

# Interdisciplinarity in Modern Scientific Knowledge: the Analysis Levels

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**Abstract**—The work considers interdisciplinarity as a characteristic of modern scientific knowledge. The reasons for the emergence of this phenomenon, its formation within the framework of classical science, the peculiarities of formation in non-classical and post-non-classical are identified. The concept of "level of interdisciplinarity" is proposed. Several levels of interdisciplinarity are indicated: disciplinary, interdisciplinary, transdisciplinary, objective. The theoretical and methodological content of each level together with its heuristic potential is shown. The thesis is based: interdisciplinarity is not only the integration of sciences, but also has other forms of appearance. Each indicated level has its own "centre" of integration: on the disciplinary level there is an association of sciences; on the transdisciplinary level, there is the expansion of universal models of knowledge; on the problematic level, there is a combination of sciences to solve some problem; on the object level, science is attracted to examine a specific topic (property, power, family, etc.). It is assumed that in addition to the vertical levels of interdisciplinarity, other horizontal levels connecting them can be distinguished in the future.

**Keywords**—science; interdisciplinary; levels of interdisciplinarity; disciplinary; transdisciplinary; problem; object levels of interdisciplinarity; natural and human sciences

## I. INTRODUCTION

Interdisciplinarity is a topic popular in modern science. It characterizes the current stage of scientific knowledge (post-non-classical science) and its predecessor - non-classical. Forms a specific type of worldview, characterized by integrity, focusing on overcoming the rigid frameworks (boundaries) that existed between the disciplines in classical science and earlier (ancient and medieval pre-science). However, quite a lot of monographs and articles have been written about interdisciplinarity recently. So, it's time to somehow summarize the accumulated knowledge not only in theory (epistemology), but also in practice (taking into account the experience of specific sciences). In this research,

being based on the article of one of the authors [1], the question of the forms of manifestation of interdisciplinarity in scientific knowledge will be raised.

Let us define interdisciplinarity as the process of integration of a series (two or more) of sciences, accompanied by diffusion (overflow) and the combination of the various approaches, theories, and analysis methods existing in each of them. The synthesis of sciences leads to the emergence of a new field of knowledge, which is called the "interdisciplinary field of knowledge" [2], or else, for example, "hybrid discipline" [3].

Such an interdisciplinary field of knowledge with a number of patterns: 1) fixation and description of one's proper subject; 2) formulate the basic provisions that, having become a model, can be extended to "united sciences" and beyond them; 3) forms a specific categorical apparatus; 4) constantly expanding the group of scientists working in this field; 5) generates on the basis of such universal provisions "private research" with a high heuristic potential. This is the content of interdisciplinarity.

There are different forms of interdisciplinarity in science. Let us introduce the concept of "level of interdisciplinarity" to describe the above forms. This is a unit of the vertical structure of interdisciplinary knowledge that fixes the level of its alliance and the limits of its prevalence in scientific knowledge. The criterion for the selection of levels of interdisciplinarity could be the subject, i.e. the "point of attraction" of separate sciences. In the first case, the sciences itself are combined (often with this level one identifies interdisciplinarity broadly), in the second case, the cognitive models which are universal for the natural and human sciences are being formed and transferred; in the third case, the sciences are integrated by some problem (which requires solution, impossible within one or several disciplines), in the fourth case - by some object [4]. From here it is advisable to distinguish the following levels of interdisciplinarity:

disciplinary, transdisciplinary, problem, objective. Let us characterize the indicated levels detailed.

## II. DISCIPLINARY AND TRANSDISCIPLINARY LEVELS OF INTER-DISCIPLINARITY

Interdisciplinarity at the disciplinary level has a long history, and it was fixed as part of the late classical science (for example, F. Engels in his work "The Dialectic of Nature"), so it still remains today.

At the disciplinary level, we distinguish two types of interdisciplinarity: intra- and inter-sphere.

Intraspheric - supposes the integration of sciences from one sphere of knowledge (humanitarian or natural). In this way arose such sciences as chemical physics, physical chemistry, historical psychology, psycholinguistics, etc. This level not only "blurs" the established boundaries of science, but also forms qualitatively new ideas about the researched object. A vivid example of intra-sphere interdisciplinarity is historical psychology. It is a product of the synthesis of the humanities: history and psychology. Both the sciences study a person, a society, and texts in which their life is described. The first is focused on the knowledge of the past of people and groups, the second one - of the past and present of these objects. Hence the synthesis of history and psychology becomes useful for all. As a result, an interdisciplinary field of knowledge arises, a group of scientists working in it and specific concepts. Theoretical and methodological unity within the framework of historical psychology is achieved by solving common problems: 1) methodological (interpretation of texts and reconstruction of the psychological and cultural mechanisms that generate these texts); 2) language-theoretic (an attempt to combine the conceptual apparatus of history and psychology into a single language to describe the existence of people of the past); 3) subject-epistemological (historical psychology is aimed at describing psychological patterns, illustrated by historical examples).

Inter-sphere interdisciplineism demonstrates the integration of sciences, representing opposite sectors of the cognitive cycle. For example, sociobiology, biopolitics, etc. Let us consider the features of inter-sphere interdisciplineism on the example of sociobiology. We should note that as late as in the XIX century the model of the "social organism" came into the social sciences (such as history, sociology, economics, etc.) from biology and was actively used (by G. Spencer and others). The full-fledged union of social and biological sciences began in the second half of the twentieth century. Such sciences as biopolitics (1964) and sociobiology (1975) appeared. These sciences united both geneticists, ecologists, ethologists and historians, philosophers, political scientists and economists.

However, inter-sphere interdisciplinarity has a disadvantage. Representatives of each of the integrated sciences, most commonly, want it to be the dominant one during the synthesis. Biologists insist that it is biology that is the basis for the creation of sociobiology [5]. As for Claude Lévi-Strauss - "XXI century will be the century of the humanities, or it will not be." Hence, with such egoism,

interdisciplinarity is simply inhibited, it does not allow to reveal the heuristic potential of the process.

At the disciplinary level of interdisciplinarity, in general, existing sciences are merged into a qualitatively new discipline (not reducible to the original "components"), suggesting the creation of a new subject, a specific categorical apparatus, an increase in knowledge in the theoretical and practical plane [6].

One should pay the special attention to the transdisciplinary level. Within its limits, there are given successful examples by psychoanalysis, synergetics and a systematic approach. Psychoanalysis, which appeared on the cusp of the XIX and XX centuries at the junction of medicine and pathopsychology, developed (by S. Freud and his followers) a model of the unconscious. This theoretical structure was extended (with more or less success) to other areas of knowledge (already purely social). The model of the unconscious possessed basic provisions, specific research methods, practical conclusions. The main thing was that any mental processes were considered as essentially unconscious, which were reduced to the desires of a sexual nature suppressed by culture (consciousness). (Thus, the peculiarities of the individual psyche were extrapolated to society). The idea of a mandatory three-level structure of the psyche was introduced: the consciousness - the subconscious - the unconscious, where the latter was dominant one. Such an approach gave a definite positive effect: for example, E. Fromm introduced the terms "sane and insane society" into social science. However, the model of the unconscious did not provide one with a full-fledged, devoid of numerous contradictions, explanations of human and social behaviour. Though, the attempt of S. Freud to propose a model of the unconscious as transdisciplinary was not the only one in the XX century.

The systematic approach appeared by the middle of the XX century. According to this approach the reality together with all its presenting features was viewed as a system. This is a whole that has properties that are absent in its parts. The system (physical, biological, social) includes subsystems (elements), but is not reducible to them. Any system (in the point of view of this approach founder - Ludwig von Bertalanffy and his followers) could be represented as a subsystem of another system. So thereby the world has been completely transformed into a giant "system turducken".

In the second half of XX century another one transdisciplinary direction emerges - synergetics (although the term itself was introduced by G. Haken as early as the 1920s) [7]. As a universal interdisciplinary model, it was especially strongly reconstructed by the school of I. Prigogine and his followers in different countries. Synergetic model of knowledge is based on a systematic approach. It proceeds from the position that the formation of any systems goes from Chaos (disequilibrium) to Order (equilibrium) through a bifurcation point. Then this Order goes into Chaos and the cycle resumes. And this process takes place spontaneously. Such a scheme is extremely useful for representatives of both the natural and human sciences, because it provides with a simple, layman's terms of complex

phenomena and situations. Therefore, for example, in historical knowledge, instead of the category “bifurcation point” that came from physics, the following concepts are more adequate for the humanities: “critical point of history”, “nodal point of history”, “historical fork”, “point of polyfurcation”, etc. Political scientists have also mastered the technique of searching for critical points, transitional states, identifying conditions of “historical forks”, for example, when operating youth policy in the USSR or when searching for its missed options in Russia after 1991 [8]. At the same time, the pattern of movement from Chaos to Order within the limits of this model is not a question for representatives of the natural and human sciences.

As a result, universal models of cognition emerge at the trans-disciplinary level of interdisciplinarity, which, on the basis of the basic category, tend to build a description of reality as a totality (integrity), subject to certain laws of development. An important difficulty in the way of the formation of this level, interdisciplinarity is the need to test the content of such a universal model for each specific science [9]. For example, in the history of the situation of synergetics in the version of I. Prigogine about the “fundamental unpredictability” of the system behaviour at the bifurcation point cannot be completely acceptable. Therefore, variants of a more specific “social synergy” (V.P. Bransky, E. N. Knyazeva, A. P. Nazaretyan and others) are being developed, where such disadvantages of the basic model are overcome.

### III. PROBLEM AND OBJECTIVE LEVELS OF INTERDISCIPLINARITY

The problematic level of interdisciplinarity is best illustrated in the research done by scientists within the limits of the Club of Rome (founded in 1968) concerning the global problems of modern times. To discuss their current status, dynamics and prospects, biologists, sociologists, climatologists, mathematicians, historians, physicists, etc. were involved. A form of expression of a similar level except for scientific monographs, articles, etc. publicized for the public “reports of the Club of Rome.” The consequence of this problematic interdisciplinarity was the emergence of a special science about global problems - global studies. In methodological terms, it is indicative that at this level of interdisciplinarity, in the authors' opinion, a special, practically oriented, model of cognition has been formed. It includes the following elements: 1) the history (stages of formation) of the problem (past); 2) current status (present); 3) prospects (future, emphasizing the prognostic aspect of the problem); 4) options (methods) of the solutions. It is also advisable to say that the problem model is used not only in the analysis of global problems, acting as the foundation of this level of interdisciplinarity. However, the difficulty with this approach is the search for a hierarchy of models of different degrees of complexity [10].

The object level of interdisciplinarity implies the unification of various sciences already around a specific subject under study: family, government, property, religion, etc. Thus, family studies, cratology, propertology, and religious studies appear. Sometimes such interdisciplinarity

areas of knowledge exist independently (short histories), sometimes within the limits of philosophy (religious studies). The object level does not yet have, according to the authors, a universal model of cognition, there is a long and difficult process of its formation. At the same time, several methodological difficulties should be noted here. 1) Are there any limits (boundaries) at this level? Can any object integrate specific disciplines, or not? 2) What is the categorical apparatus that can be correctly used at this level? [11]; 3) What specific (except for those used at the disciplinary, transdisciplinary, problem level) models and methods should be applied at the object level of interdisciplinarity? So far, according to the authors, these questions are yet to be answered.

### IV. CONCLUSION

The conclusions of the material presented in the research could be summarized in the following trends. At first, the forms of interdisciplinarity performance are highlighted – i.e. its levels: disciplinary, transdisciplinary, problematic, objective. Secondly, it is shown that the degree of theoretical and methodological validity of each level is different. If the disciplinary level has a long experience of existence, the transdisciplinary and problematic have even developed universal models of cognition, then the object level has yet to be developed to the necessary conditions. Thirdly, the development of interdisciplinarity is incompatible with disciplinary “separatism”, i.e. with an attempt to declare one of the others integrated into the system of sciences “higher, better, more perfect”. This will only slow down the development of interdisciplinarity. Fourth, the transdisciplinary level of interdisciplinarity is currently the most dynamically developing and it is in demand. However, a high heuristic potential is also maintained at the object level. Fifth, the transdisciplinary level is studied by us on the example of psychoanalysis, a systems approach, synergetics. In fact, there are much more contenders for its “content”: cybernetics, world-system analysis, counterfactual historical research [12] [13] [14], cyborgology and other areas of studying the future of humanity [15], etc. Therefore, there is still a lot of work for specialists studying interdisciplinarity. Sixth, the work highlights vertical levels of interdisciplinarity, but there are probably horizontal ones that are only to be identified and described from theoretical and methodological positions.

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