrete situation. (BADIN; GIANNATTASIO; CASTRO, 2017, p. 7).

The goal of the didactic case is instigating the student to learn and develop skills to deal with the issues and problems raised with a number of possible perspectives of solution and paths. As regards the characteristics, the didactic case must take into account: the present i.e., it can not be outdated or deteriorated; one case should not have more than 2 (two) years; proximity, i.e., it should be close to reality, which requires that we consider the quantity and quality of data and information that should be included in the case; the case materials must correspond to a real situation and spatial and temporally determinable; impartiality and neutrality: the narrative of the didactic case must be devoid of any judgments or theories; literary, which may attract the student by reading, the text should be structured and written within an understanding less concerned with the scientific rigor and closer to some literary technique of writing; sufficiency, which refers to the narrative of didactic and case unfolds in two respects, quantitative (extension of the narrative) and a qualitative aspect (complexity of narrative). The methodology of "Didactic case" makes it possible the interdisciplinarity, because from the "case" which brings in itself a real issue or supported by real data and information, requires the student to seek in the areas

of knowledge those that clarify the case and that allow the search for solutions.

### **7 Inclusion of cross-cutting themes, interdisciplinary seminars of case study and interdisciplinary evidence only at the end of the period.**

In Souza *et al* (2012) these proposals for activities to the achievement of interdisciplinarity with the inclusion of cross-cutting themes are found and took into account that:

The themes were selected from the topicality and the presence of the subject in the media; social relevance and proximity with the reality of training in health; the power of the theme in helping to understand the reality; and the students' interest. Issues related to human rights, ethics, the legalization of abortion and public policies, hunger, social inequalities, as well as others, were selected and worked (SOUZA *et al*, 2012, p.160).

In relation to the activities and didactic resources used, these were: videos, reading books, news of the written press and television and scientific articles; research roadmaps, interviews, invited panelists, simulated Jury, seminars and writing of argumentative texts on the issues (SOUZA *et al*, 2012). Regarding the evaluation of this practice, according to Souza *et al* (2012), students recognize the interdisciplinary function of activity, its importance for better comprehension of the reality and recognize that acquired skills to act as transforming agents in the society. The Interdisciplinary Seminar of Case study contained cases prepared by a team of professors and cases proposed by groups of students under the supervision of a professor tutor and coordinated by the Clinical Center. "All cases, by staff orientation, contained information on the context of the patient's life, the oral and systemic condition, this last one selected in function of the prevalence and its occurrence in clinical teaching." (SOUZA *ET AL*, 2012, p.161).

### **8. The seminars were important for the discussion of the differences and complementarities of each**

knowledge and professional area, for the promotion of exchanges among specialists and tool for the drafting, reviewing and awarding of care services protocols in the clinic. For students the seminars have contributed to the construction of autonomy as an apprentice, from the possibility of integrated thinking to solve the problems using the content of disciplines already fulfilled, for example. In addition to providing students and professors the opportunity to experience in practice group work and optimize the interactive relationship among different subjects involved in the seminar.

In relation to the Single Interdisciplinary Test only at the end of the period, this consisted of an instrument with 40 (forty) questions, being four of discursive type and interdisciplinary character and the others objective. Two objective ones were related to cross-cutting themes and the others should contemplate disciplinary intersections. The construction of the multi/interdisciplinary instrument of evaluation comprised three stages: the first, called global, consisted of a mapping of the percentage share of each subject, in terms of hours/classes in school time to visualize the distribution of objective questions by the subject; the second step, comprises the selection for each subject of its contents in accordance with

the contribution in workload and the importance of themes, its percentage was set forth in the syllabus and the third step focused on four discursive issues and in identifying the possibilities of interface among the subjects of the period, which led to the joint elaboration on the part of professors of these disciplines of the questions and the pattern of response to each of them. About the authors' conclusions about these interdisciplinary activities, they say that: "are feasible in higher education, provided that there are institutional managers committed to make changes, that the political-pedagogical project contemplates this guidance and that, from an operational point of view, count on someone that articulates the collective in that direction." (SOUZA *et al*, 2012, p.162).

### **9. The rhizomatic practice in counterpoint to the arboreal cartesian epistemological model**

Novikoff and Cavalcanti (2016) bring the "rhizomatic practice" as a possibility of counterpoint to the Cartesian model of teaching and research from the proposition of Deleuze and Guattari (1995) for the production of knowledge on the concept of rhizome. But what is the "rhizome"?

Rhizome is a concept used by Deleuze and Guattari (1995), in the social sciences, from an appropriation of a concept of botany, area of Biology that studies the plants. In this area, rhizome refers to a type of stem that some green plants have that grows horizontally. These authors have appropriated that concept to explain social phenomena in which a beginning or end is determined; the phenomena are always in the middle, imbued of other phenomena, in *Intermezzo*, without a defined cause or pre-established consequence (NOVIKOFF; CAVALCANTI, 2016, p.43). Thus, the rhizomatic proposal proposes to understand the world in all its complexity and breadth, and for this reason the authors say is necessary to have an interpretation in horizontal network and of knowledge, thus forming a rhizome, a root in which are interwoven and secure various connections, at various points, themes and ideas (NOVIKOFF; CAVALCANTI, 2016). That is: "The rhizome resembles a map, a time that has open character, connectable and susceptible to receive modifications. Therefore it is a non-centered, non-hierarchical and non-significant system, defined only by a circulation of states (DELEUZE; GUATTARI, 1995 apud NOVIKOFF; CAVALCANTI, 2016, p.49)."

The proposal of the rhizome refers to the idea of "whole", complexity, interconnection, integration of complex thinking. In relation to the effectiveness the "rhizome" enables the integrated and networking vision with the problem of knowledge and the object of research, as well as analysis, reflection and search for answers and/or integrated solutions for the same.

### **Final Considerations**

Regarding the categories the interdisciplinarity proved that they have occupied the scenario of education and formation since the decade of 1960 and aim to contribute with a more effective, efficient and responsible formation and professional action in respect to meet the demands of various areas of knowledge and branches of work. Coming from the world of work, it was inserted in the educational environment in an attempt to improve vocational training in view of the current demands and complex society. Regarding interdisciplinary methodology, various strategies were indicated, but here the

following stand out: definition of a problem and a common language in order to facilitate the interdisciplinary work; flexibilization of the structure of the IES concerning the Departmentalization; development of attitudes, interdisciplinary skills and abilities and course coordinators with interdisciplinary profile, organization of integrated seminars and integrated assessment. These strategies were presented in the analyzed articles as possibilities of implementation of interdisciplinarity in graduate and undergraduate programs, but which also have some difficulties and need improvement. However, it is believed that only with attempts, trials and errors, it is possible to say which methodological strategies enable or not the construction of interdisciplinarity.

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