Contemporary Concepts of Interdisciplinarity

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ABSTRACT

Interdisciplinarity is defined in this article as a function of interdependence between disciplines. Interdependence is presented as a result of combined sets of characteristics of a given discipline. According to the level of these characteristics, a science is more or less dependent on one or several other sciences. "Multidisciplinarity", "pluridisciplinarity", and "transdisciplinarity" are discussed as facets of interdisciplinarity. It is suggested that interdisciplinarity is natural, spontaneous, and unpredictable, and that it can be verified only through research results; whereas its facets are either artificial arrangements or mere juxtapositions. Interdisciplinarity is also identified with the areas of the Knowledge in which it most happens. New interpretations of "interdisciplinarity" are given, in this paper.

RESUMO

Neste artigo a interdisciplinaridade é definida como uma função da interdependência existente nas diversas disciplinas. E, interdependência á apresentada como resultado da combinação de características de uma dada disciplina. De acordo com o nível dessas características, diz-se que uma ciência é mais ou menos dependente de uma ou de várias disciplinas. Discute-se "multidisciplinaridade", "pluridisciplinaridade", e "transdisciplinaridade" como diversas facetas da interdisciplinaridade. Sugere-se que a interdisciplinaridade é natural, espontânea e imprevisível, e que é verificável apenas através dos resultados de pesquisas; enquanto que suas facetas são arranjos artificiais ou simplesmente justaposições. A interdisciplinaridade é também identificada com as áreas do Conhecimento em que ela mais ocorre. Novas interpretações de "interdisciplinaridade" emergem do estudo parcial, aqui apresentado.

INTRODUCTION

Interdisciplinarity among sciences has seldom been measured. It has been assumed to exist per force of practical results as viewed by classifiers of sciences and demonstrated by tradition.

Some disciplines have grown as branches of sciences and often treated as discrete sciences. Others are believed to belong to a given science just because they use the same principles, material field, methods and analytical tools. Their growth and interpenetration with other disciplines which make them differently dependent on different disciplines and sciences have often been ignored.

This study, as part of a larger one, presented as a thesis, explores the concept of interaction among discipline and characterizes interdisciplinarity under a new light.

DISCIPLINES AND INTERDEPENDENCE

The early classification systems enphasized a serial dependence among sciences. With the advent of universities in the modern sense, the sciences were divided into disciplines which became units of study, each with its own problems and interests. But, disciplines are nothing more than the very sciences that were divided for the sake of teaching and research. Therefore, a discipline can be seen as a unit of knowledge or science that can be taught within a socially convenient period of time. With the expansion of disciplines and their growth in number the serial dependence among the sciences is seen as an inextricable interdependence where all sciences interpenetrate each other to a certain extent, more or less dynamically. This phenomenon is well described by Pliss: "However special a study may be, however concentrated a specialist, the deeper the study goes and the more it gathers, the more it penetrates into others domains".[1]

But, interdependence does not happen in a vacuum or even randomly. It is the result of combined sets of characteristics of a given discipline. Heinz Heckhausen characterizes a discipline and distinguishes it from others by (1) its material field, (2) its subject matter, (3) its level of theoretical integration, (4) its methods, (5) its analytical tools, (6) its application in fields of pratice, and (7) its historical contingencies.[2] In this study, a synthesis of these seven characteristics is made: (1) material field with subject matter, (2) theoretical integration with methods and analytical tools, and (3) application with historical contingencies. Interdependence is more noticeable when two or more disciplines share the same material field and subject matter, e.g., botany and phytopathology deal with plants and their functions.

The second set of characteristics can be interpreted as the best indicator of maturity of a discipline. Heckhausen observes that a discipline is said to have established its autonomy if it has developed methods of its own.[3] The same can be said concerning the level of theoretical integration, since a discipline that has developed its own theory system will explore the phenomena of its field more condidently. Although the analytical tools, i.e., statistical techniques, a discipline uses are seldom developed by it, many disciplines have their own models and they are among the most mature disciplines. Interdependence can be affected by the degree a discipline is practice-oriented. On the other hand, external factors influence the growth of any discipline. This last set can be, more than any other, the determinant of interdependence. Since practice and theory never move at the same pace, a highly practice-oriented science tends to be eclectic and borrows from other sciences more or less randomly, while external factor, such as political and

national priorities, economic conditions and tradition may influence the growth and maturity of a science.

THE DIFFERENT FACETS OF INTERDISCIPLINARITY

It has been shown that a discipline or science possesses characteristics that distinguishes it from all the other sciences. According to the level of these characteristics, a science is more or less dependent on one or several other sciences. Determination of these levels is what constitutes one facet of interdisciplinary studies. Some researches deal with the interaction among sciences as it is revealed in their results, i.e., from the practical viewpoint. Other research, which includes the educational aspects of interdisciplinarity, studies it from conceptual or epistemological viewpoint. The present research is designed to explore interdisciplinarity from the point of view of its actual manifestation in the literature. These different research approaches are somewhat mixed in the literature and it is difficult to separate one from the other.

Guy Michaud distinguishes and defines some of the facets of interdisciplinarity:

> **Interdisciplinarity** ... *is the interaction among two or more different disciplines. This interaction may range from simple communication of ideas to the mutual integration of organising concepts, methodology, procedures, epistemology, terminology, data and organization of research and education in a fairly large field.*
>
> **Multidisciplinarity** ... *juxtaposition of various disciplines sometimes with no apparent connection between them; e.g., music + mathematics + history.*
>
> **Pluridisciplinarity** ... *juxtaposition of disciplines assumed to be more or less related; e.g., mathematics + physics or French + Latin + Greek.*
>
> **Transdisciplinarity** ... *establishing a common system for a set of disciplines (e.g., anthropology considered as the science of man and his accomplishments).*[4]

From these short definitions one can see that interdisciplinarity in its strictu sensu is that which is related mainly to research. Multidisciplinarity and pluridisciplinarity are attempts more educational in nature to give students a minimum of general knowledge. Interdisciplinarity is a natural development in research rather than a planned schema of relationships. But, it can also be a belief in a kind of isomorphism among sciences. Transdisciplinarity, however, is another matter. It can be interpreted as a control over interdisciplinary relationships. Jean Piaget sees transdisciplinarity as a higher stage succeeding the stage of interdisciplinary relationships.[5] It will be the result of many interdisciplinary studies, such as the present research, combined into a separate system of study.

Another facet of interdisciplinarity which is of relevance to this research is disclosed in the different forms of disciplinary associations. Pierre de Bie, looking at interdisciplinarity from the specific viewpoint of research group formation, distinguishes between multidisciplinary research and interdisciplinary research:

> *La recherche multidisciplinaire fait appel à divers chercheurs afin que, chacun d'eux se penchant sur un même problème dans la ligne de sa formation spécifique, il découle de leurs savoirs réunis une connaissance plus complète et moins unilatérale. Mais, lorsqu'une recherche incorpore les résultats de plusieurs disciplines, lorsqu'elle leur emprunte des instruments et des techniques, mieux encore, lorsqu'elle fait usage de schèmes conceptuels et d'analyses qui se retrouvent dans plusieurs domaines du savoir, afin de les faire converger après les avoir comparés et jugés, nous nous trouvons devant un effort interdisciplinaire.*[6]

Thus, the multidisciplinary research takes place when a group of researchers of different specializations study one problem. Interdisciplinary research is, however, almost opposite to this. It happens when one research embodies the results of several disciplines either directly or indirectly, in conformance with the level of the characteristics that a discipline possesses, as previously seen.

So interdisciplinarity can be said to be natural and in many ways directed to a specific goal. Interdisciplinarity requires integration of research results while most of its other forms require only juxtaposition or comparison. Karpinski and Samson see the difference in terms of degrees of integration of concepts:

> *... Qu'il nous suffise de dire pour le moment qu'entre la simple juxtaposition des travaux de recherche et leur integration réside toute la difference entre multidisciplinaire et l'interdisciplinaire.*[7]

Because of this unpredictable relationship among sciences, as viewed from the perspective of interdisciplinarity, techniques such as citation analysis and special methods like bibliometrics and scientometrics have been developed. Studies that make use of citation analysis as a technique for determination of interdisciplinarity, can be described as scientometric studies.

INTERDISCIPLINARITY: CURRENT CONCERNS

As seen from the previous paragraphs, interdisciplinarity has had different names and has been studied under different approaches: from the tripartite divisions of Plato and Aristotle to the hierarchical principle of Comte and his followers of the possitivist school; from Ampère's serial classification to the more modern schemes; or from the natural systems to the artificial or practical systems of classification of sciences. These efforts and others less pertinent to this study have looked for a precise demarcation of the boundaries between interdisciplinarity and multidisciplinarity. Ellingham points out that provision of a rational and self-consistent system of classification is thwarted not so much by the indefiniteness and mobility of the boundaries, but rather by the diversity of directions in which the boundary zones run because of the dissimilar principles on which the divisions are made.[8] In another passage, Ellingham makes this point even clearer:

> *... moreover, the boundaries have never been precisely drawn and, although at any given time there might be general agreement as to what lay wholly within the province of a particular science, there have always been extensive border areas within which the impacts of diverse principles and disciplines have ensured vigorous activity and have frequently led to a new syntheses of more or less enduring character, as exemplified by the emergence of biochemistry and geophysics.*[9]

Many of the studies that set the foundations for the studies of interdisciplinarity were either descriptive or prescriptive, i.e., they either defined and suggested what interdisciplinarity is or stated what it shoud be. The preoccupation with interdisciplinarity has been more marked in the applied sciences than in the pure or theoretical sciences. In the division that Van Laer made of the operative sciences as opposed to the speculative sciences he distinguishes those that are concerned with the welfare of man himself (some

human sciences) from those that depend more upon the physical sciences.[10] Both are considered here as applied sciences. The literature seems to indicate that the "softer" or less scientific a science is the greater the degree of interdisciplinarity; perhaps because the soft sciences, or those whose techniques cannot produce exact measurable results,[11] are those that are the most interdisciplinary.

The social sciences, because they are less well structured and lack the hierarchy which gives the natural sciences more or less asymmetrical dependences[12], are the sciences with the greatest interdisciplinary activities. To a great extent their departamentalization can be said to be more due to historical accidents than to intrinsic differences. Murray Wax observes that the social sciences are "chaotically organized and that the various disciplines are professional rivals for the same subject areas"[13]. J. Spengler discloses vestiges of unity underlying broad areas of social sciences[14]. He emphasizes the need for collaboration by diverse social science specialists based on the great interdependence among their disciplines. Sherif and Sherif summarize the views of many thinkers on the subject:

> *... an examination of the substantive problem of the core of interdisciplinary relationships will reveal that each discipline needs others in a fundamental and basic sense... We propose that each discipline needs the findings from others as a check on the validity of its generalizations.*[15]

Maybe even more expressive, because they emanate from an experimenter in interdisciplinarity in some of the natural applied sciences, are the statements made by Earl Heady:

> *Modern scientific concepts and theories transcend the lines of classical delineations in applied fields and modern trends are away from the barriers that scientists historically were prone to erect around their particular fields. I foresee that the productivity of all applied fields will increase greatly as these tendencies pick-up momentum. My experience over a decade in working on an interdisciplinary basis with agronomists, engineers, and animal scientists leads me to believe that the process is (a) easily possible and highly stimulating, and (b) conducive to creation of a broader scientific output in all fields involved.*[16]

Probably the same interdisciplinary propensities that exist among certain social sciences can also be found in other human sciences, because man is their unified concern they all constitute what Rickert calls Kulturwissenschaft[17]. However, the sciences of nature (Naturwissenschaft) are no longer rigid, hierarchical, and fragmented as they once were. They have more structure than the human sciences, but they are also older. Most of what has been said so far about interpenetrating boundaries also refers to the applied natural sciences, but interpenetration and even consolidation of a new sciences also take place in the so-called pure natural sciences. J. Ziman points out that the territories merge into one another, and interdisciplinary subjects such as chemical physics and biochemistry are strongly encouraged[18]. Generally speaking, interdisciplinarity pervades all sciences; it is often difficult to tell where one discipline ends and another begins (e.g., chemistry and physics, physics and mathematics, political science and sociology, sociology and psychology).

It is obvious that sciences are not equally interdisciplinary, neither within the same large group (human sciences or natural sciences) nor between groups. This researcher believes there exists a link-science both within and between groups, as well as within small groups in each large group of sciences. A link-science is defined as that science most used by two or more sciences. Identification of such link-sciences will greatly enhance the studies of interdisciplinarity and will make them more objective while focusing on specific interests. However, such identification can only be made by the very studies of interdisciplinarity as they have been described elsewhere in this work, i.e., those studies that attempt to measure and determine degrees of integration of research results among sciences, through the used of their information flow.

CONCLUSION

It was partially shown that a discipline or science possesses characteristics that distinguishes it from all the others sciences.

Interdisciplinarity cannot be ascertained only through examination of the subject matter of a discipline. Its determination requires measurement of the disciplines various interaction with other disciplines, as revealed by its activities.

It has also been suggested that interdisciplinarity takes place in those areas of knowledge where there is greatest expansion. This is more frequently verified in applied fields and in those social and human sciences which have a unified concern.

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