„Analiza i Egzystencja" 60 (2022), 21–42
ISSN (print): 1734-9923
ISSN (online): 2300-7621
DOI: 10.18276/aie.2022.60-02

ARTYKUŁY

MONIKA WALCZAK
ORCID: 0000-0003-1405-8855
The John Paul II Catholic University of Lublin
email: monika.walczak@kul.pl

The interdisciplinary problem: an analysis

Słowa kluczowe: interdyscyplinarność, problem, pytanie, problem interdyscyplinarny, pytanie interdyscyplinarne

Keywords: interdisciplinarity, problem, question, interdisciplinary problem, interdisciplinary question

Abstract

The purpose of this paper is to analyze the concept of the interdisciplinary problem using the categories of the logic of questions. The problem is seen in a logical and epistemic sense: the problem is the meaning of the question, and the question is a formulation of the problem in a particular language. Demonstrating that the interdisciplinarity of an interdisciplinary problem is understood in terms of a particular kind of complexity, I indicate the places where it is realized in the structure of the problem-question, in the problem's solution-answer to the question, and in the cognitive context of the problem solving – answer to the question. The paper also displays how an interdisciplinary problem is situated within the broader structure of an interdisciplinary research process. Thus, the paper provides not only a metatheoretical characterization of the interdisciplinary problem but also a general methodological tool for analyzing particular interdisciplinary problems.

Introductory remarks

The category of interdisciplinarity applied to science as a whole and to its various elements is a concept that characterizes an important area of doing science today. The specific concept which finds basic application in the description of interdisciplinary research is the "interdisciplinary problem". However, the term is often used in an ambiguous, unclear and vague way. Therefore, the present paper deals analytically with the category of the interdisciplinary problem by proposing a clarification of its meaning by appealing to the tools of question theory (logic). My approach is metatheoretical. Because it is useful from the methodological point of view – i.e., with regard to control and the self-consciousness of the research process – the problem is seen here in a logical and epistemic sense: the problem is the meaning of the question, and the question (an interrogative sentence) is a formulation of the problem in a particular language. This methodologically operative understanding of the problem allows us to analyze it by taking the structural elements of the question as a reference point and also reveals the epistemic structure of the problem. Methodological concepts – including the concepts of problem, question, question presuppositions and question particles – have a dual nature. They are theoretical in that they serve to describe and interpret science, and practical in that they serve as tools for obtaining research self-awareness and methodological analysis, thus improving the research process and the researcher's control over it. Thus, my analysis provides what I believe is not only the metatheoretical characteristics of the interdisciplinary problem but also a general methodological tool for analyzing particular interdisciplinary problems.

With the background presented above, the following sections attempt to state in detail what the interdisciplinarity of an interdisciplinary problem consists of. In the first section, the general concept of interdisciplinarity is introduced and the meaning elements of the category of interdisciplinarity relevant to the characterization of an interdisciplinary problem within an interdisciplinary research process are highlighted. The second section invokes the general notion of a problem and its solution as they are understood and expressed in logical semiotics with respect to their place in knowing. Then, the structure of the problem-question and its solution-answer are characterized by pointing out their elements, which are further used to analyze the interdisciplinary problem (the question's presuppositions, the question's

particle/unknown, background/context knowledge, input knowledge, desired output knowledge). The third section notes that complexity is a fundamental property of interdisciplinary problems, constitutive of their interdisciplinarity. The idea that the complexity of an interdisciplinary problem lies in the fact that it has several components and that they are of different disciplinary natures is developed in the subsequent sections of the paper, where these components are identified in the internal structure of the problem-question and the solution-answer, and in the broader structure of the knowledge context in which the problem-question is epistemically embedded. Section four examines the interdisciplinary complexity of the problem-question by analyzing the question's particle/unknown and its presuppositions in relation to two basic types of questions (decision and complementation) and their closed and open variants. The fifth section illustrates the dependency of the interdisciplinary complexity of the solution-answer on the interdisciplinary complexity of the problem-question by analyzing how it is realized for the types of questions discussed in the preceding section. The sixth section discusses the interdisciplinary complexity of the epistemic context of posing a problem and searching for its solution, since the existence of this context is one of the conditions for the interdisciplinarity of the problem itself. Section seven considers the place of the interdisciplinary problem in an interdisciplinary cognitive process defined as the process of solving such a problem. The interdisciplinary problem is seen here as an element of a larger structure, the construction and logic of which are determined by it. The conclusions recapitulate that the paper details and complements the proposals of A.F. Repko (2008) and Repko and Szostak (2020), characterizing interdisciplinary problems.

1. Interdisciplinarity and (mono)disciplinarity

The notion of interdisciplinarity has recently become a significant category in the theory and methodology of science. Many attempts to define it have been made. It is opposed to "disciplinarity", while some see it as a kind of cross--disciplinarity,[1] with disciplinarity being a kind of monodisciplinarity

[1] I use the term *cross-disciplinarity* because it is already used like this, and the term *multidisciplinarity* has already been reserved to denote a specific version of combining research from different disciplines.

(Chettiparamb, 2007). "Interdisciplinarity" is sometimes used as a collective name to describe the phenomenon of conducting research across multiple scientific disciplines and transcending a single discipline. It appears in science in different versions and is known variously as multidisciplinarity, transdisciplinarity, pluridisciplinarity, syndisciplinarity, etc. These are often variously distinguished and characterized. Differentiated ways to construct/project their meaning (i.e., postulates) are proposed and there is no consensus in understanding them (Repko, 2008, pp. 3–15; Repko and Szostak, 2020, pp. 24–28; Klein, 2010, p. 16; Poczobut, 2012).

I provisionally accept the broad meaning of the term interdisciplinarity and I use it as a collective name for various kinds of cross-disciplinarity. It is often used in the literature in this way (cf. in the title of *The Oxford Handbook to Interdisciplinarity*, 2010, 2017). However, I consider it more appropriate to treat interdisciplinarity as a variety of cross-disciplinarity and to use the latter term as the broadest category, covering all situations in which science goes beyond a single discipline and crosses the boundaries of individual disciplines to integrate research perspectives and knowledge.

Meaning elements of the category of interdisciplinarity, important from the point of view of the issues discussed in the article, are given by Allen F. Repko and Rick Szostak's definition of interdisciplinary studies (research):

> Interdisciplinary studies is a process of answering a question, solving a problem, or addressing a topic that is too broad or complex to be dealt with adequately by a single discipline, and draws on the disciplines with the goal of integrating their insights to construct a more comprehensive understanding (Repko and Szostak, 2020, p. 9).

It considers the research process as a process of solving a problem – answering a question which is interdisciplinary in the broad sense introduced earlier. Thus, this description gives a preliminary definition of the interdisciplinary problem. It also draws attention to the initiating and directing function of the interdisciplinary problem in the interdisciplinary research process. The existence of interdisciplinary problems and the need to solve them provide an important reason for crossing disciplinary boundaries and undertaking interdisciplinary research.

2. The problem and its solution

a) The logical-semiotic approach to the problem

There is no uncontroversial philosophical, logical, methodological, or semiotic definition of the problem. Many philosophical or logical dictionaries, encyclopedias, and companions neither list "problem" nor record it in the index.[2] Only a small number of logical or philosophical dictionaries, usually in general terms, state that it is concerns unsolved tasks or simply interrogative sentences, i.e., questions (*The Stanford Encyclopedia of Philosophy* (2020); *The Encyclopedia of Philosophy* (2005)). Both the term "problem" and the term "question" are understood ambiguously.

Because it is useful from the methodological point of view – i.e., with regard to control and the self-consciousness of the research process – I see the problem here in a logical and epistemic sense: the problem is the meaning of the question, and the question (an interrogative sentence) is the formulation of the problem in a particular language (Pelc, 1991, p. 292). I thus treat the question and the "problem behind it" as a kind of speech act (cf. Searle, 1969, 1979; Cross and Roelofsen, 2020). Being primarily a mental act, the act of asking a question can be expressed in various language forms. If you have a problem, you should properly express your intention to ask a question. To say that the question is a representation of the problem suggests that it exists before it is given linguistic form.

Problems or questions are not independent units of knowledge, but together create knowledge with solutions or answers. Moreover, stating an adequate problem is itself already dependent upon previously acquired knowledge. The procedure of clarifying questions by means of answers and answers by means of questions assumes a specific concept of knowledge extended by questions: knowledge is more than just a set of justified true beliefs, as traditionally quoted from Plato, but is wholly composed of questions and answers. A question and an answer are elements of one and the same knowledge. Both, as elements of knowledge, have propositional content.

[2] For example: *The Routledge Encyclopedia of Philosophy* (1998); *The Stanford Encyclopedia of Philosophy* (2020); *The Encyclopedia of Philosophy* (1967, 2005).

b) The structure of a problem

The (logical and epistemic) structure of a problem consists of two parts: the unknown – expressed by the question particle/the interrogative operator – and the known – expressed by *datum quaestionis* (the data of question/the input – in terms of system theory) in the form of the question's presuppositions (Ajdukiewicz, 1974, pp. 85–86; Ziembiński, 1976, p. 157–158; cf. Brożek, 2007, p. 66). They can be true or false; consequently, they are sentences with a logical sense (Wiśniewski, 2001, pp. 20–21). When posing a problem, a scholar generally does not know whether the input she accepts is appropriate or sufficient. In addition, the input

> largely determines the variants of possible answers, as well as the form of the question itself. For these reasons, many of the problems that bother humanity today could not have been born before (Skarga, 1989, p. 39).

In other words, a question is an expression of a specific structure[3] (often) preceded by an interrogative operator (like how?, why?, or operators of place and time), consisting of a constant and a variable:

> The interrogative operator is followed by an expression in which the variables are all free variables that occur in the operator. The variables shown in the interrogative operator represent what is asked for and what is not known to the inquirer (often, but not always). Because in one and the same question we sometimes ask about several different things or events, therefore there may be more variables in the interrogative operator (Kubiński, 1970, p. 95).

The structure of the problem can also be characterized by indications of its subjective and objective sides (Skarga, 1989, p. 41). The subjective side of the problem is formed by the individual and cultural knowledge of the subject, situating the problem in a certain epistemological field, on which "the shape of the initial theses largely depends." The objective side of the problem is determined by the thematic field in which the object

[3] Approaches which hold that questions are not reducible to expressions of other syntactic categories are classified by A. Wisniewski (2001, pp. 9–10) as anti-reductionist. He also includes among such approaches the inferential erotic logic (IEL) he develops (Wiśniewski, 1995; 2001, p. 5).

of the question appears. As an intentional act, the problem is directed towards an object, even though that object is not yet precisely defined, especially at the moment it is born, because there is more in the thinking of "doubt in relation to dogmatic theorems than in the positives of the question" (Skarga, 1989, p. 37). The fragments of the thematic field do not occupy a fixed place:

> they may move in it towards the center or, contrary, towards the periphery, and then disappear completely. [...] Each new question, the sense of which has not previously been seen, even if it has not yet yielded a positive answer, enriches this field, bringing to existence a new fragment of it, and is therefore a creative act (Skarga, 1989, pp. 38–39).

As a mental response to various external stimuli (perception, conceptual thinking) and internal stimuli (emotional states), the problem also has a psychological component. Understanding the problem as a mental state, Jan Doroszewski (2001, p. 140 et seq.) distinguishes three of its elements: 1) a fragment of starting (initial) knowledge, considered insufficient by the subject, 2) the subject's awareness of what she or he would like to enrich her/his knowledge (desired knowledge) with, and 3) motivation (with an emotional component) to undertake research to enrich the initial fragment of knowledge. The author calls what the subject wants to find by solving the problem the *explorandum* (desired knowledge) and what is found as a result of its solution the *exploratum* (knowledge actually obtained). When the subject solves the problem, i.e., accepts one of the initial sentences to be true, it becomes the *exploratum* of the problem. It can be expressed in the form of one or more alternative sentences/propositions that are more or less general. In the case of an attempt to achieve total certainty, only a single statement/proposition can be a satisfactory *explorandum*. When such certainty is not possible or required, a "group of alternative sentences/propositions with possible degrees of probability" is sufficient. A problem whose *explorandum* consists of a single statement/proposition of a narrow range is called a sharp problem by the author and is distinguished from fuzzy problems whose *exploranda* have a wide range of meaning and are composed of several alternative statements/propositions.

3. The interdisciplinary problem and its features (complexity)

a. Definition

In their *Interdisciplinary Research: Process and Theory*, A.F. Repko and R. Szostak, referring to Ch. Myers and C. Haynes (2002), define the interdisciplinary problem/question (in the context of teaching how to do interdisciplinary research):

> It should be open-ended and too complex to be addressed by one discipline alone, it should be researchable, and it should be verified using appropriate research methods (Repko, 2008, p. 344; cf. 145, 157; cf. Repko and Szostak, 2020, p. 84).

Because the definition is formulated in the context of developing a student's ability to ask an interdisciplinary question, it is formulated normatively, in the form of the criteria (rules) that should be fulfilled by a good interdisciplinary question. Additionally, it is noted that subsequent steps in the research process may require the researcher to revisit the statement of the problem (question) and modify it in some way (Repko, 2008, p. 145; Repko and Szostak, 2020, p. 86). At first sight, of these three criteria (features) of an interdisciplinary problem, the first strictly refers to interdisciplinarity, while the other two are basically features – conditions imposed on problems in general. The first criterion refers to the openness and complexity of interdisciplinary problems that cannot be taken up or asked (formulated) by one discipline, requiring materials and tools from at least two different disciplines to be raised. Neither the (correct) understanding of problems of this kind nor the setting and formulation of such problems is possible if one has only the point of view and approach of one scientific discipline.

An analysis of how Repko understands the next two criteria shows that these criteria also have an important connection to interdisciplinarity. The second criterion, which states that the interdisciplinary problem should be researchable, does not mean that it needs to be researchable at all, but that it is supposed to be researchable in an interdisciplinary sense, i.e., "it is the focus of two or more disciplines" and "there is a gap in attention to a problem beyond one domain" (Repko, 2008, p. 144; Repko and Szostak, 2020, p. 85). The problem "can be resolved only by taking subsequent steps in the interdisciplinary process" (Repko, 2008,

p. 157; Repko and Szostak, 2020, p. 98).[4] The third criterion for a good interdisciplinary question is analogous to the general condition for correct (rational) questioning. i.e., the condition of decidability. It holds that the question should be resolvable, i.e., there should be an effective way of justifying the truthfulness/logical value of one of the possible answers to it. Although Repko writes about the decidability of the questions and not the answers to them, it is actually a matter of deciding which statements are answers to the questions. The understood justification is the use of appropriate (i.e., interdisciplinary) research methods.

The sense given to these three properties (criteria) of interdisciplinary problems ultimately lies in their complexity, which generally consists of combining elements from at least two different disciplines at the level of posing a problem, seeking a solution, and justifying it. I will therefore address the problem of their complexity as an essential property in their understanding. The issues and characteristics of the interdisciplinary problem fall within the framework of a structural approach (i.e., the trinity of genesis, structure, and function) if interdisciplinary complexity is the main feature of the interdisciplinary problem, its solution, and justification.

b. The complexity of interdisciplinary problems

One way to characterize the complexity of an interdisciplinary problem is in the context of the theory of systems.

> In our context, complexity can be defined as the study of the behavior of systems. A system is any group of interacting components or agents around which there is a clearly defined boundary between the system and the rest of the world, but also clearly definable inputs from the world and outputs to the world that cross the boundary (Boyd, 2006, p. 27). As applied to interdisciplinary research, complexity means that the problem has several components and that each component has a different disciplinary character. [...] Examples of complex questions include these: What is consciousness? What is freedom? What is a family? What does it mean to be human? Why does hunger persist?

[4] Question-answer/problem-solving processes can be conceptualized as interrogative inquiries in the sense explained and studied in papers by J. Hintikka (for a survey, see Hintikka, Halonen and Mutanen 1999a).

> Admittedly, these problems are so fundamental and complex, requiring sophisticated analysis from so many disciplines (Repko, 2008, p. 152; cf. Repko and Szostak, 2020, p. 94).

The intuition of the complexity of an interdisciplinary problem lies in the fact that it has several components and that due to its different disciplinary nature it can be developed by attempting to identify these elements: a) in the structure of the problem, that is, the question; b) in the problem solution-answer to the question; c) in the structure of the cognitive context for the interdisciplinary problem and its solution, and d) in the process (method) of searching for the answer to the question, i.e., in particular activities of the method, especially in estimating an (epistemic) value of the answer.

A.F. Repko points to several aspects of the complexity of interdisciplinary problems: a) important insights concerning the problem have been produced by at least two disciplines, and this condition makes the problem researchable; b) no single discipline has been able to explain comprehensively or resolve the problem (the one-sidedness problem or unilaterality error); c) the problem is at the interface of disciplines; and d) the problem is an unmet societal need or unresolved question (Repko, 2008, pp. 152–155; Repko and Szostak, 2020, pp. 94–95). Since the aforementioned features explain the general sense of externally characterized "interdisciplinarity" rather than the interdisciplinary, internal complexity of the problem, I will further address the missing characteristics of its internal complexity, otherwise understood as the main feature of an interdisciplinary problem.

4. Interdisciplinary complexity in the structure of an interdisciplinary problem

When we assume that a problem consists of two parts – the unknown (expressed by the question particle/interrogative operator), and the known (expressed by *datum quaestionis* (the data of question/the input) in the form of presuppositions of the question) (Ajdukiewicz 1978, pp. 155–157; Ajdukiewicz, 1974, pp. 85–86; Ziembiński, 1976, pp. 157–158; cf. Brożek, 2007, p. 66) – we can analyze interdisciplinary complexity in these two components of the problem. This structure is completed by a potential answer to the question, the obtaining of which is equal to solving the problem (Hintikka, 1999a, p. 75; 1999b, p. 120).

The type of question particle/interrogative operator used determines what the answer to the question is to be, and thus determines the nature of the interdisciplinary complexity associated with these types of questions. The questions can be either decision questions (whether-or-not questions) or complementation questions (Ajdukiewicz, 1978, pp. 157–158; Ajdukiewicz, 1974, p. 87; Ziembiński, 1976, p. 159; Brożek, 2007, p. 84). Decision questions are those that require the selection of one of a number of mutually excluding/conflicting propositions/statements, such as: "Is thinking a physical process?" These are closed questions. The answer to such a question requires a choice between the answer: "Yes, thinking is a physical process" and the answer: "It is not so that thinking is a physical process" (in short, "yes" or "no"). The presupposition of the question is trivial here: that thinking is a physical process or not (Ziembiński, 1976, p. 159; Ajdukiewicz, 1974, p. 87). The components of this presupposition are concepts from different disciplines, such as "thinking" (e.g., philosophy or psychology) and "physical process" (e.g., philosophy or physics). Clarifying these concepts and giving them a precise meaning requires referencing the theses/statements and theories (knowledge) of these disciplines as well as linking them within a more general conceptual scheme (language, linguistic rules, and especially semantic rules). Moreover, answering the question, i.e., choosing a "yes" or "no" answer, requires methods of justification typical of any of these disciplines (e.g., a method of conceptual analysis characteristic of philosophy) or some methods combining them (a combination of the method of conceptual analysis and empirical verification or the modelling of cognitive processes).

Complementation questions are those in which we are asked not to choose the only answer given, but to formulate it without reference to a "yes" or "no" answer. In the simplest case, the answer to the question to be completed will consist of filling in the appropriate phrase in the place where the question particle was put (the question particle is different from "whether" or "which of the following" in decision questions) (Ziembiński, 1976, p. 159; Ajdukiewicz, 1974, p. 87). Such complementation questions define a category of expressions that can be meaningfully put in the place of a question particle and will result in true or false answers to the question, but in any case will answer the request formulated in the question. These types of complementation questions are closed questions because they determine the scheme for answering them, consisting in filling in the gap (lacuna) created in the question after the removal of the question particle by entering an appropriate

phrase (or replacing the question unknown/the unknown of the question with a specific expression). The class of elements whose names can be inserted in the place of the unknown of the question according to what the question concerns is called the range (scope) of the unknown of the question (Ziembiński, 1976, pp. 159–160; Ajdukiewicz, 1974, p. 87). Defining the scope requires knowledge of the disciplines in which the question is answered, and identification of the specific disciplinary elements being used.

An example of such an interdisciplinary question is: "Where is the structure of the nervous system with the function of transferring (consolidating) information from short-term memory to long-term memory located?"[5] The presupposition of the illustrative quoted question is: "The function of transferring (consolidating) information from short-term memory to long-term memory is located in one of the structures of the nervous system." The presupposition (thesis) is interdisciplinary. It not only involves concepts from different disciplines (psychology, anatomy, neuroscience) but also combines levels of analysis/research of human memory: psychological and biological as well as physical and chemical (cf. Poczobut, 2012, p. 49). Moreover, this question is resolvable by combining methods from psychology and neuroscience (e.g., observation methods used in cognitive task problem solving situations, and PET or fMRI methods).

There are also complementation questions (like why? how? or what?) – e.g., "How does the memorization process work?" – which do not have a specific answer pattern for giving the answer and are thus open questions (Ziembiński, 1976, p. 161; cf. Hintikka and Halonen, 1999c, pp. 183–204). In such questions, the interdisciplinary approach works differently. The answer here is not just something that fills in one gap in knowledge. The knowledge to be filled in is much broader in its scope. In these questions, the information in the question does not include presuppositions that guide one in a precise direction to search for answers. This makes the context and background knowledge available to researchers seeking answers even more important. In the case of such complex, open questions such as: What is consciousness? What is freedom? What is a family? What does it mean to be human? or Why does hunger persist?

[5] If only very complex and wicked problems are considered problems, such a relatively simple question will not be treated as a problem, although it will not be denied interdisciplinarity.

(Repko, 2008, p. 152; Repko and Szostak, 2020, p. 94), because the questions' presuppositions are poor, the knowledge upon which the answer to the question is sought must be broad in scope and come from a number of different disciplines (input knowledge). The concepts used to formulate a question have interdisciplinary potential (e.g., concepts such as consciousness, freedom, family, human, etc.), and are interdisciplinary in the sense that, on the one hand, they are general and, on the other, they have multiple meanings, associated with different levels of understanding and different aspects of the characteristics of the objects they designate. These concepts integrate elements from different disciplines, which are distinct sections, aspects, or points of view of objects they designate (cf. Walczak, 2015).

5. Interdisciplinary complexity in the solution to the interdisciplinary problem – an answer to the question

The interdisciplinary complexity of the solution to the problem (the answer to the question) is somewhat derivative of the interdisciplinary complexity of the problem-question itself, its unknown (question particle/interrogative particle), and the data of the question (*datum quaestionis*). The range of this dependency is relativized to the type of question: closed/closed-ended questions (decision/whether-or-not questions or complementation questions) or open/open-ended questions. In the case of decision questions/whether-or-not questions, the interdisciplinary complexity of the answer is secondary to the interdisciplinarity of the question presuppositions, since the answer to such questions consists of choosing one of the alternative parts (e.g., "Yes, thinking is a physical process") that constitute the question presupposition ("Yes, thinking is a physical process or No, thinking is not a physical process"). In formulating a thesis-answer to such a question, there are no content elements (propositional content) new to the presupposition of the question. However, a new element appears in the form of an assertion of one of the selected answers. It does not, however, have an interdisciplinary character, which can be attributed to this assertion's basis in the form of reasons supporting it or arguments in its favor, as well as the process of justifying it by seeking those reasons/arguments (justification of the answer method).

Also in the case of closed complementation questions, the interdisciplinary complexity of the thesis-answer to the question is derivative of

the interdisciplinary complexity of the problem-question: the scope of the unknown part of the question, especially its data, which determines the pattern of possible answers. This applies to a proper answer to a question, i.e.,

> any statement which is obtained from the *datum quaestionis* by the substitution for the unknown of the question of a value which is in the range of that unknown (Ajdukiewicz, 1974, p. 89; cf. Ajdukiewicz, 1978, p. 159).

The proper (adequate) answer to a question can be true or false and the elements integrated within it from different disciplines are the same as those for the presupposition of the question and the answer scheme generated by it. For example, the presupposition "The function of transferring (consolidating) information from short-term memory to long-term memory is located in one of the structures of the nervous system" in the process of answering is transformed into the statement-answer: "The function of transferring (consolidating) information from short-term memory to long-term memory is located in the hippocampus" (a true answer) or "The function of transferring (consolidating) information from short-term memory to long-term memory is located in the amygdala" (a false answer). These answers integrate concepts from different disciplines. Having the theses and theories in the background helps introduce their meanings; moreover, justifying theses-answers and judging their logical value requires methods from the relevant disciplines.

As well as proper answers there are so-called improper (inadequate) answers. These are defined as answers that – while not proper – do fulfil the questioner's intentions to a greater or lesser degree (Ajdukiewicz, 1978, pp. 159–160; Ajdukiewicz, 1974, p. 89), or as answers that are different from what is demanded by the person formulating the question (Ziembiński, 1976, pp. 162–163). With this second definition, closer to the approach represented in this paper, suggesting a syntactic-semantic account of the nature of the improper answer, giving such an answer may require additional knowledge beyond the scope of the question's unknown and the question's presupposition from different disciplines.

The interdisciplinary complexity of the answer to the open question is different in character. The answer is often not a single sentence, but a more or less complex set of multiple sentences. Because the open question does not have a specific pattern for answers, and the question does not contain presuppositions that precisely identify the direction of the search for an answer,

a significant role in the search for an answer is played by the knowledge of which it is sought, i.e., the broader, multidisciplinary epistemic context of the interdisciplinary problem and its solution (input knowledge).

6. Interdisciplinary complexity in the structure of the cognitive context of solving an interdisciplinary problem (input knowledge)

The posing of the problem-question and the search for the solution-answer is performed in a specific cognitive context: the input data needed to solve the problem. Typically, in science, this context is identified with

> the body of theories within the discipline and, in particular, the body of methodological rules employed within the discipline (Brożek, 2007, p. 138).

In other words, the context is a set of theses (beliefs) and tools within which the solution to the problem and its formulation is sought, whereby, in the case of interdisciplinary problems, they belong to at least two scientific disciplines. In this sense, interdisciplinary research, solving the interdisciplinary problem, is based on disciplinary research and disciplinary knowledge. The existence of an interdisciplinary cognitive context of individual disciplines is considered a necessary condition for the resolvability of interdisciplinary problems (Repko, 2008, pp. 152–153; Repko and Szostak, 2020, p. 94).

The interdisciplinary complexity of the cognitive context for the interdisciplinary problem lies precisely in the fact that its elements – "perspectives, insights, assumptions, concepts, theories, and methods" – come from at least two disciplines and while simultaneously "focusing on the same problem create an overlapping area between them" (Repko, 2008, p. 152). In this sense, the problem is interdisciplinary, since its aspectual interpretations (meanings) are formulated by at least two disciplines that can offer, with these interpretations, some solution to it. The fact that solutions to a problem can be found in different disciplines does not necessarily constitute grounds for interdisciplinary research, but it does if

> (a) no single discipline has been able to explain it comprehensively or resolve it, or if (b) each discipline offers a more or less misleading understanding of it (Repko, 2008, p. 153; cf. Repko and Szostak, 2020, p. 95).

This is the meaning of the word interdisciplinary: comprehensive and in this sense complex, i.e., multidimensional, taking into account many aspects of the problem or phenomenon under consideration. In this way, interdisciplinarity is the opposite of unidimensionality/one-sidedness and unilateralism. As is emphasized:

> The value of using an interdisciplinary approach is that it can address complex problems in a more comprehensive way than is possible using a single disciplinary approach (Repko, 2008, p. 153; cf. Repko and Szostak, 2020, p. 95).

The interdisciplinary cognitive context of an interdisciplinary problem-question may include, on the one hand, general presuppositions about the existence and nature of the solution-answer, such as the claim that there is a solution to the problem, by which is meant a true answer to the question, the presupposition that not every answer is true, the belief that there is only one answer to the question that is correct, and the belief that the answer should be sought in a limited set, etc. (Giedymin, 1964, p. 8). These presuppositions are interdisciplinary in their generality because they are applicable to problems across disciplines and potentially to different types of problems.

On the other hand, the interdisciplinary, cognitive context for solving an interdisciplinary problem is created by knowledge from various disciplines that have already addressed the problem from their own perspective and relevant already existing interdisciplinary perspectives. If the context of discovery is taken into account – which is what we are primarily concerned with here – it consists of already existing disciplinary solutions to the problem at hand, together with theories, epistemic values, methodological rules, and their components, that create units in the form of paradigms (Kuhn 1962) or other extra-theoretical structures such as Laudan's research traditions (1977) or Lakatos' research programs (1968, 1970) operating in their respective disciplines. Concepts such as paradigms,[6] research programs, or research traditions[7] could be used to analyze the interdisciplinary cognitive context of solving interdisciplinary problems.

---

[6] In Kuhn (2001, p. 303) one of the meanings of the term *paradigm* is a model solution to a certain problem.

[7] In Laudan (1977) the concept of a problem is considered crucial in the research process.

7. The place of interdisciplinary problem in the interdisciplinary research process – the process of solving the problem

Models of the interdisciplinary research process are placed by theorists of interdisciplinarity within the problem-focused research approach (problem-based research, Mode II science, problem-solving for the life world). This approach is distinguished from traditional basic (purely theoretical) research because its aim is not only to obtain new knowledge, but first of all to solve practical problems and meet unresolved societal needs (cf. Repko, 2008, p. 154; Repko and Szostak, 2020, p. 95; Terpstra et al., 2010, pp. 516–517; Hirsch-Hadorn et al., 2010). However, examples of problems, including those provided by A.F. Repko (2008, p. 152; Repko and Szostak, 2020, p. 94), are not limited to practical problems, but also include problems belonging to basic research, such as: What is freedom? What is consciousness? etc. (cf. also e.g. Thagard, 2010). Therefore, it is important to remember that interdisciplinary problems are not only practical but also theoretical, belonging to basic research. The process of basic research is also problem-focused in the sense that problem-posing and problem-solving are the main activities that determine its course (cf. Giedymin, 1964, p. 7).

A.F. Repko and R. Szostak propose an integrated model of the interdisciplinary research process in which they distinguish between and recommend the implementation of the following stages and activities by formulating them in the form of methodological rules:

A. Drawing on disciplinary insights
   1. Define the problem or state the research question.
   2. Justify using an interdisciplinary approach.
   3. Identify relevant disciplines.
   4. Conduct a literature search.
   5. Develop adequacy in each relevant discipline.
   6. Analyze the problem and evaluate each insight or theory.

B. Integrating disciplinary insights.
   7. Identify conflicts between insights and their sources.
   8. Create common ground between insights.
   9. Construct a more comprehensive understanding.
   10. Reflect on, test, and communicate the understanding (Repko and Szostak, 2020, p. 77; Repko, 2008, p. 142).

They point out that the nonlinear nature of the interdisciplinary research process is similar to a feedback loop. It consists of the fact that the researcher should critically reflect on earlier work, which may need revisiting and is sometimes revised. It also draws attention to the overlap between the various steps of the research process, i.e., the parallel performance of the activities identified in it (Repko, 2008, pp. 142–143; Repko and Szostak, 2020, pp. 81–82).

In the interdisciplinary cognitive process, as in the monodisciplinary, problem-posing and formulation is the initial step of the research.[8] The activities making up the traditionally characterized cognitive process are: a) raising the problem-question; b) collecting data; c) formulating a hypothesis/interpretation or explanation of the data – formulating a solution to the problem-answer, and d) justifying/testing the hypothesis – problem solution. In both the traditional model and A.F. Repko's integrated model, which combines various models of the interdisciplinary research process available in the literature (Hursh et al., 1983; Klein, 1990, pp. 192–193; Newell, 2001; Szostak, 2002), the problem and its solution form the main framework of the whole cognitive process, with other activities subjected to them. In the interdisciplinary cognitive process, there are other activities in addition to those in the monodisciplinary process. These are associated with its interdisciplinary nature. A.F. Repko's and R. Szostak's formulation of the methodological rules that guide these activities identifies within each activity the distinctive disciplinary elements that create its interdisciplinary complexity: insights, concepts, theories, methods, etc.

8. Conclusions

The above considerations provide the metatheoretical description of interdisciplinary problem and its analytical scheme that can be applied to the specific interdisciplinary problems within particular interdisciplinary research. They detail and complement the proposals of A.F. Repko (2008)

[8] Some models of interdisciplinary research emphasize the specific position of an integrated interdisciplinary problem definition and theoretical framework, subsequent to a previously defined problem and monodisciplinary responses to that (cf. Menken and Keestra, 2016); taking them into account, however, does not change the central function of the problem that initiates and directs the research process.

and Repko and Szostak (2020) characterizing interdisciplinary problems in the external context of the structure of the interdisciplinary research process with the internal characterization of the problem (question) itself and its interdisciplinary complexity, the solution to such a problem (the answer to the question) and the cognitive context of solving the interdisciplinary problem. The issue of the types of potential integrative relations that occur in the structure of interdisciplinary problems, their solutions, and the cognitive context of their solution – omitted in this article – would require further analysis.

Biblography

Ajdukiewicz, K. (1974). *Pragmatic Logic*. Trans. O. Wojtasiewicz. Dordrecht: Reidel.

Ajdukiewicz, K. (1978). "Interrogative Sentences (1934/1938)." Trans. J. Giedymin. In: K. Ajdukiewicz, *The Scientific World-Perspective and Other Essays, 1931–1963* (pp. 155–164). Synthese Library, Vol. 108. Dordrecht: Springer.

Borchert, D. M. (2005). *The Encyclopedia of Philosophy* (2nd ed.). Detroit: Thomson Gale.

Brożek, A. (2007). *Pytania i odpowiedzi*. Warszawa: Wydawnictwo Semper.

Chettiparamb, A. (2007). *Interdisciplinarity: A Literature Review*. https://www.llas.ac.uk/resources/3219 (accessed January 2nd, 2015).

Craig, E. (ed.). (1998). *The Routledge Encyclopedia of Philosophy*. London: Routledge.

Cross, C., Roelofsen, F. (2020). "Questions." In: E.N. Zalta (ed.), *The Stanford Encyclopedia of Philosophy*. (https://plato.stanford.edu/archives/fall2020/entries/questions (accessed February 21, 2021).

Doroszewski, J. (2001). "Pojęcie problemu w nauce i działalności praktycznej." *Studia Semiotyczne*, 23, 39–152.

Edwards, P. (ed.). (1967). *The Encyclopedia of Philosophy* (1st ed.). New York: The Macmillan Corporation and The Free Press; London: Collier-Macmillan Ltd.

Giedymin, J. (1964). *Problemy, założenia, rozstrzygnięcia. Studia nad logicznymi podstawami nauk społecznych*. Poznań: UAM.

Harrah, D. (1998). "Questions." In: E. Craig (ed.), *The Routledge Encyclopedia of Philosophy*, vol. 8 (pp. 2–3). London: Routledge.

Hanks, P.W. (2005) "Questions." In: D.M. Borchert (ed.), *The Encyclopedia of Philosophy*, Appendix, vol. 10. 2nd edition (pp. 32–37). Detroit: Thomson Gale.

Hintikka, Jaakko. (1999). *Inquiry as Inquiry: A Logic of Scientific Discovery*. Jaakko Hintikka Selected Papers, vol. 5. Dordrecht: Springer.

Hintikka, J., Halonen, I., Mutanen, A. (1999a). "Interrogative Logic as a General Theory of Reasoning." In: J. Hintikka, *Inquiry as Inquiry: A Logic of Scientific Discovery*. Jaakko Hintikka Selected Papers, vol. 5 (pp. 47–90). Dordrecht: Springer.

Hintikka, J. (1999b). "True and False Logics of Scientific Discovery." In: J. Hintikka, *Inquiry as Inquiry: A Logic of Scientific Discovery*. Jaakko Hintikka Selected Papers, vol. 5. (pp. 115–126). Dordrecht: Springer.

Hintikka, J., Halonen, I. (1999c). "Semantics and Pragmatics for Why-Questions." In: J. Hintikka, *Inquiry as Inquiry: A Logic of Scientific Discovery*. Jaakko Hintikka Selected Papers, vol. 5 (pp.183–204). Dordrecht: Springer.

Hirsch-Hardon, G., Pohl, C., Bammer, G. (2010). "Solving Problems through Transdisciplinary Research." In: R. Frodeman, J.T. Klein, C. Mitcham (eds.), *The Oxford Handbook of Interdisciplinarity*, 1st ed. (pp. 431–452). Oxford: Oxford University Press.

Hursh, B., Haas, P., Moore, M. (1983). "An interdisciplinary model to implement general education." *Journal of Higher Education*, 54(1), 42–59.

Keestra, M., Menken, S. (eds.). (2016). *An Introduction to Interdisciplinary Research. Theory and Practice*. Amsterdam: Amsterdam University Press.

Klein, J.T. (1990). *Interdisciplinarity: History, Theory and Practice*. Detroit: Wayne State University Press.

Klein, J.T. (2010). "A Taxonomy of Interdisciplinarity." In: R. Frodeman, J.T. Klein, C. Mitcham (eds.), *The Oxford Handbook of Interdisciplinarity* (pp. 15–30). Oxford: Oxford University Press.

Kubiński, T. (1970). *Wstęp do logicznej teorii pytań*. Warszawa: Państwowe Wydawnictwo Naukowe.

Kubiński, T. (1980). *An Outline of the Logical Theory of Questions*, Berlin: Akademie-Verlag.

Kuhn, T.S. (1962). *The Structure of Scientific Revolutions*. Chicago: The Chicago University Press.

Kuhn, T.S. (1970). "Postscript-1969." In: T.S. Kuhn, *The Structure of Scientific Revolutions*. 2nd edition (pp. 174–210). Chicago: The Chicago University Press.

Kuhn, T.S. (2001). "Postscriptum (1969)." Trans. J. Nowotniak. In: T.S. Kuhn, *Struktura rewolucji naukowych* (pp. 301–360). Warszawa: Fundacja Aletheia.

Lakatos, I. (1968). "Criticism and the Methodology of Scientific Research Programmes." *Proceedings of the Aristotelian Society*, 69, 149–186.

Lakatos, I. (1970). "Falsification and the Methodology of Scientific Research Programmes." In: I. Lakatos, A. Musgrave (eds.), *Criticism and the Growth of Knowledge* (pp. 91–196). Cambridge: The Cambridge University Press.

Laudan, L. (1977). *Progress and Its Problems. Towards a Theory of Scientific Growth*. London, Berkeley: University of California Press.

Mayers, C., Haynes, C. (2002). "Transforming undergraduate science through interdisciplinary inquiry." In: C. Haynes (ed.), *Innovations in interdisciplinary teaching* (pp. 179–197). Phoenix, AZ: American Council on Education/ The Oryx Press.

Newell, W.H. (2001). "A Theory of Interdisciplinary Studies". *Issues in Integrative Studies*, 19, 1–25.

Pelc, J. (1991). "O poznawczej roli pytań." In: J. Pelc (ed.), *Prace z pragmatyki, semantyki i metodologii semiotyki* (pp. 287–302). Wrocław: Ossolineum.

Poczobut, R. (2012). "Interdyscyplinarność i pojęcia pokrewne." In: A. Chmielewski, M. Dudzikowa, A. Grobler (eds.), *Interdyscyplinarnie o interdyscyplinarności. Między ideą a praktyką* (pp. 39–61). Kraków: Impuls.

Repko, A.F. (2006). "Disciplining Interdisciplinarity: The Case for Textbooks". *Issues in Integrative Studies*, 24, 112–142.

Repko, A.F. (2008). *Interdisciplinary Research: Process and Theory* (1st ed.). Los Angeles: Sage Publications Inc.

Repko A.F., Szostak, R. (2020). *Interdisciplinary Research: Process and Theory* (4th ed.). Los Angeles: Sage Publications Inc.

Searle, J. (1969). *Speech Acts*. Cambridge, UK: Cambridge University Press.

Searle, J. (1979). *Expression and Meaning*. Cambridge, UK: Cambridge University Press.

Skarga, B. (1989). *Granice historyczności*. Warszawa: IFiS PAN.

Szostak, R. (2002). "How to Do Interdisciplinarity: Integrating the Debate." *Issues in Integrative Studies*, 20, 103–122.

Terpstra, J.L., Best, A., Abrams, D.B., Moor, G. (2010). "Health Sciences and Health Services." In: R. Frodeman, J.T. Klein, C. Mitcham (eds.), *The Oxford Handbook of Interdisciplinarity* (pp. 508–521). Oxford: Oxford University Press.

Thagard, P. (2010). "Cognitive Science." In: R. Frodeman, J.T. Klein, C. Mitcham (eds.), *The Oxford Handbook of Interdisciplinarity* (pp. 234–245). Oxford: Oxford University Press.

Walczak, M. (2015). "Interdyscyplinarny charakter kulturoznawczego pojęcia kultury." *Człowiek i Społeczeństwo*, 39, 135–152.

Wiśniewski, A. (1995). *The Posing of Questions: Logical Foundations of Erotetic Inferences*. Dordrecht: Kluwer.

Wiśniewski, A. (2001). "Questions and Inferences." *Logique et Analyse*, 173–175, 5–43.

Zalta, E.N. (ed.). (2020). *The Stanford Encyclopedia of Philosophy*. https://stanford.library.sydney.edu.au/archives/fall2020/ (accessed February 21, 2021).

Ziembiński, Z. (1976). *Practical Logic*. Trans. L. Ter-Oganian. Dordrecht: Springer.

Note on the author

Monika Walczak – hab. PhD, associate professor at the John Paul II Catholic University of Lublin (KUL), in the Department of Methodology of Sciences at the Faculty of Philosophy. Author of the books: *Wgląd i poznanie. Epistemologia Bernarda J. F. Lonergana* [Insight and Knowing. Bernard J. F. Lonergan's Epistemology] (Lublin: Wydawnictwo KUL 2012), *Racjonalność nauki. Problemy, koncepcje, argumenty* [The Rationality of Science: Problems, Conceptions, and Arguments] (Lublin: TN KUL 2006), and over fifty articles in Polish and English. Editor and co-editor of four volumes of collective works.

Address for correspondence: Faculty of Philosophy, The John Paul II Catholic University of Lublin, Al. Racławickie 14, 20-950 Lublin, Poland.

Citation

Walczak, M. (2022). The interdisciplinary problem: an analysis. *Analiza i Egzystencja*, *60* (4), 21–42. DOI: 10.18276/aie.2022.60-02.