Interdisciplinarity and Transdisciplinarity – Problems and Guidelines

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ABSTRACT

The production of new scientific knowledge and practical solutions to complex problems require increasing amounts of interdisciplinary collaboration, while requirements for transdisciplinary cooperation have recently likewise become more frequent. In practice, however, they are rarely implemented adequately; what occurs instead is merely multidisciplinary collaboration. True implementation of inter- and/or transdisciplinary collaboration is often met with certain difficulties and obstacles: problems due to limited disciplinary competence, problems due to protecting knowledge and power, the problem of competence required for inter- and transdisciplinary collaboration, complexity problems, methodological problems and problems caused by differences in cultural traditions. It is necessary to acquire clear general definitions of the concepts of multidisciplinarity, interdisciplinarity and transdisciplinarity, to define and implement general guidelines for the development of multidisciplinary and transdisciplinary practice and to develop a new general culture of collaboration in research and practice of complex problem-solving.

Key words: multidisciplinarity, interdisciplinarity, transdisciplinarity, problems, guidelines

Introduction

The concept of interdisciplinarity has been in more frequent circulation since the 1960s, and so has the emphasis of its necessity in producing new scientific knowledge and practical solutions to complex problems. However, it was rarely successfully implemented in practice. Many scientific research projects or development projects declared themselves interdisciplinary while participants belonging to different professions or disciplines rarely collaborated in any kind of close manner[1]. What occurred most frequently was merely multidisciplinarity: individual participants working separately and producing separate contributions at the conclusion of the work process. The decade of the 1990s saw the beginning of a more thorough examination of problems which arose from interdisciplinary collaboration in order to discern patterns of its rare true implementation. Alongside such practices, the concept of transdisciplinarity was gaining traction.

An examination of problems pertaining to the implementation of inter- and transdisciplinarity calls for answering several starting questions:

Why and when did the need arise for interdisciplinary collaboration?

How did the implementation of interdisciplinary collaboration develop?

Why did the need arise for transdisciplinary collaboration?

What problems and obstacles occurred in the process of implementing inter- and/or transdisciplinary collaboration?

What prerequisites are necessary in order to achieve inter- and/or transdisciplinary collaboration?

Origins and Concepts of Interdisciplinarity and Transdisciplinarity

The concept of discipline as a starting point for other concepts

What is implied in every mention of multidisciplinarity, interdisciplinarity and transdisciplinarity is the existence of disciplines, that is, the existence of various types of disciplines.

How did disciplines come into existence? Since time immemorial, humans have been naming phenomena in order to differentiate between them and thereby structure (classify) the complex reality of their surroundings. Using the symbolic terminology (i.e. language) established in such a way enabled them to communicate amongst themselves about the system of phenomena found in their en-

vironment and to collaborate in order to master it. Therefore, it was one of the earliest methods employed to structure and build the human world. Thus men structured knowledge (and beliefs) about their world, which was, among other things, based on discerning, establishing, and defining differences.

Humanity did not immediately become aware of such method of distinguishing phenomena within a system of phenomena, of dividing the lived and imagined reality into differentiated segments. This was an intuitive and lengthy process which took place without humans becoming aware of the method itself. It was only Descartes who in his *Discourse on the Method*[2] brought a definitive description of this practice and introduced it into consciousness as a fact about human behaviour present in striving to comprehend reality and solve complex problems. In describing his method, Descartes defined four rules of comprehending reality and/or overcoming even the most complex phenomena and problems. The second rule, he notes, is: „to divide all the difficulties under examination into as many parts as possible, and as many as were required to solve them in the best way". However, he fails to take note of the relations that exist between the elements of the whole which have been divided in such a way. In his third rule, nevertheless, he attempts to reassemble this divided reality into a whole once again: „The third [rule] was to conduct my thoughts in a given order, beginning with the simplest and most easily understood objects, and gradually ascending, as it were step by step, to the knowledge of the most complex; and positing an order even on those which do not have a natural order of precedence." But given that he failed to take relations into consideration, such allegedly reassembled whole becomes a mere sum of parts, an assembly of elements, and not a new synthesis of the initial whole[3]. Parts of reality differentiated in such a way together with separate segments of study and acquired knowledge about them gradually took on definitive nomenclature and mutual distinctions, and were defined as separate scientific disciplines and related practical professions.

The development of a system of separate disciplines

For several centuries after that and leading up to present times, due to aforementioned characteristics, Descartes's exceptionally influential treatise, which can be seen as the culmination of contemporary thought, impacted the subsequent development of knowledge, professions and disciplines, especially the methodology of science. Followers of the approach Descartes defined found it easier to (then and later, and even today, uncritically) divide the phenomena found in reality into segments, then divide those segments into further segments, without taking into account the dissolved relations among the segments divided in such a way, that is, without taking into account the possibility of their reunification into a whole. Consequently, over the course of several centuries, overall knowledge has developed into a set of specialized areas of knowledge, that is, into separate scientific disciplines and sub-disciplines and related practical professions as carriers of knowledge for specific fields.[4,5] This is how the structure

of the world-conception came into being, the segmented structure of knowledge. Individual professions and scientific disciplines started developing specialized terminologies, thereby creating specific „languages" for each knowledge segment, as well as specific research methods and methods for solving complex problems. What developed in the field of knowledge, professions, scientific disciplines, aspects of perceiving certain complex problems was the Cartesian divide (the loss of a whole), while on the basis of such an approach a system of institutions, that is, the organization of science was created[6].

Such Cartesian, divided structure of knowledge (and, following this, a divided structure of consciousness) developed considerably and dominated the western culture for several centuries, despite criticism which was voiced from the very beginning of this development. Attempts to bridge the divides, that is, to form relations – such as Lambert's, who posited the first relation theory and introduced the concept of system into philosophy[7] – had no influence on the developments lead by the Cartesian approach for a very long time. On the one hand, such an approach was conducive to a mechanistic worldview and the development of machines and technology, to the first and second industrial revolution and mass (specialized) production. On the other hand, such divisionary approach led to breaches between disciplines (created in such a way) and problems in communication, agreement, collaboration, exchange and connection of separate contributions. This developmental direction reached its critical limits in the 20th century.

The appearance of system theory and the call for inter- and transdisciplinarity

Every complex problem/phenomenon contains a number of standpoints within itself and it is both possible and desirable to study it bearing this in mind. It is only possible to grasp the whole of a complex problem/phenomenon if we interconnect each and every individual standpoint that is studied. In order to accomplish this, what is required is meaningful collaboration of all subjects who study the same complex problem/phenomenon from different standpoints.

It was only when unsolvable problems started occurring, due to knowledge and methods being separated, that more resolute attempts at bridging, connecting and creating an overview of the lost whole were on the rise. „Hybrid" disciplines such as physical chemistry, social psychology and the like, became more frequent, and, ultimately, what arose was the movement which sought to bridge everything, to allow for an overview of everything and a connection of everything: the gatherings and discussions of protagonists, experts and scientists belonging to diverse disciplines on the topic of disintegration and disconnection of knowledge. It became apparent that similar problems and obstacles („walls") were encountered in diverse fields – problems which remained unfamiliar to others – and that methods used in one field could potentially be used in other (all) fields. What was developed was an approach

which enables insight into the whole (overview of the whole), its structure and relations between its components, as well as general principles which promote cross-fertilization of certain insights and methods, a shared (meta) methodology, a common (meta)language, a *de facto* single meta-approach (ontological and methodological). This approach was named systems theory[3].

At the same time, what developed was a demand for interconnecting diverse contributions into a unitary solution to a problem, a demand for interdisciplinarity (which was affirmed in the second half of the 20th century), declared in principle from numerous sides. Towards the end of the 20th century demands for transdisciplinarity likewise started to occur.

Definitions of Concepts

Given that individual concepts under examination in this text are often understood differently and that a lack of precision in defining them[1] occurs quite frequently, in order to achieve more clarity in further analysis, it is necessary to establish working definitions of primary concepts, as the author understands them. Depending on relationships and degrees to which collaborators are connected, how intense their collaboration is and how exactly it is they collaborate, we differentiate between three primary concepts of collaboration: multidisciplinarity, interdisciplinarity and transdisciplinarity[4–6].

Multidisciplinarity (multidisciplinary collaboration) is a problem-solving procedure which engages, parallelly and separately, all relevant practical professions and scientific disciplines with their specific skills and methods, without the exchange of specific information, ideas, theoretical and practical skills, techniques or methods, without interacting, without permeating or integrating their individual contributions.

Interdisciplinarity (interdisciplinary collaboration) is a procedure of joint, collaborative and interactive explanation of phenomena, solving of problems, creation of products or introducing new questions which, from the very start of the process, engages all relevant practical professions or scientific disciplines with their specific skills and methods, by integrating specific information, concepts, theoretical and practical knowledge, techniques and methods, with the aim to advance the thorough and comprehensive understanding or solving of problems whose solutions, due to their complexity, fall beyond the reach of a single discipline or research-practice field.

Various understandings of transdisciplinarity have been in circulation given that it is a relatively new concept which originated in the fields of different sciences and practices, and no single definition has been agreed upon yet. Its understandings range from the theory of self-organising systems and their synergy which developed a new (world)view of surpassing the limitations of primary scientific disciplines and reaching a meta-scientific level of research, through knowledge society theory which understands transdisciplinarity as a combination of inter-disciplinarity and non-disciplinarity[8], to various concepts of activities which connect certain scientific disciplines or a combination of them with various forms of art, economy and other social activities[3]. What is essential is that the concept of transdisciplinarity is more inclusive than the concept of interdisciplinarity and that, while it strives to reach a more comprehensive problem-solving synthesis in specific problem areas, it transcends the exclusivist limitations which call for the inclusion of merely experts and scientists and manages to include all relevant and interested participants from various fields of society. Such interconnectedness has the potential to draw significant attention to the complexity of the problems which are studied. It also facilitates a more direct interaction between the skill bearers (professions and sciences) and society, while, going deeper towards the core of the problem, it reaches more comprehensive, better founded and socially verifiable solutions. What follows is a working definition of transdisciplinarity.

Transdisciplinarity (transdisciplinary collaboration) is a procedure of joint, collaborative and interactive elucidation of phenomena, solving of problems, creation of products, or introducing new questions which, from the very start of the process, engages all relevant practical professions or scientific disciplines with their specific skills and methods, as well as all relevant and interested participants from various fields of society, by employing interaction and the exchange of information and knowledge between all relevant participants, with the aim to reach deeper and more comprehensive solutions to problems in specific problem areas.

Difficulties and Obstacles in Implementing Inter- and Transdisciplinarity in Practice

Despite increasing claims (proclamations) for interdisciplinarity, which are lately coupled with claims for transdisciplinarity, as well as claims that a given developmental project or research used interdisciplinary methods, true interdisciplinarity, and especially transdisciplinarity, is still achieved very rarely in practice. At best, what occurs most often is merely multidisciplinarity. Evidently, there are certain difficulties, and even obstacles, which stand in the way and are caused by specific problems[1,4]. In a nutshell, the problems we are dealing with are, as follows:

Problems due to limited disciplinary competence

The result of the Cartesian divide of knowledge and specializations in certain fields, together with holding such specializations (and sub-specializations) in high esteem (or even glorifying them), is an understanding that the competence in certain area of knowledge can only be reached if one is limited to that specific field, that is, an understanding that competence is directly related to expertise in a certain (sub)disciplinary field and that the results of such highly specialized research field will never be examined by someone from a different sub-specializa-

tion or (sub)discipline[9]. We could call this the principle of exclusive competence primacy.

If, in addition to aspects of someone's nominal competency, dealings within a specific problem area involve viewpoints which require nominal competency in other scientific fields, this is regarded as incompetency, a lack of expertise or scientific approach, charlatanry, or the like, and can potentially have adverse consequences for the person striving to surpass the limitations of their own nominal competence. This kind of understanding is reinforced by specific organizations of professions and sciences, the relevant legislation of a particular country, and even certain traditional beliefs held by representatives of various fields of knowledge which can lead individuals and/or disciplinary groups to self-censorship.

This makes researchers cautious, even fearful, of overstepping boundaries set by a specific (sub)specialisation and leaving their field of competence. This, according to such a view, entails incompetent action, that is, non-scientific and/or unprofessional, even amateurish or charlatan-like behaviour. It discourages a certain number of scientists and experts in practical professions from acquainting themselves with the methods of communication and collaboration with other disciplines/professions which may be relevant for the research or development of a specific problem. More generally speaking, these issues occur due to differences in opinions concerning worldviews, ideologies and value systems. This is no longer acceptable in today's development stage.

Problems due to protecting knowledge and power

With the development of segmented knowledge, that is, with the occurrence of specialised skills, specific groups started showing interest in such knowledge, ranging from knowledge as an existential basis for members of specific crafts or professions, to knowledge as a source of power for the ruling castes. We could track this from the development of different crafts, for instance, at the time cities started appearing in the Neolithic, or the development of the clergy in ancient Egypt, through the formation of medieval guilds in Europe, the development of capitalism in the Modern Age with its striving for monopolization, all the way to contemporary capitalism characterised more and more by basing prosperity on the possession of knowledge as intellectual capital and its usage in acquiring profit and power. Knowledge is seen as intellectual capital which needs to be protected. Capital takes the bearers of specialized knowledge under its wing by financing the development of specialist knowledge and establishing jobs (and careers) for the holders of that knowledge, obliging them to keep (to not disclose) that knowledge outside of companies. This stage of development sees the emergence of various types of „secret" knowledge which aims to protect the interests of specific groups, the emergence of, for instance, patent institutes which protect individual or group interests, as well as various bans on disclosure of knowledge outside the entrepreneurial framework. These bans are often influenced by capital upon which governing structures, in specific countries introduced even with the help of legislation, depend. Likewise, certain institutions (as well as their authorized individuals) which „represent" certain areas of knowledge, possess legislation-protected authority and power over their „own" field. What exists are, therefore, various types of „secret" and protected knowledge, various bans on the distribution of knowledge, etc., that is to say, „closed" knowledge.

All of this exerts pressure on the bearers of specific knowledge, whether they are obliged to respect the group interest (for instance, that of a guild), or they have an obligation towards their employer or an institution to protect their workplace and perhaps their career. Such bearers of knowledge who have to deal with such moral and/or material obligations are *a priori* at least partially limited in the exchange and development of knowledge in interdisciplinary collaboration.

The problem of competence required for inter- and transdisciplinary collaboration

Competence for a particular field on behalf of which someone participates in an inter- or transdisciplinary process with their stated limitations is somewhat incongruous with one of the preconditions for participating in an interdisciplinary process. Indeed, „professional competence is a necessary, but by no means sufficient requirement for interdisciplinary collaboration"[9]. The precondition for participation in interdisciplinary collaboration is precisely the competence of each of the participants for interdisciplinary collaboration: … interdisciplinary work is primarily the competence of a person, which is always a prerequisite for dialogue and collaboration to be successful beyond disciplinary boundaries. Interdisciplinarity requires the widening of scientific perception beyond the boundaries of one's own field. It is a competence which requires training and practice, and which is not simply established the moment people from different disciplines come together. For this reason, any discussion of interdisciplinarity remains optional, until steps are taken to support training for collaborative work which would connect various professions[9]. This entails, … interested, curious and open engagement with other disciplines." Therefore, „interdisciplinary competence (…), being a skill and ability, likewise requires practice and training"[9]. Because of all of the above, it is understandable that „the debate on interdisciplinary competence is young; it only emerged in the 1990s" [9], while the awareness of the need for specific knowledge as a prerequisite for the success of inter- and transdisciplinary collaboration is still underdeveloped and extremely rare.

Complexity problems

The need for inter- and/or transdisciplinary collaboration is proving to be a necessity, especially when we are faced with highly complex problems[4]. According to the definition[6], „complexity is a property of a given whole to be composed of however small a number of mutually interacting, heterogeneous, mutually irreducible and therefore possibly more or less contradictory, while at the same

time inseparable and possibly also interdependent, constituents, which is essential for the existence of that whole"[3]. Complexity can in principle be a. „complexity in itself", simply due to the objective irreducibility of the constituents to each other or b. „complexity in the eye of the beholder" based on their perceptive intention or their undercapacity due to a too narrow a viewpoint caused by disciplinary limitations.

The result of interdisciplinary collaboration should be a whole integrated from various components, which is in itself characterized by complexity, and therefore also irreducibility to individual constituents. In order to achieve this, participants of interdisciplinary collaboration need to be motivated to create the results of their collaborative work as a whole, which, in principle, is always complex, as difficult as it may be for many to perceive it integrally in the end. But precisely this integration is the creation of new knowledge or values that would not exist without that integration, which is both the original goal and the meaning of inter- and/or transdisciplinary collaboration. This is a potential difficulty for a number of participants unaccustomed to such practices or ideologically opposed to each other by previous indoctrination.

Methodological problems

Certain specific segments of knowledge, professions and disciplines, in the process of their development, also invent specific methods of work and research. In academia, it is the very use of certain methods which forms one of the criteria of determining whether a work is scientific or not. During the development of modern science, the Galilean principle of scientific objectivity has long dominated the elimination of any subjective observations other than those based on measurement, either physical or statistical. Quantitative methods and criteria have been developed in the name of scientific objectivity, so the results are achieved and published primarily in the form of quantitative accounts.

For a long time, this has especially hampered the humanities and social sciences and stopped them from being accepted as scientific at all, because of the fact that within their problem area they often take subjective experiences, evaluations and conclusions as their starting point. It was primarily the humanities, but also some of the social sciences, which have developed systems of qualitative research methods and evaluation criteria for research in their fields, the results of which are not always easy or even possible to ultimately present in the same way as those disciplines do which use quantitative methods.

One of the examples of methodological problems in interdisciplinary, and especially in transdisciplinary collaboration, is precisely the problem of confronting qualitative and quantitative methods and their results. This is why the problem of synthesizing the results, that is, of the presentation of interdependencies and the influence of certain aspects that are dealt with in various disciplinary/professional fields, often remains unsolved. There are various attempts, most often attempts of using the

„fuzzy"[3] approach to present the results of qualitatively oriented research/development in the form of quantified results, for instance, evaluation scales and the like, or qualitative interpretations of results achieved by quantitatively-oriented research.

When we connect work and results, it is optimal to connect methods as well, for example by trying to quantify qualitatively expressed attitudes with the quantitative attitudes of another participant, to connect „objective facts" with subjective interpretations. This is certainly one of the difficulties present in collaboration and linking the results of joint work efforts.

Problems caused by differences in cultural traditions

Certain historical and cultural traditions also influence the understanding and development of science[9]. Differences between them, and especially the lack of knowledge and understanding of these differences, can create difficulties and even obstacles for inter- and/or transdisciplinary collaboration. In this regard, and due to the development of world globalization, the concept of intercultural competence is emerging, which is increasingly important in all forms of collaboration in science and practice, especially in transdisciplinary collaboration between scientists, experts and interested non-professionals.

Guidelines for the Development of Interdisciplinary and Transdisciplinary Practice

In order to achieve true interdisciplinarity and/or transdisciplinarity, it is possible to define a number of basic, most general guidelines:

- Proactive action should lead scientists, experts in various fields and interested non-professionals to accept the view that certain problem areas are in principle inter- and/or transdisciplinary in nature and that they should, and can only be solved with the help of inter- and/or transdisciplinarity[4]. It is possible to determine (assume) the character and level of complexity of the problem in each individual case and thus determine the inter- and/or transdisciplinary structure of the required participants from different disciplines and interests in specific problem-solving situation.

- Fruitful inter- and/or transdisciplinary collaboration requires openness in the exchange of information and knowledge. If, due to obligations to financiers, power-players or institutions, there are certain *a priori* limitations related to the possession of knowledge, then, when planning interdisciplinary collaboration, it is necessary to determine these limitations as well as mutual obligations of all participants in advance, in order to assess the feasibility of accomplishing joint goals up to a satisfactory level of viability and cost-effectiveness. If necessary, efforts should be made to define the levels of free in-

formation flow through state and sub-state regulations, as well as company and institutional statutes and/or regulations, in order to achieve the required level of openness between individual participants in inter- and/or transdisciplinary collaboration.

- In each planned venture of inter- and/or transdisciplinary collaboration, necessary levels and structure of knowledge or competences[9] of each individual participant should be determined in advance, depending on their intended role in the process. This entails: a. appropriate specific disciplinary knowledge and competencies; b. sufficient general (prior) knowledge of inter- and/or transdisciplinary collaboration; c. sufficient knowledge of other individual participants in the process with which each participant collaborates directly, that is, on the problems and methodology of their discipline; d. sufficient knowledge about the forthcoming process and its structure, about the roles of the participants in the process and the rules of mutual collaboration. In addition to determining the structure of the knowledge required from participants in each case, the interested public should be proactively provided with information on the benefits and/or necessity of interdisciplinary collaboration and specific types of knowledge for its implementation.

- In order for the processes of inter- and/or transdisciplinary collaboration to be successful, it is necessary, in general, to theoretically and methodologically develop general rules of collaboration, coordination and ways of resolving conflicting attitudes and synthesizing research/development results, and in specific cases such rules should be set in advance.

- In order to achieve the permeation of contributions (rather than a set of separate contributions) of diverse (sub)disciplines and professions involved in the same task/problem/process, it is necessary to start from a common plan of the process, establishing the role of individual participants in the process, as well as the rules of mutual collaboration and electing the coordinators of the entire process. In a process of this kind, it is necessary to adjust one's own plan and method of research or development to the common plan and methods of the process. This presupposes *a priori* acceptance, with conviction, of such collaboration and the necessary level of understanding of issues and methods of other participants. This entails informing each other about the intentions of individual participants and looking for a „common denominator" while defining the problem and methods of solving it.

- Given the differences in specific methods used by participating disciplines and practical professions, during the process of inter- and/or transdisciplinary collaboration in which different „worlds" come together, it is necessary to be willing to accept the methods of each other's disciplines outside the knowledge and disciplinary competence of individu-al participants, that is, to be mutually willing to combine methods. Knowledge and application of systems methodology can also successfully contribute to this[3].

- Given the possibility of considerable differences in the level of knowledge of individual participants in the case of transdisciplinary cooperation, it is necessary that participants with a higher level of knowledge, that is, scientists and professional practitioners, approach collaboration unprejudiced towards interested non-professionals or their organizations and provide them with sufficient information which would enable them to be actively involved throughout the entire process.

- The complex process of inter- and/or transdisciplinary collaboration requires constant coordination of diverse contributions. It is possible through a. the „classical" method of determining one subject (individual or smaller group) responsible for coordination, or through b. a method such as concurrent engineering[10] where, within the „dynamic network,"[3] everyone permanently participates in mutual coordination, but still through the established (technical) coordination centre. Participants in the process should either a. accept the coordination of one subject, or b. permanently actively participate in joint coordination. In doing so, the responsibility of individual participants can be graded on the basis of different weights of significance within specific components of the whole.

- A necessary precondition for successful development of complex processes of inter- and/or transdisciplinary collaboration, especially for the possibility of permanent information exchange between all participants, the coordination during the entire problem-solving process, as well as successful presentation and implementation of results, is an appropriate level of technological equipment and skills, especially with regard to information technology.

- For successful interdisciplinary – and especially transdisciplinary – collaboration which involves scientists, practitioners and interested non-experts, for deeper its understanding and possible understanding between participants, it is necessary to take into account possible differences in cultural traditions between individual participants from the very start of the process.

In addition to implementing the above general guidelines for the development of inter- and/or transdisciplinary collaboration, in order to equip the participants with necessary levels of (prior) knowledge and skills, to achieve the necessary mutual exchange and coordination and finally integrate contributions into a coherent whole or synthesis of results, what is necessary above all is for each and every participant to be motivated. We could say that all of this is a part of a new general culture of scientific research and solving practical problems, one characterized not by closedness but by openness, not by competition but by collaboration.

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INTERDISCIPLINARNOST I TRANSDISCIPLINARNOST – PROBLEMI I SMJERNICE

SAŽETAK

Interdisciplinarna suradnja sve je nužnija za postizanje novih znanstvenih spoznaja i za praktično rješavanje složenih problema, a u zadnje su vrijeme sve češći i zahtjevi za transdisciplinarnom suradnjom. U praksi, međutim, često izostaje njihova istinska provedba, već se provodi tek multidisciplinarna suradnja. Za istinsko provođenje inter- i/ili transdisciplinarne suradnje postoje određene poteškoće i zapreke: problemi ograničenja disciplinarne kompetencije, problemi uslijed zaštite znanja i moći, problem kompetencije za inter- i transdisciplinarnu suradnju, problemi složenosti, metodološki problemi i problemi uslijed razlika u kulturalnim tradicijama. Potrebno je usvojiti jasne opće definicije pojmova multidisciplinarnosti, interdisciplinarnosti i transdisciplinarnosti, definirati i provoditi opće smjernice za razvoj interdisciplinarne i transdisciplinarne prakse i razvijati opću novu kulturu suradnje u znanstveno istraživačkom radu i rješavanju složenih praktičnih problema.