DOI: 10.34170/2707-370X-2023-45-57
UDC: 101:001

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PHILOSOPHY OF SCIENCE: INTEGRATIVE STRATEGIES OF RESEARCH

Contemporary socio-cultural environment, whose civilizational processes constantly bring to the forefront and make relevant the issues of sustainable development, digitalization, pandemics and hybrid threats influence the conceptual content and tendencies of development of science and philosophy. An objective and integral element of the new global world is the integration processes that create opportunities for systematic solutions to problems, fast, offering flexible and non-standard responses to the challenges of today. As a result of the unification and standardization of a significant theoretical and methodological basis in science, there emerge reliable principles for multicultural and extra disciplinary dialogue, stimulating a growing consensus between academic and non-academic communities, which shapes the preconditions for constant development of the integrative processes and polyvariable selection of integration.

Integrative processes in modern science take place within the framework of the formation of research strategies through the combination of theoretical and applied methodology and the complex use of qualitative and quantitative methods with the formation of mixed research methods. On the basis of disciplinary approach, historically

we can distinguish: disciplinary, participatory, cross-disciplinary, interdisciplinary, multidisciplinary and transdisciplinary research. Cconsequently, the study of a set of interrelated cognitive contexts or areas of conceptualization of different strategies for scientific research makes it possible to speak about the possibility of forming a systemic architecture of knowledge processes formed on basis of integrativeness and involves focusing on disciplinary, interdisciplinary academic and extra disciplinary non-academic interaction. Modern integrative strategies, therefore, differ in content and at the same time possess certain common components.

Assessment of the frequency of grammatical changes of the grammatical-categorical apparatus of the integrative studies in the historical perspective, conducted in binary variant terminological field, in particular, indicates that the relative particles of the linguistic group are principally much more widespread, compared to linguistic group of terminological constructions, one can note a differing correlation of linguistic groups within their respective terminological domains. In particular, research materials analyzing a thirty-year period highlight trends of a decreasing degree of the use of the terms interdisciplinary research" and "multidisciplinary research" and the steady uniform use of the "transdisciplinary research" terminology. However, in general, each type of the formed cross-disciplinary strategies of conducting scientific research equally corresponds to the overall socio-cultural changes and reflects the multivariable methodology of the modern academic environment.

***Keywords**: philosophy of science, research, cross-disciplinary, interdisciplinary, multidisciplinary, transdisciplinary approach, integrative strategies.*

Анотація. Яновська В.П., Творонович В.І., Творонович І.О. Філософія науки: інтегративні стратегії досліджень. *Сучасне соціокультурне середовище, у цивілізаційних процесах якого постійно актуалізуються питання сталого розвитку, цифровізації, пандемії та гібридних загроз, визначальним чином впливають на концептуальних зміст та тенденції розвитку науки та філософії. Об'єктивним і невід'ємним елементом нового глобального світу стають інтеграційні процеси, завдяки яким створюються можливості для системного розв'язання проблем, швидкого, гнучкого та нестандартного реагування на виклики сьогодення. В наслідок уніфікації та об'єднання значного теоретичного і методологічного базису у науці створюються надійні засади для мультикультурного та поза дисциплінарного діалогу, діалогу між академічною і неакадемічною спільнотами, що формує передумови постійного розвитку інтеграційних процесів та поліваріантного вибору інтегративних стратегій проведення наукових досліджень.*

Інтегративні процеси у сучасній науці в рамках формування стратегій проведення досліджень відбуваються через поєднання теоретичної та прикладної методології та комплексне використання якісних і кількісних методів із формуванням змішаних методів проведення досліджень. За ознакою дисциплінарного підходу історично можна виокремити: дисциплінарний,

учаснісний, кросдисциплінарні, інтердисциплінарні , мультидисциплінарні та трансдисциплінарні дослідження. *Відповідно, вивчення сукупності взаємопов'язаних когнітивних контекстів або областей концептуалізації різних стратегій проведення наукових досліджень дозволяє говорити про можливість формування системної архітектури процесів пізнання, що формується за ознакою інтегративності та передбачає фокусування на дисциплінарності, міждисциплінарній академічній та позадисциплінарній неакадемічній взаємодії. Сучасні інтегративні стратегії, отже, відрізняються за змістом і одночасно мають певні спільні складові.*

Оцінка частотності граматичних змін понятнійно-категоріального апарату інтегративних досліджень в історичній перспективі, що проводилась у двох варіантному термінологічному полі, зокрема, свідчить, що відносні частки ознакової лінгвістичної групи є суттєво більш поширеними порівняно із лінгвістичною групою термінологічних конструкцій, спостерігається різна кореляція лінгвістичних груп в межах термінологічних доменів. Зокрема, дослідні матеріали проаналізованого тридцятирічного періоду підкреслюють тренди щодо послаблення ступеню застосування термінів «interdisciplinary research» та «multidisciplinary research» та стійкого рівномірного поширення термінології transdisciplinary research. Проте загалом кожен з видів сформованих cross-disciplinary стратегій проведення наукових досліджень у рівній мірі відповідає загальним соціокультурним змінам та відображає поліваріантну методологію сучасного академічного середовища.

Ключові слова: *філософія науки, дослідження, крос-дисциплінарний, міждисциплінарний, мультидисциплінарний, трансдисциплінарний підхід, інтегративні стратегії.*

Relevance of the research topic. The science of the socio-cultural system of a new reality in the process of its development gives rise to more complex synthesized complexes of knowledge. In the world of constant changes, integrative studies help describe the current state of affairs and cope with future problems caused by large-scale transformations such as sustainable development, digitalization, pandemic and hybrid threats. In addition, new knowledge formed in a wide landscape of subject domains will continue to allow flexibly and non-standard approaches of responding to the challenges of VUCA-world, the concept of which prevailed for the last thirty years and has been used to refer to the conditions that indicated the conditions of extreme volatility, uncertainty, complexity and ambiguity, in the pandemic period as a result of swift changes brought about the onset of the BANI concept: brittleness, anxiety, nonlinearity, incomprehensibility. Another extremely relevant point requiring our attention is examining the mechanisms of knowledge production and acquisition in their relation to the fact that nowadays there needs to occur constant constructive dialogue between the specialists in different disciplines in order to solve complex issues, through which new knowledge is born and breakthroughs are born in the

understanding of the world.

Objectives setting. Modern academic cooperation is based on the broad differentiation of the various forms of scientific relations and the formation of integrative research strategies. Specific and complex problems that require innovative solution and new methodological approaches, increasingly stimulate the processes of experience exchange, foster joint development of theory and practice, facilitate scientific methodology and academic potential. Due to the fact that in our rapidly accelerating globalized social and academic world, research issues acquire the same accelerated transformative changes, integrative research strategies require their elucidation through historical review and typological separation of issues important for modern Ukrainian philosophical thought. Similarly, academic practice, which is implemented both in the scientific and educational environment, requires attention given to the main concepts underpinning the conceptual system of synthesized integrative search.

Analysis of recent research and publications. According to modern research, integration processes in the scientific environment began with the origin of science itself and are constantly accruing complexity [20]. Hence, empirical and rational elements found within New European philosophy focused on the combination of sciences with a common methodological arsenal. In its turn, logical positivism combined phenomenalist empiricism with the method of logical analysis of the language of science, and tried to unify the sciences on the basis of physical methodology. Holism, which was based on the principles and methodology of synergy, interpreted integrity or unity as a central concept of philosophy, which combines objective and subjective, material and ideal.

As a result, there emerged a concept of a single unified science directed towards the unification of academic achievements of researchers working in different scientific fields. Thus, the priority of collective work, the search for a neutral descriptive system, liberated from the traditional methodology of the scientific language, and a joint conceptual and terminological apparatus prompted further integration of the scientific knowledge. At the same time, clarification of traditional philosophical problems by the methods of logical analysis with their subsequent expression through scientific language (terms, concepts, laws, theories) taking into account the structure of the object of study expressed the mainline epistemological tendencies. The unification of terminology has, likewise, supported a further tendency of combining the sciences, while outlining the prospects of their integration process. Consequently, the opportunity to explore various object structures caused the indivisibility of integrity, which was later expressed in the need to study structural elements of the world in their unity, following the worldview paradigm of a synergistic model of development.

Integrative processes taking place within modern science in their connotation are represented by the formation of research strategies through the combination of theoretical and applied methodology and the complex use of qualitative and quantitative methods with the formation of mixed research methods [12, 6, 4]. In

effect, there is a transition from within the isolated disciplinary silos to searching for methodological possibilities beyond the scope of conventional interdisciplinary research programs. Integrative strategies currently on offer, thus, are primarily focused on a mixed methods approach which offers a vision, allowing: (1) a core problem research; (2) use of a mix of quantitative and quantitative methodologies to examine the problem both deductively and inductively so that the findings are explainable and explicable; (3) to produce results encouraging scholarly conversations across disciplines as well engaging policymaker to weigh in on research substantiation and ramifications [4, p. 67].

Historically, there exists a distinction between disciplinary, participatory, cross-disciplinary, interdisciplinary, multidisciplinary and transdisciplinary modes of research. Accordingly, the problems of the nature, features of formation and evolution of integrative strategies has been raised by many scientists whereby the interest in integrative research concepts in the academic environment is constantly increasing with scientific meetings held and research policy clarified with an emphasis on integrative approaches in research landscapes. At the same time, scientists agree that the principal doctrines and documents outlining integrative concepts are rarely defined, expected outcomes of integration are seldom specified with terminology pertaining to research policy being inconsistent and lacking properly defined terminilogy. It should be noted, that although representatives of research policy agencies have clear but disparate inetrpretations of integrative research concepts, it is seldom possible to identify what is meant by integrative research in research policy documents [17, p. 485].

Outlining of the previously unexamined parts of the general problem. It should be emphasized that in recent years there has been a spike in the scientific interest in an integrated approach to research observed in Ukrainian academia. In light of this, we believe that Ukrainian scientific community should speed up this consistent and timely effort to adapt to the global context, effectively utilizing accumulated academic potential, which would allow an increase in the level of competitiveness and a productive degree of crosspollination into a wider research environment. Hence, it is important to summarize the content of existing developments to form a common understanding of the integrated strategies in landscape research, the degree of distribution of as well as to clarify content definitions employed in integrative approaches such as interdisciplinary, multidisciplinary, participatory and transdisciplinary concepts. Accordingly, the purpose of the article is the need to clarify terms, obtain a set of definitions which form the conceptual foundation of the process of knowledge production in integrative strategies of general research landscape and exchange of experience. In particular, the main generalizations were made by the search and formation of a sample of theoretical and applied research, published documents and scientific articles on the subject of an integrative approach in science. Terminological and meta-analysis, as well as comprehensive examination of literary sources was used in order to establish the degree of distribution, ordering

and clarification of the content of key said categories.

Presentation of the main materials of the study. As noted above, the results of the terminological analysis demonstrate, the integrative strategies are described by a categorical-terminological apparatus, which includes participatory, cross-disciplinary, interdisciplinary, multidisciplinary and transdisciplinary research which, in principal, differs from purely disciplinary or monodisciplinary research methods. Participatory research (PR) encompasses research designs, methods, and framework that rely on systematic inquiry in direct collaboration with those affected by a particular issue being studied for the purpose of action or change [18]. PR prioritizes co-constructing research through partnerships between researchers and stakeholders, community members, or others with insider knowledge and lived expertise [7, p. 324]. Moreover, in the framework of a PR approach researchers often choose methods and tools which presuppose a democratic engagement of the research partners in the research process. Research partners must also collaborate to prioritize and choose methods that maximize the potential for real-world impact and best represent stakeholder interests. Another key strength of PR is the integration of researchers' theoretical and methodological expertise with non-academic participants' real-world knowledge and experience into a mutually reinforcing partnership [3].

Cross-disciplinary, research is related to two or more academic disciplines, and can vary from a simple comparison of disciplinary ideas to more integrative or transformative approaches. Cross-disciplinary research can be implemented using integration strategies such as: interdisciplinary, multidisciplinary and transdisciplinary research.

Conversely, Interdisciplinary research (IDR) is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or field of research practice [15]. A good starting point for understanding the meaning of interdisciplinary studies is to position ones academic interests between two or more fields of study, whereby the focus of the interdisciplinarian's attention is the problem that each discipline is addressing within the purview of its respective field.

Multidisciplinary research (MDR) is a mode of research in which tools from different sciences and disciplines are used to find an explanation for the problem being studied. Hence, multidisciplinary research involves more than a single research focus to which each separate discipline makes an incremental contribution. In particular, certain scientists highlight the fact that multidisciplinary refers to the parallel scrutinizing of insights from two or more disciplines, whereby there is no real integration between them [13]. On the other hand, if experts restrict their work to the limits of their own discipline they may not enjoy a continuous achievement of the intended results. That is why, it is critically important to challenge and transcend the boundaries of specialized knowledge to form new concepts creating an entirely novel, interdisciplinary pitch.

Lastly, when compared to the previous modes, transdisciplinary research (TDR) involves the integration of insights generated outside the academy, utilizes a team approach to research, the active involvement of non-academic participants in research design, and a «case study». All in all, TDR aims to promote a unity of knowledge or – more generally – the actual means with which such an integration of otherwise disciplinary fragmented knowledge cannot be achieved [1].

Table 1. Key distinctions of integrative startegies

Terms	Nicolescu B. (2005)	Back S.M., Greenhalgh-Spencer H., Frias K.M. (2016)
Transdisciplinary research	Concerns that which is at once between the disciplines, across the different disciplines, and beyond all discipline. Its goal is the understanding of the present world, of which one of the imperatives is the unity of knowledge.	A fusing of theories, methods and expertise across disciplinary boundaries in which each discipline merges with the others in the formation of a whole that is greater than the sum of its parts. TD may also include perspectives and methods from disciplines and a wide range of stakeholders.
Multidisciplinary research	Concerns itself with studying a research topic in not just one discipline only, but in several at the same time. Any topic in question will ultimately be enriched by incorporating the perspectives of several disciplines. Overflows disciplinary boundaries while its goal remains limited to the framework of disciplinary research.	An approach whereby specialists from varying disciplines address common problems by each focusing on their respective areas of expertise, resulting in a side-by-side attempt to reach a solution or product. There is little cross-over from one area of expertise to the other.
Interdisciplinary research	Concerns the transfer of methods from one discipline to another. Overflows the disciplines, but its goal still remains within the framework of disciplinary research. Has the capacity of generating new disciplines.	A joint effort to solve a problem or develop a product in which experts from different disciplines exchange theories and methods in a process of sharing their areas of expertise. In this process techniques are borrowed across different fields.

Source compiled according to: (Nicolescu B., 2005; Back S. M., Greenhalgh-Spencer H., Frias K. M., 2016)

Studies of a set of interrelated cognitive contexts or areas of conceptualization of different research strategies as a set of domains that concentrate around a certain concept, that is, a set knowledge, by function as selective protocols for more the identification of more nuanced informational concepts, affords the possibility to develop and refine a systemic architecture of knowledge acquisition processes. The systemic architecture of cognitive processes viewed as a set of research strategies, formed on the basis of integrativeness and as such involves disciplinary focus, according to the results of terminological analysis, interdisciplinary academic and extra disciplinary as well as non-academic interaction presented in Fig. 1.

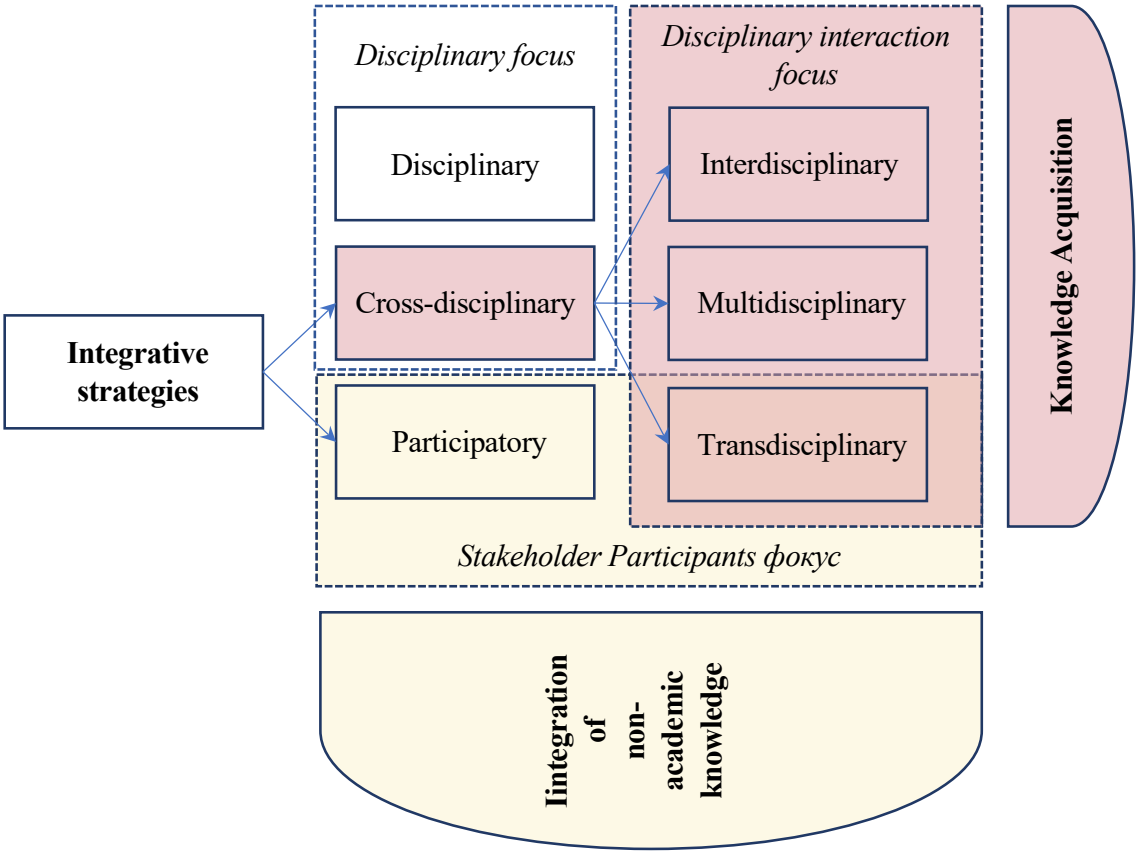


Fig. 1. Strategies of scientific research based on integration
Source: compiled by the authors

The substantive differences in integrative strategies are visualized in Fig.; 2. As noted earlier, integrative strategies have been formed at different periods of time and modern thematic journals contain information concerning certain scientists and relevant scientific works, as the primary sources of introduction of individual terms into the general conceptual and categorical apparatus; of the philosophy of science focuses on an integrative approach. Parallel to these works, it is important to investigate the problems from the standpoint of determining the historical age of different concepts.

In order to restore the history of conceptualization of integrative knowledge processes a researcher requires access to massive databases, containing data from heterogeneous resources (periodicals, monographs and other scientific and popular science literature). The meta-analysis of large data allows establishing chronological interdependences between certain phenomena and language at the academic lexical level while identifying the patterns of grammatical changes in the historical perspective. Moreover, task-specific tools like Google Books and NGram Viewer allows putting the frequency of words in a historical context by identifying the change in the frequency of a term or terminological group in time. Online tools, in general, are a valuable and convenient means of conducting research due to the fact that their functionality permits the researcher to spend more time on the analysis of data than what

is required on their collection [19]. Boasting the largest database available to-date, English, unsurprisingly, is the recommended linguistic medium of search.

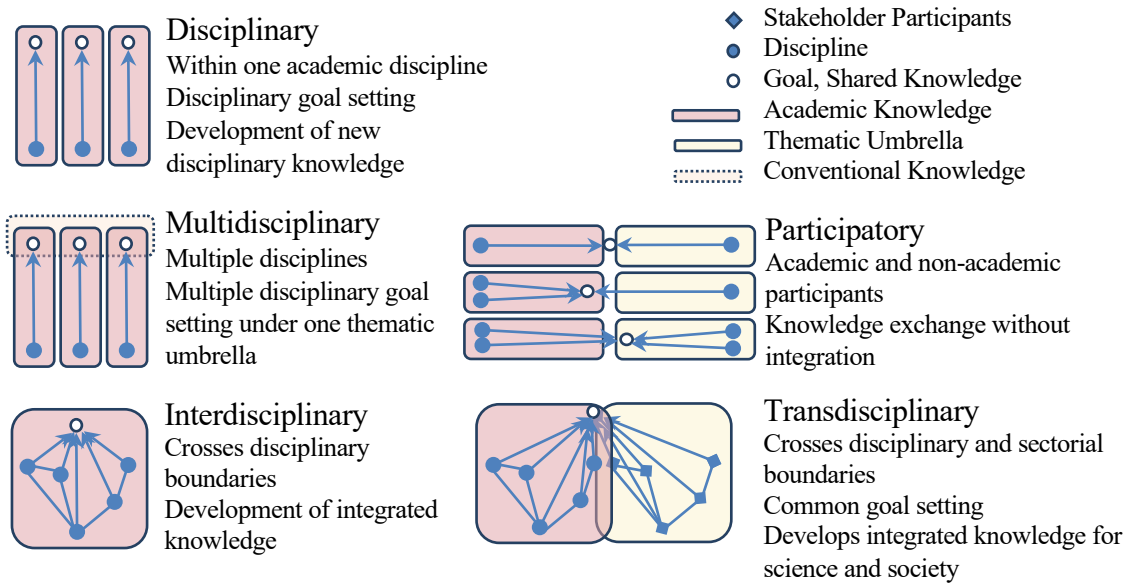
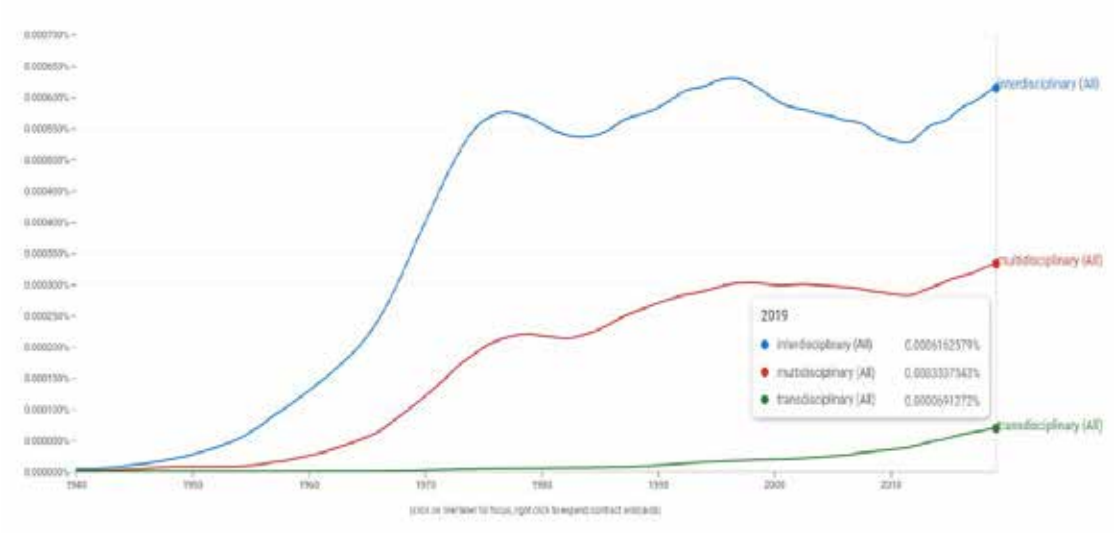


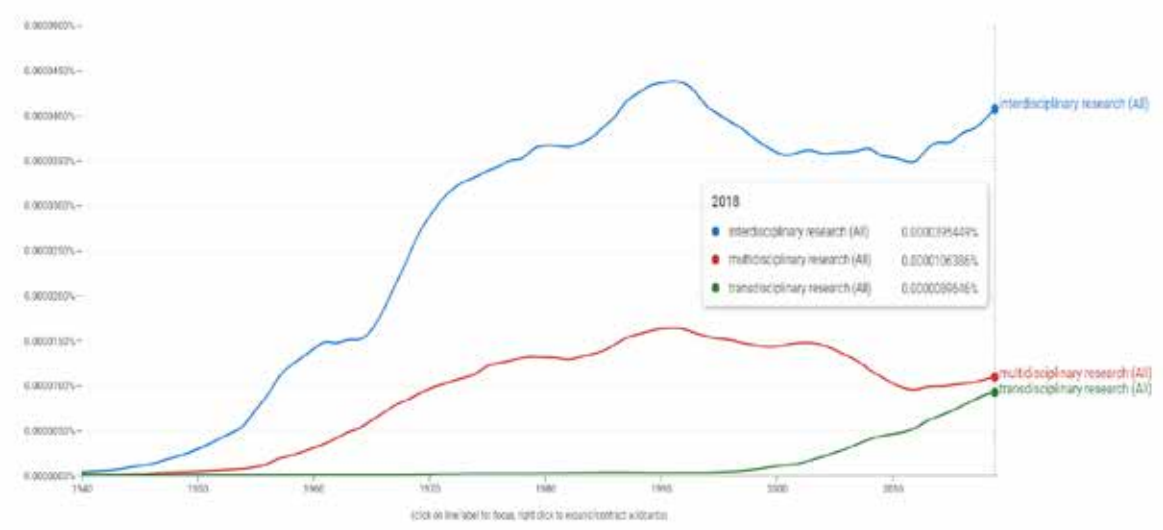
Fig 2. Graphical comparison of disciplinary and integrative strategies.
Source: (Tress G., Tress B., & Fry G., 2004)

What follows is the examination of the frequency assessment carried out in a binary variant terminological field (the first denotes only signs, the second represents complex linguistic constructions of cross-disciplinary research strategies) during the 1940–2019 period, which is characterized by the amplitude of the relative frequency of words and phrases spread in time. According to the results below, when comparing the level of distribution of terminological groups, three conclusions seem to suggest themselves, one of which is objectively predictable. First, the relative particles of the sign linguistic group are significantly more common than the linguistic group of terminological structures. As of 2019, they are respectively in the first group: Interdisciplinary – 0.0006162579%, Multidisciplinary – 0.00033337543%, Transdisciplinary – 0.0000691272%; According to the second: Interdisciplinary Research – 0.0000395449%, Multidisciplinary Research – 0.0000106386%, Transdisciplinary Research – 0.0000089646%, differing in order and scope. Secondly, the correlation of linguistic groups within terminological domains is likewise different. According to the "interdisciplinary – interdisciplinary research" domain it is 15.6 times, whereas according to the "multidisciplinary – multidisciplinary research" domain – 31.4 times, compared to the 7.7 times when analyzed according to the "transdisciplinary – transdisciplinary" domain. This indicates a relatively higher degree of associative connection in the part of transdisciplinary research and lower, tighter connection, and subsequently a higher terminological field for using the trait in the

part of multidisciplinary research. Thirdly, the peak period in the use of the terms "interdisciplinary research" and "multidisciplinary research" was in the year 1990, which observed the largest relative proportion of the use of linguistic structures (respectively 0.0000435931% and 0.0000163222%) right about time that transdisciplinary terminology began to acquire a character of steady uniformity.



(a) «interdisciplinary», «multidisciplinary», «transdisciplinary»



(b) «interdisciplinary research», «multidisciplinary research», «transdisciplinary research»

Fig. 3. Graph of frequency of terminological use in English language scientific literature in the period from 1940 to 2019. Axis of abscissa – time interval from 1940 to 2019. Source: (Google Books Ngram Viewer)

S. Fricke maintains that another excellent terminological landscape is formed when viewed through the prism of artificial intelligence-enabled search engines, in particular, semantic Scholar whose function is to comb the web for citations via an undefined algorithm [9, p. 146]. Considering that a potential researcher utilizing Semantic Scholar in its current form cannot employ it to produce an exhaustive search of background literature in their respective discipline, the detailed search query result statistics (filtered on a period basis – 1,5,10 years) available in Semantic Scholar indicates the relatively balanced use in the scientific works of the studied linguistic structures of the second terminological group, at the same time highlighting relatively close rates of their distribution. This means that each type of a cross-disciplinary scientific research strategy formed proportionately corresponds to the overall socio-cultural changes and reflects the multivariate methodology of the modern academic environment.

Table 2. Statistics of frequency of use in English -language scientific literature in the period and 2022, thousand units Semantic Scholar search results

Terms	**interdisciplinary**	**multidisciplinary**	**transdisciplinary**
All	528,0	506,0	38.5
2012–2022	307.0	323.0	28.9
2017–2022	169.0	193.0	18.4
2021–2022	35.5	44.8	4.2
Terms	interdisciplinary AND research	multidisciplinary AND research	transdisciplinary AND research
All	13400,0	13400,0	13200,0
2012–2022	8000.0	8010.0	7860.0
2017–2022	4280.0	4300.0	4210.0
2021–2022	879.0	885.0	864.0

Source: (Semantic Scholar)

Conclusions and prospects of further research. The integration of modern science occurs using a number of integrative strategies that differ in their respective disciplinary focus depending on the forms of interaction and involvement of academic and non-academic communities. Depending on the problems under study, which goes beyond certain disciplines, requires the use of methodology of other disciplines or involves an integrating methodological tools, the choice of research strategies is substantiated and systemic scientific interaction is formed. The conceptual and categorical apparatus of integrative research strategies covers the categories of participatory, cross-disciplinary, interdisciplinary, multidisciplinary and transdisciplinary researches and is in the permanent process of its methodological and substantive development. At the same time, integrative research has proven itself a reliable tool for establishing scientific interaction in solving complex problems we nowadays face. Attempts at improving sustainable global development, while stimulating digitaliza-

tion, combating pandemics and hybrid threats influence the conceptual content and ways of doing and using science.

Integrative research methodology allows for a mode of analysis in which tools from different sciences and disciplines are used to find an explanation for the problem at hand. Hence, integrative research involves more than a single study focus prompting seemingly disconnected disciplines makes a contribution to the common shared pool of knowledge. Moreover, scientists highlight the fact that the power of this approach stems from its ability to the parallel analysis of data and insights from two or more disparate disciplines, utilizing and fruitfully cross-pollinating varying research methodologies, apparatus and agendas. On the other hand, it has been observed that despite certain phenomenal breakthroughs in closed research projects subsequently pushing forward and impacting the whole scientific enterprise if experts restrict their work to the limits of their own discipline they may not enjoy a continuous achievement of expected and intended results. That is why, it is critically important to challenge and transcend the narrow boundaries of specialized knowledge to form new concepts creating an entirely novel, interdisciplinary cohesive cooperative research paradigms.

Accordingly, the emergence of new tools in the form of implementation of integrative strategies does not determine the narrowing of the research effectiveness of others, but aims to expand the range of proposed options allowing contemporary researchers to focus on the study of different issues present in the modern world.

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