The Interdisciplinary Methodology in the Postnonclassical Theory Conception

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Abstract

Currently, the term interdisciplinary research became a fashionable label, an attribute of popularization of the obtained results, meanwhile, the methodology of interdisciplinary approach to research involves deeper aspects of a new knowledge reduction. In today's world of increasing avalanche of information the focusing on the subject of disciplinary strategies research is increasingly being shifted towards the study and the solution of complex problems that require the development of new methods of its organization. The article provides an overview of current scientific views on the main directions of the superordinate genus "interdisciplinarity", covering both direct interdisciplinary and multidisciplinary and transdisciplinary researches. The essence of each of these methods is determined; the boundary of appropriateness of some kinds of them is defined. Common trends and peculiarities of the methodology development in Russia and abroad are identified and based on the analysis of the publications by leading specialists of Russian and foreign schools of interdisciplinary studies. Special attention is paid to the coverage of transdisciplinary (TD) research methodology as its beyond-disciplinary aspect, historical roots and current trends are presented.

Keywords: transdisciplinarity, interdisciplinary research, methodology, scientific research, multiple-level system, interdisciplinarity, multidisciplinarity.

1. Introduction

The concept of transdisciplinary (TD) methodology is widely replicated in the modern scientific community, however, different, diverse phenomena are defined by the concept of TD. In the typology of Organization for Economic Cooperation and Development (OECD), Transdisciplinarity (TD) is defined as a system of axioms that allows expanding the narrow scope of disciplinary investigations by the introduction of general knowledge, such as anthropology, philosophy, the study of man (Multidisciplinary and Interdisciplinary Research, 2010). In the Russian, European and American literature TD is treated as interdisciplinarity, multidisciplinarity and beyond-disciplinarity.

TD as beyond-disciplinarity has its exclusionary scope of research, methodology and axiomatic apparatus that detaches it from the multi- and interdisciplinarity and suggests the emergence of a new area of knowledge. Due to the multiplicity of approaches to the category of the TD, an attempt was made to distinguish between "transdisciplinarity", "interdisciplinarity", "multidisciplinarity" concepts, the specific subjects of scientific research organization of each approach and the relationships between them were singled out in the article. Along with the different content of certain types of areas of interdisciplinary research, the national differences in classification and interpretation of categories, differences between various scientific schools were presented.

2. Literature Review

In the theoretical and methodological aspects the search for universal, transdisciplinary laws and their applicability to the solution of the problems of socio-economic development has its origins in the early 20th century in the works by A. A. Bogdanov, G. I. Gurdzhiev. An important contribution to the development of transdisciplinary methodology was

made by a systematic approach based by Ludwig von Bertalanffy. Synergetics can be regarded the first scientifically based school of interdisciplinary direction of research, its task is to study natural phenomena and processes based on the principles of self-organizing systems. A significant contribution to its development was made by G. Khaken, S. P. Kurdyumov, A. A. Samarskiy, E. N. Knyazeva, G. G. Malinetskiy, M. V. Volkenshtein, D. S. Chernavskiy, I. R. Prigozhin and others.

For the first time a theoretical conceptualization of transdisciplinary approaches was made by Julie T. Klein. Today the problems of transdisciplinary research methods are developed by scientists and research teams both in Russia and abroad. Among the Russian scientists the philosophical direction of TD is being developed by L. P. Kiyashchenko, V. I. Moiseyev, E. G. Grebenschikova, A. A. Krushanov, I. B. Ardashkin and others, methodological aspects of TD are studied by M. S. Mokiy, V. S. Mokiy, P. M. Gureyev and others as well as the representatives of foreign schools such as B. Nicolescu, J. Papst, M. Bergmann, A. Repko, M. Max-Neef, M. Boden and others. The analysis of scientific papers in the field of transdisciplinarity made it possible to identify the main directions of transdisciplinarity, define the subject of their research and limitations when used in a particular study.

3. Methods

When solving assigned tasks the main provisions of the dialectical approach, methods of theoretical knowledge: formalization, the axiomatic method, hypothetical-deductive method were used. General logical research methods and techniques: analysis, abstraction, generalization, idealization, induction, analogy, simulation, system analysis allowed substantiating the distribution of the subnotion of "interdisciplinarity" to the directions of "transdisciplinarity", "interdisciplinarity", "multidisciplinarity".

The examples of the usage of the specific transdisciplinary methodology given in the article, illustrate the possibility of using accepted in the physics the phenomenological approach to the analysis of the mankind demographic development on the basis of "self-similar development, the causality expressed in statistical representations" (Kiyashchenko, 2012).

4. The Basic Part

4.1 Interdisciplinary Researches

Today, the use of a multidisciplinary approach is regarded as an indispensable attribute of modern studies, however, its use requires the feasibility and a clear understanding of this approach appropriateness and its borders. As Matthias Bergmann rightly points out the slogan "interdisciplinary" has become an integral part of the organization of research. However, despite the enormous potential of multidisciplinary approaches one should clearly answer the questions of what to include or exclude from the research subject, what parameters to use to assess the results (Bergmann, 2012). Lisa R. Lattuca also expresses this caution. The interdisciplinary approach, in her view, has become a favorite expression of teachers and administrators, however, it is used to describe so many scientific endeavors, which makes the term "multidisciplinary approach" almost meaningless (Lattuca, Voigt, & Fath, 2004). The interdisciplinary approach (IA), its necessity and urgency are recognized by leading educational and scientific institutions. A significant number of studies and research, both abroad (Hadorn, 2008; Huutoniemi, 2010; Interdisciplinary Research, 2008; Knight, 2013; Lyall, 2011; The Oxford Handbook, 2010) and in Russian literature are devoted to the methodology and practice of the organization of IA studies (Grebenshchikova, 2010; Kiyashchenko, Moiseyev, 2009; Mokiy, n.d.; Steny i Mosty, 2013; Kapitsa, 2012; Andreyeva, 2013). This proves the necessity, importance and feasibility of IA. The OECD report emphasizes that interdisciplinary communication can be achieved through academic training in individual-oriented model based on the deepening of disciplinary competencies. Basarb Nicolescu underlines that interdisciplinarity has an enormous potential, making possible the use of research methods of one discipline in relation to another, but the objectives of the study are in the disciplinary framework, so as a result of the method not new knowledge, but rather a new discipline appears (Transdisciplinarity, 2008). M. Max-Neef points out that the IA study is a multi-level hierarchical structure, low levels of which are co-ordinated by the higher ones. The base of the pyramid forms the empirical level, the pragmatic level is directly located after it, which can be represented with such disciplines as architecture, medicine, engineering and so on. The third, normative level, is formed by the planning, policy, development of social systems, etc. Finally, the top of the pyramid, the so-called "value level" is created by ethics, philosophy, theology (Max-Neef, 2005).

A great contribution to the development of the theory and practical application of TD methodology was made by the studies of Julie Thompson Klein (Klein, 2003; 2010). In one of her last works, "A Taxonomy of Interdisciplinarity", she

undertook a comprehensive study of the IA essence (Klein, 2010). Julie Thompson Klein singles out various species of ID: Pseudo ID, In Contextualizing ID, Composite ID, Broad or Wide ID, Cooperative ID. In this article Methodological and Theoretical ID present the greatest interest. A typical methodological problem of ID studies is improving the quality of results based on borrowing of methods or concepts from other disciplines to test the hypothesis, to answer the research questions or develop a new theory. Referring to R. Miller's works (Miller, 1984), Julie Thompson Klein remarks that back in 1984 R. Miller identified two kinds of methodological ID: Shared Components (research methods that are shared across disciplines) and Cross-Cutting Organizing Principles ("focal concepts or fundamental social processes used to organize ideas and findings across disciplines, such as 'role' and 'exchange')" (Klein, 2010). Julie Thompson Klein pays attention to the fact that "for Boden, the highest levels of the genus *Interdisciplinarity* are Generalizing ID and Integrated ID", in the framework of the first one "a single theoretical perspective is applied to a wide range of disciplines", as for the second – "the concepts and insights of one discipline contribute to solving the problems of another, ... fostering new conceptual categories and methodological unification" (Klein, 2010; Boden, 1999). It is important to note that in this case, a unified methodology is the methodology of interdisciplinary studies covering a limited range of subjects.

4.2 Multidisciplinary researches

In the OECD classification, Multidisciplinarity (MuD) was defined as an approach that juxtaposes disciplines. Disciplinary knowledge remains in the usual limits maintaining its categorical and methodological apparatus. Scientific discussion on the chosen subject, allows considering it from the perspective of all the participants from representing different disciplines, as a result a complex opinion on the problem under study is formed. MuD helps achieving encyclopedic knowledge. However, not everyone agrees with this interpretation, thus Margaret Boden says that the multidisciplinarity often represents inaccurate and even 'false' reality, because the real relationship between the society and nature study is not formed, and there is only overlapping of certain results over others (Boden, 1999). In our view, this can happen when there is insufficient level of research organization, the artificial use of MuD approach what many authors anticipate (McGregor, 2001; Transdisciplinarity, 2008). According to M. Max-Neef multidisciplinary research teams are well represented in research practice, but the general report as a result of their work is a summation of disciplinary knowledge without integrating synthesis (Max-Neef, 2005). Noting the undeniable advantages of multidisciplinary studies Basarab Nikolescu emphasizes upon the co-subordination of objectives and results of the involved disciplines to goals and objectives of the leading discipline (Nicolescu, 2014).

OECD classification makes a clear distinction between multidisciplinary and interdisciplinary research (Multidisciplinary and Interdisciplinary Research, 2010) – interdisciplinary researches are based on the joint use of disciplinary knowledge in solving this problem, creating such new areas as nanotechnologies. The highest result of the ID is the synthesis of a new field of discipline knowledge, created as a result of the interpenetration of the original basic disciplines. Multidisciplinary studies have another task, their aim is to unite the representatives of different discipline areas in one study to provide the comprehensive information on the issue. The study is carried out in different discipline areas in parallel, and is summarized in the final report, the example of which can serve environmental studies. One of the main objectives of a multidisciplinary study is identifying the largest number of problem areas, disciplinary fragmentation of the research subject.

4.3 Transdisciplinary researches

Transdisciplinary methodology, as opposed to multi- and interdisciplinary assumes not interpenetration or summation of disciplinary knowledge, but the new beyond disciplinary methodology. Matthias Bergmann rightly notes that transdisciplinarity cannot be reduced either to the summation of discipline knowledge or to a combination of certain disciplines, its purpose is the study of the world in its unity that can only be possible in overcoming disciplinary disunity (Bergmann, 2012). The need for the transdisciplinary (TD) approach demonstrates a new level of cognition. If the early stages of the disciplinary development were indeed a kind of analysis, then we are on the threshold of synthesis, which requires the development of a new methodology. A similar approach is being developed both by foreign researchers, especially Basarab Nikolescu, and representatives of the Russian school of Transdisciplinarity and Institute of Transdisciplinary Technologies (Russia), Russian Humanitarian Science Foundation. Sharing the general principle of transdisciplinary approach, researchers have fundamentally different views on the TD investigation methodology.

Justifying the essence of TD methodology Basarab Nikolescu formulated three axioms of scientific research construing: the ontological axiom, the logical axiom and the complexity axiom, later the concept was called "the new logic". The ontological axiom comes from the fact that Nature and society and our knowledge of them reflect different

levels of Reality of both the Object and the Subject of the study. The logical axiom defines that the passage from one level of Reality to another is ensured by the logic of the included middle. And finally, according to the complexity axiom the structure of the totality of levels of Reality and perception of this structure is complicated by the fact that "all the levels exist at the same time" (Nicolescu, 2010).

For years, the hypothesis of the multilevel world and the logic of the included middle were not adopted by the scientific community, and only thanks to the development of interdisciplinary researches, the inclusion of "the subject" into the research process and the development of quantum physics, something similar to it became possible (Steny and Mosty, 2013).

In the first half of the 20th century the Russian philosopher G. Gurdzhiev made a hypothesis about the multiple-level system according to which everything in the universe is subject to the law of Triamazikamno (the Law of Three) which "always flows into a consequence and becomes the cause of subsequent consequences, and always functions by three independent and quite opposite characteristic manifestations, latent within it, in properties neither seen nor sensed (Gurdzhiev, 2007). Under this law, the emergence of new creations out of the former ones occur as follows: "The higher blends with the lower in order together to actualize the middle, and thus to become either higher for the preceding lower or lower for the succeeding higher" (Gurdzhiev, 2007).

In later works B. Nicolescu and his students developed the concept of "the new logic" visualizing it as a dynamic triangle two vertices of which are at the same level of reality, and the third one is at a different level. He also underlined that the Included Middle essentially serves as the included third (Cilliers, Nicolescu, 2012). Exclusively the failure of the subject to a holistic perception of multilevel reality does not allow him seeing the triangle, for him, in his truncated perception the movement is brought into action through the struggle of opposites, in fact, there already exists their unity on another level thanks to the included third. G. Gurdzhiev confirms that if there were no third force, the dual world would cease to exist as a result of self-destruction in the result of antagonistic struggle of opposites, but this does not happen, it is because there is a third force not considered in researches. Heisenberg's uncertainty principle formulated by him in relation to quantum mechanics and his further philosophical studies also lead to the conclusion about the inevitability of a rethinking of the concept of three-dimensional space and one dimensional time, the multiple-level system of the universe and knowledge (Gejzenberg, 2008).

However, B. Nicolescu rightly points out that the application of the principle of "included third" should be restricted to a specific TD research within TD methodology, i.e. where it is really necessary for the synthesis of new knowledge. The usage of the TD methodology should not be seen as a tribute to fashion, only in this case, the TD will be a truly scientific method and leave its mark in history.

Developing the new logic of Basarab Nicolescu, the idea of the triple helix of Richard Lewontin in the context of postnonclassical science E. Kiyaschenko develops the concept of the triple helix of transinstitutsionality, importing the application function in it (Kiyashchenko 2010). Based on the general provisions of the theory – the internal indeterminacy of the situation under analysis, the plurality of combinations and the mutual independence of selected helices, the presence of a multiplicity of solutions and their dependence on the specific conditions of "here and now", the author illustrates the application of theory in the proper transdisciplinary perspective. An important condition for the application of the theory should be regarded as non-linearity, multivariation and statistical deterministic processes under study. An example of such research is the work of the Keldysh Institute of Applied Mathematics (Russian Academy of Sciences, Moscow), the works by E.N. Kniazeva, S.P. Kurdyumov (29), S.P. Kapitsa (26).

From the methodological point of view, the triple helix of transinstitutsionality works as follows: every two of the selected characteristics (helices) provide with respect to the third one the interval situation, the last one acts as "medium creation 'in between'". The groups of characteristics (helices) which are singled out, due to the heterogeneity of quality, can be "redefined" through its different, for example, universities through interaction with industrial production. The generation of new knowledge is the result of a mutual change of all elements, in addition, "changes in the functioning of each of these helices are possible only if, having adequate communicative competence, the participants ... of the process put into practice the double hermeneutics" (Kiyashchenko, 2010). On the one hand, they reveal themselves as the bearers of disciplinary approaches in a particular study, on the other – as representatives of monodisciplinary knowledge.

The idea of multi-level system and uniqueness of the Universe as a fundamental axiom of transdisciplinarity the representatives of the Russian school of transdisciplinarity (Russia) share as well. However, without sharing the included middle, they present the gnostic methodology of TD as follows. To ensure the uniqueness of the World there must exist a priori an order in it, determining this unity, which is achieved by a single form of organization both as a whole and all its natural elements – fragments, interactions and relationships between them. This system is a transdisciplinary system.

TD system manifests itself in the form of spatial, temporal and informational "units of order". The model of the spatial "unit of order" showing the unity of the sequence and structure of fragments of space in the TD system allows

proving the physical boundaries of the object of study. The model of the informational "unit of order" expressing the unity of the sequence of characteristics of the complete information in the TD system, formulates logical boundaries of the object of study. The model of the temporal "unit of order" revealing the unity of the sequence of time periods, allows proving the duration of the complete information conversion of the object of study (V. Mokiy, n.d.). From the perspective of the researcher the uniqueness of the system and order allows them to fundamentally change the approach to the research process. Due to the fact that each natural fragment selected as the object of study has all the properties of the system, due to the uniqueness of the order and the system, the researcher directs them activities in search not for structural elements and their relationships, but for identifying the last and the ratio of their parameters with the system reference parameters. At the same time not only natural objects but any new formations, for example, business organizations, can act as natural fragments.

5. Conclusion

The study undertaken involves a limited scope of methodology of postnonclassical science, its interdisciplinary component. The need in search for a new methodology is stipulated by the avalanche of information, the further deepening and the differentiation of the concept disciplinary field of study. The current requirements include the production of complex knowledge, overstepped over disciplinary limitations. The new methodology design is in all areas of interdisciplinary research, each of which has its own areas of object, tools, and tasks. However, due to the complexity and immensity of the goals and objectives, transdisciplinary methodology is positioned as a new logic, the highest manifestation of interdisciplinarity, the true interdisciplinarity among Russian and foreign researchers. Drawing an analogy with physics, we can say that the TD studies lay claim to be the "theory of everything". Today, however, questions about the acceptability and feasibility of the TD methodology in the organization of applied research, tools, axiomatic system remain open. These aspects have to be addressed and require further scientific understanding.

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References

Andreyeva, M. Yu., Votintseva, L. I. (2013). Transdistsiplinarnyy podkhod k issledovaniyu sotsialno-ekonomicheskikh protsessov. Ekonomika i sovremennyy menedzhment: teoriya i praktika [The Transdisciplinary Approach to the Study of Socio-Economic Processes. Economy and Modern Management: Theory and Practice]. – Novosibirsk: *Izdatelstvo: NP SibAK. No.*27. (pp. 86-90). (in Russian).

Bergmann, M. et al. (2012). Methods for Transdisciplinary Research: A Primer for Practice. – Campus-Verlag.

Boden, M. A. (1999). What is Interdisciplinarity? Interdisciplinarity and the Organisation of Knowledge in Europe. (pp. 13-23).

Burak, P. M. (2014). Koevolyutsionnyy podkhod v formirovanii sovremennoy nauchnoy ratsionalnosti [Co-evolutionary Approach to the Formation of Modern Scientific Rationality]. (in Russian).

Geizenberg, V. (2008). Shagi za gorizont [Steps Beyond the Horizon]. – Moscow: Progress. (P. 397).

Cilliers, P., Nicolescu, B. (2012). Complexity and Transdisciplinarity–Discontinuity, Levels of Reality and the Hidden Third. *Futures*. Vol.44, *No.*8. (pp. 711-718).

Grebenshchikova, E. G. (2010). Transdistsiplinarnyye osnovaniya bioetiki i "vtoroy tip" proizvodstva znaniya [Transdisciplinary Foundation of Bioethics and the "Second Type" of Knowledge Production]. *Znanie. Ponimanie. Umenie, No* 4. (in Russian).

Gurdzhiev, G. I. (2007). Rasskazy Velzevula svoemu vnuku [Beelzebub's Tales to His Grandson]. *Moscow Fair-Press.* (P. 832). (in Russian).

 $Hadorn, G.\ H.\ et\ al.\ (2008).\ The\ Emergence\ of\ Transdisciplinarity\ as\ a\ Form\ of\ Research.\ -\ Springer,\ Netherlands.$

Huutoniemi, K. et al. (2010). Analyzing Interdisciplinarity: Typology and Indicators. Research Policy. Vol.39, No.1. (pp. 79-88).

Interdisciplinary Research: Process and Theory. (2008). Repko, A. F. (ed.). - Sage.

Kapitsa, S. (2012). Paradoksy rosta: Zakony globalnogo razvitiya chelovechestva [Paradoxes of Growth: the Laws of the Global Human Development]. *Alpina Pablisher*. (in Russian).

Kiyashchenko, L. P. (2012) Kognitivnaya innovatsiya v fokuse filosofii transdistsiplinarnosti. *Gumanitarnye nauki: teoriya i metodologiya* [Cognitive Innovation in Philosophy Transdisciplinary Focus. Humanities: Theory and Methodology]. *No.*2. (pp. 24-32). (in Russian).

Kiyashchenko, L. P. (2010). Troynaya spiral transdistsiplinarnosti v obshchestve znaniy [Triple Helix of Transdisciplinarity in the

Knowledge Society]. Znanie. Ponimanie. Umenie, No.3. (pp. 67-74). (in Russian).

Kiyashchenko, L. P., Moiseyev, V. I. (2009). Filosofiya transdistsiplinarnosti [Philosophy of Transdisciplinarit]). IF RAN. (in Russian).

Klein, J. T. (2010). A Taxonomy of Interdisciplinarity. Oxford Handbook of Interdisciplinarity. – Oxford, United Kingdom: Oxford University Press. (pp. 15-30).

Klein, J. T. (2003). Unity of Knowledge and Transdisciplinarity: Contexts of Definition, Theory and the New Discourse of Problem Solving. Encyclopedia of Life Support Systems.

Klein, J. T., Frodeman, R. & Mitcham, C. (2010). The Oxford Handbook of Interdisciplinarity.

Knight, D. B. et al. (2013). Understanding Interdisciplinarity: Curricular and Organizational Features of Undergraduate Interdisciplinary Programs. *Innovative Higher Education. Vol.38*, No.2. (pp. 143-158).

Knyazeva, E. N., Kurdyumov, S. P. (2003). Transdistsiplinarnost sinergetiki: sledstviya dlya obrazovaniya [Synergy Transdisciplinarity: Implications For Education]. Sinergeticheskaya paradigma. Chelovek i obshchestvo v usloviyakh nestabilnosti, Vol.4. (in Russian).

Lattuca, L. R., Voigt, L. J. & Fath, K. Q. (2004). Does Interdisciplinarity Promote Learning? Theoretical support and researchable questions. *The Review of Higher Education. Vol.28*, No.1. (pp. 23-48).

Lyall, C. et al. (2011). Interdisciplinary Research Journeys: Practical Strategies for Capturing Creativity. FT Press.

Max-Neef, M. A. (2005). Foundations of Transdisciplinarity. Ecological Economics. Vol.53, No.1. (pp. 5-16).

McGregor, S. (2010). Knowledge Generation in Home Economics Using Transdisciplinary Methodology . Kappa Omicron Nu FORUM. Vol. 16, No. 2.

McGregor, S. L. T. (2011). Transdisciplinary Axiology: to Be or not to Be. Integral Leadership Review. Vol.11, No.3.

Miller, C. R. (1984). Genre as Social Action. Quarterly Journal of Speech. Vol.70, No.2. (pp. 151-167).

Mokiy, V. Methodology of Transdisciplinarity-4 (Solution of Complicated Multi-Factor Problems of Nature and Society). Retrieved from: http://www.anoitt.ru/cabdir/materials_eng.php.

Multidisciplinary and Interdisciplinary Research. (2010). Retrieved from: http://www.oecd.org/ site/innovationstrategy/45185249.pdf.

Nicolescu, B. (December, 2010). Methodology of Transdisciplinarity – Levels of Reality, Logic of the Included Middle and Complexity. Transdisciplinary Journal of Engineering & Science. Vol.1, No.1.

Nicolescu, B. Methodology of Transdisciplinarity. World Futures. Vol.70, No.3-4. (pp. 186-199).

"Steny i Mosty" – II: mezhdistsiplinarnye i polidistsiplinarnye issledovaniya v istorii: Materialy Mezhdunarodnoy nauchnoy konferentsii, Moskva, Rossiyskiy gosudarstvennyy gumanitarnyy universitet, 13–14 iyunya 2013 ["Walls and Bridges" – II: Interdisciplinary and Multidisciplinary Research in the History of the International Scientific Conference, Moscow, Russian State Humanitarian University, 13-14 June 2013]. Ershova, G. G. (otv. red.), Krom, M. M., Mironov, B. N., Savelyeva, I. M.,. Shkuratov, V. A, Dolgova, E. A. (2014). – Moscow Akademicheskii Proekt. (P.248). (in Russian).

The Oxford Handbook of Interdisciplinarity. (2010). Frodeman R., Klein J. T., Mitcham C. (Eds.)

Transdisciplinarity: Theory and Practice. (2008). Nicolescu, B. (ed.). Hampton Press.