Philosophy of Interdisciplinarity

Studies in Science, Society and Sustainability

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Perceiving and acknowledging the existence of societal problems are indeed the first steps towards a critical-reflexive approach. However, critical reflexivity is not found in all variants of problem-oriented interdisciplinarity. The reference to problems does not necessarily involve a reflexive practice, namely an explicit reflection on problems and on how problems are produced. And it does not connote consideration of the values, underlying normative convictions, and the amalgam of metaphysical and factual aspects interlaced with a particular problem.

Shortcomings of this kind are typical of many variants of problem-oriented interdisciplinarity.[1] Many such variants advocate an instrumentalist viewpoint, signifying that, in addition to adopting a means-centred approach, they are strictly solution-oriented: The existence of, and the possibility of finding, an ultimate and benign solution is attributed to and implied by the notion of problem. Such variants presuppose a *solutionism*;[2] namely, they advocate the belief that solutions (in principle do) exist and furthermore provide a final elimination of the problem. By contrast, since there is no ultimate solution in many and the most urgent cases (e.g., global change), the critical-reflexive approach is not centred primarily on solutions. It deals with the wicked problems[3] on a deeper level. It addresses the cultural background behind the emergence of a certain problem—that is to say, the values, ontological convictions, and metaphysical presuppositions underlying the problem and its societal context. The explication of the causes of a specific problem is particularly relevant to enabling and fostering sustainable development. The point of departure of the critical-reflexive approach is the realization that, in our science-based societies, societal problems are often co-produced together with the progress of science and technology. The side effects—from asbestos and chlorofluorocarbons to nuclear waste, carbon dioxide, and the loss of biodiversity—show the inherent ambivalence of scientific/technological knowledge. The critical-reflexive kind of interdisciplinarity addresses this ambivalence. In order to contribute to thwarting new problems at their very root, critical-reflexive interdisciplinarity scrutinizes the underlying dynamics of scientific/technological advancement. In other words, emerging problems and, more fundamentally, the prevention of problems in the early phases of scientific progress are the focus.

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When interdisciplinarity is framed from such a perspective, it does "not [stand solely] for problem-solving, but [also] for a continuous process of profound self-renewal." Jantsch (1972, 102) argues that interdisciplinarity (and transdisciplinarity) should not be regarded primarily as a better means or more efficient instrument to come up with an ultimate solution to a given problem but rather as a medium of self-reflection and self-enlightenment in order to change a situation from the bottom up. Interdisciplinarity signifies a thorn in the flesh of the academy. Specifically, it challenges the interrelation between the production of knowledge and the production of problems. Therefore, the ends, goals, or purposes of sciences or scientific projects, even of interdisciplinary projects, need to be reflected and, if necessary, be changed. Jürgen Mittelstraß (1987, 155) stresses that inter- or transdisciplinarity

> should not solely be considered as a repair initiative providing a solution that is needed when problems transcend the disciplinary scope. In complementation, inter- or transdisciplinarity—understood in the right way—serves to re-gain and to recuperate the general perception capacities and the [normative] orientation of the academy.[4]

In this sense, interdisciplinarity must be seen as an art of deeper questioning aiming to change the direction and inherent structure of scientific progress.

The critical-reflexive approach in problem-oriented interdisciplinarity is for sure an ambitious endeavour which goes beyond mere problem solving—although it is highly sensitive to problems. I will outline various aspects of this approach in the next three chapters, but before doing so I will use this short "interlude" chapter to list some further shortcomings of the instrumentalist or solutionist stance dominating many variants of problem-oriented interdisciplinarity.[5] At the heart of the instrumentalist approach is the guiding ideal that appropriate means and adequate tools need to be developed. In a nutshell, problems are taken as being given; methods and means are what matter most; an ultimate solution to the given problems is feasible; values and goals cannot—and should not—be addressed by the sciences since that goes beyond the scope of scientific rationality.[6] This position is interlaced with and fuelled by traditional dichotomies that have become engraved in our conceptualization of what is typically regarded as scientific knowledge: knowledge vs. values, facts vs. norms, and is vs. ought.[7] According to this traditional view, science is expected to tell us what the case is. Science seems to produce objective, justified, and true knowledge insofar as science is based on strict methodological guidelines; draws on empirical/experimental results; refers to a body of true propositions, concepts, or theories; and holds true regardless of human intentions and desires.

Although that type of standpoint has been vigorously disputed, its central ideal that scientific knowledge is, or must be, free of trans-epistemic values[8] is still prominent—surprisingly also in the discourse on interdisciplinarity. The thesis of value-free science was explicated by Max Weber in the early 20th century, but it originates from the birth of the modern age. In the

17th century, René Descartes provided the epoch-breaking foundation of modern science when he introduced the subject/object dichotomy, or the res cogitans/res extensa divide. His dichotomy substantiated the modern idea of the self-consciousness of the autonomous subject, on the one hand, and objective, value-free, scientific knowledge about quantifiable/describable nature, on the other hand.

Related dualisms were renewed or developed by Kant, also by Hume and Moore in the 19th century, by New Kantians like Windelband and Rickert, or by Hermeneutists such as Dilthey, Droysen, or Simmel. They postulated a big difference between academic disciplines: natural sciences vs. humanities, cultural sciences, or historical sciences. The New Kantians and Hermeneutists took the natural sciences in a seemingly value-free direction. Their viewpoint served as the basis for demarcating and defining the specific character of the humanities, including some of the emerging cultural and human sciences, in terms of understanding vs. explanation, idiographic vs. nomothetic approach, history vs. nature, or culture vs. nature. But the question then is how to characterize the social sciences—which emerged in the late 19th and early 20th century—such as economics, sociology, or behavioural psychology? These fields are strongly quantitatively, empirically, and mathematically oriented and thus not all that different from the natural sciences.

Well-known precursors of such a positivist view of the natural *and* the social sciences include Auguste Comte and John Stuart Mill. Also, Emile Durkheim and Max Weber advocated, though from different angles, the ideal of value-free empirical/experimental knowledge as a guideline for social scientists. Social scientists, they believed, should copy and mimic what seems to have guaranteed the success story of the natural sciences and of physics in particular. Science per se—which includes the social sciences—is expected to provide neutral expertise that can be used in various (e.g., good or bad) ways: Scientific knowledge production, on the one hand, and the application of scientific knowledge in societal contexts, on the other hand, appear to be strictly different enterprises.

In the following, I will look briefly at some lines of criticism levelled at instrumentalist approaches.

First, the (positivist) fact/value dichotomy (or knowledge/normativity split) underlying the instrumentalist account of interdisciplinarity has given rise to waves of criticism: from schools embracing the materialist, pragmatist, and constructivist tradition, to the early debates during the founding period of the social sciences, to Robert K. Merton's later seminal work in the 1940s[9] and the positivist dispute in the 1960s, to more recent movements such as new experimentalism, social or cognitive constructivism, social epistemology, science and technology studies, or feminism. The critics argue that a (positivist or neopositivist) value-free understanding of science and of scientific knowledge is just a myth. It is too limited, too decontextualized, and too simplified to correspond to the practice of the scientific enterprise. Some critics go so far as to object to the so-called naturalistic fallacy, which

maintains that there is no transition from *Is* to *Ought*. Acknowledging a fallacy in this regard means presupposing a dichotomy between the two spheres (cp. Jonas 1984, 44). Critics argue that if such a limited understanding of scientific knowledge—and of the *Is* as a mere "fact"—were to be exposed to a deeper analysis, the fact/value dichotomy, and what was branded a fallacy, would turn out to be nothing but a circular thinking cycle or a meaningless tautology. Pragmatists in the Anglo-American tradition have objected to ascribing the fact/value dichotomy to an ontological or any other fundamental level and, in consequence, have turned it into a mere heuristic that is interlaced with the aim being pursued (Dewey 1929).

In addition to Jürgen Habermas's (1971) arguments, which were drawn up at the advent of the positivist methodology dispute in the social sciences, Hillary Putnam (2002) in *Collapse of the Fact/Value Dichotomy* articulates a more recent rejection in connection with the myth picturing science as value-free. Putnam objects to any ontological dichotomy but not to a pragmatic context-specific distinction.[10] As he notes, "the fact/value dichotomy is, at bottom, not a distinction but a thesis" that is inflated with "metaphysical" contents (ibid., 19). Essentially, it can be "defended [only] on metaphysical grounds" (ibid., 40). Therefore, we can conclude, any kind of instrumentalism—even one that purports to be anti-metaphysical—is interlaced with metaphysical presuppositions. Besides Putnam, the field of Science and Technology Studies (STS) has addressed various fact/value hybrids, boundary objects, and trading zones (Hackett et al. 2008). This field has strongly questioned these dichotomies, viewing them as mere academic constructions or normative ideals that cannot be justified by reference to the practice of the scientific enterprise.

From a descriptive perspective, the fact/value dichotomy is therefore only a delusion. Moreover, from a more normative angle, it is debatable whether the dichotomy provides orientation in the world we live in. Some scholars claim that the fact/value dichotomy should be preserved, at least heuristically, in order to guarantee action-theoretical approaches and to correlate three aspects of human action: (1) goals/intentions, (2) means/instruments, and (3) consequences/results. But is their claim based on sound arguments? It may well be the case that the opposite is true: The fact/value dichotomy might foster ignorance and blindness about what is at stake with regard to the unsustainability of late-modern knowledge societies at large.

Let us now consider, *second*, another line of criticism: the critical-materialist or transcendental-pragmatist one. Critical materialists perceive the fact/value dichotomy as the result of a societal process of erasing the value, purpose, and goal perspective. The market-driven dynamics of the technoscience-based knowledge industry induces a loss of ends—and the replacement of ends with means, methods, and algorithms. Through this process, ends and goals are eliminated, concealed, or excluded from that which counts as knowledge: They are stigmatized and devaluated as being contingent and subjective, whereas scientific knowledge or facts are deemed to be objective and based on clear evidence and truth criteria. This prevalent dichotomy is thus a result

of the market-driven dynamics of the modern age, witnessed even in the university and research system, towards a means-, method-, and algorithmic-oriented rationalization. According to Max Horkheimer, Theodor W. Adorno, and Herbert Marcuse, the "subjectivization of ends" is part of an ambivalent historical process of a formal rationalization and secularization of societies in general.

The subjectivization of ends has become institutionalized in the alienating production conditions of the capitalist economy and its leading institutions, which include contemporary, neoliberally driven universities. Critical theorists argue that the dichotomist means/ends rationality has undermined the core ideal of the Enlightenment: reason and its inherent critical potential to scrutinize and question what is given. Over the course of history, reason has been transformed and reduced to what Horkheimer branded "instrumental reason," thereby revealing the dialectic inherent in the tradition of the Enlightenment. Means/ends rationality is today becoming increasingly prevalent and governing individual, social, and institutional actions. It cements the unequal and unjust distribution of power in society at large.

In light of the tendency to lose or abandon ends and to disregard purposes, critical materialist philosophers strongly resist throwing out the baby with the bath water. They put their focus on maintaining the normative aspect of action theories while placing strong emphasis on ends, goals, or purposes and seek to re-establish and institutionalize a participatory, rational discourse on ends (Habermas 1970, 1984). They see reflection on and the potential revision of ends as being central to a rational societal as well as scientific discourse and demand that ends be deliberately defined by informed public consent via a power-free discourse among equally informed, communicative actors—unswayed by interest groups such as neoliberals or other stakeholders. Many of these ideas have been condensed in Karl-Otto Apel's and Jürgen Habermas's transcendental pragmatist *Discourse Ethics* (Apel 1988; Habermas 1993).

Third, whereas critical materialist and transcendental pragmatist philosophers uphold the possibility and the effectiveness of a rational discourse on ends, purposes, and problems, environmentalists and environmental philosophers typically take a different approach. Since the emergence of major environmental problems in the 1960s, environmentalists have perceived these pressing issues to be symptoms of a more fundamental (cultural or knowledge) crisis: of the predominant way in which society perceives, conceives, and frames nature and the societal relations to nature, including the guiding ontologies and metaphysical concepts of nature. The environmental problems cast a shadow on what the modern epoch has stylized as a core achievement: scientific knowledge about nature. The sciences themselves—the production of scientific knowledge and the instrumental shortcomings resulting from the means/ends split—are at stake here. According to environmentalists, global change problems cannot be seen as side effects of technoscientific progress that are eliminable in principle or as having been induced simply by the inappropriate application of technology by certain

stakeholders. Rather, the problems are intrinsically intermingled with the modern way of framing nature and the societal relations to nature and of conceptualizing knowledge about nature. Environmentalists have identified and branded a technomorphic way of thinking of nature—including what is prevalent in the instrumentalists' account—as the central underlying source of the problems. Since scientific/technological progress can no longer be equated with societal/human progress, the Baconian age of value-free knowledge and instrumental reason comes to a close, Gernot Böhme (1993) argues. In line with the criticism raised by environmentalists, Georg Picht (1969, 80) disputes what is typically regarded as knowledge: "The present-day kind of knowledge that is interlaced with the destruction of its objects—in other words: that destroys nature in technological apparatus and in daily technical actions—cannot be considered as true." Besides criticizing Francis Bacon, Picht accuses René Descartes for his alienated view of nature and his strong ontological dualism. Like Picht, Hans Jonas questions the value-neutrality thesis, arguing that

> if the picture that the natural sciences portray of nature were the ultimate word on what is the essence of the whole world, the latter would be a value-neutral mechanical gear. […] Men would have no duty to care about nature.[11]
>
> (Jonas 1993, 44)

Arne Næss (1973) and the deep ecology movement even go so far as to posit the need for a cultural shift in the conceptualization of nature towards a perception that is linked to a kind of spiritual thinking. In sum, many environmental philosophers diagnose the origin of the environmental crisis as lying at the very beginning of the modern epoch, during the time of Bacon and Descartes with their specific materialist concept of nature as a mechanical system which became the culturally predominant interpretation: We are faced not solely with an environmental crisis but also with a cultural, societal, or scientific one.

A further point of criticism, similar to the one outlined above, is, *fourth*, articulated by Martin Heidegger as well as by phenomenologists and cultural philosophers. In his work *The Question Concerning Technology*, Heidegger argues that the instrumental and anthropological, means-oriented framing of objects of the entire world (and, therefore, of nature) is not solely central to modern technology but that this kind of thinking and framing can already be found in the sciences:

> Modern science's way of representing pursues and entraps nature as a calculable coherence of forces [and as mathematical laws]. Modern physics is not experimental physics because it applies apparatus to the questioning of nature. Rather the reverse is true. Because physics, indeed already as pure theory, sets nature up to exhibit itself as a coherence of forces calculable in advance, it therefore orders its experiments

> precisely for the purpose of asking whether and how nature reports itself when set up in this way […]. The modern physical theory of nature prepares the way not simply for technology but for the essence of modern technology. […] Because the essence of modern technology lies in *Enframing [in German: Ge-stell]*, modern technology must employ exact physical science. Through its so doing, the deceptive illusion arises that modern technology is applied physical science. This illusion can maintain itself only so long as neither the essential origin of modern science nor indeed the essence of modern technology is adequately found out through questioning.
>
> (Heidegger 1977, 21f)

For Heidegger and the phenomenological tradition, the instrumentalist approach and its technomorphic thinking have been initiated and fostered by the exact sciences: Technomorphic thinking has become crystallized in modern physics and also in modern action theories.[12] Therefore, the *Crisis* of modern science—to paraphrase Edmund Husserl—consists in the way in which the sciences approach and frame nature and humans' relations to nature: The crisis is "rooted in the abstraction by which [… science] views the life-world as just an ensemble of bodies" (Husserl 1950, Series 6, 230).[13] From Heidegger's diagnosis of "enframing" and Husserl's of "abstraction," we can conclude that, in order to change our behaviour and action today, we need to rethink our thinking and to reframe our framing of nature and humans' relations to nature. To enable such a cultural transformation, we need to take a closer look at exact science—since its conceptualization of nature also determines our understanding of nature in our life-world and our day-to-day practices concerning nature. These concepts and preconcepts strongly matter.

The above-listed four lines of critique have been articulated from a perspective "external" to the sciences. In addition, we need to consider, *fifth*, that critical voices are also raised from an "intra-scientific" perspective. These voices complement the attempt of environmentalists and phenomenologists to frame and understand nature in a different way. They argue in favour of opening avenues towards a pluralistic and more differentiated understanding of nature and of humans' relations to nature *and* of scientific knowledge. The Belgian Nobel laureate Ilya Prigogine and the philosopher Isabelle Stengers criticize the traditional exact sciences for having largely failed to acknowledge and to address nature's temporal, dynamic, evolutionary side. In their *Order Out of Chaos: Man's New Dialogue with Nature*, Prigogine and Stengers (1984) advocate a fundamental transformation in the conceptualization of nature, namely *From Being to Becoming* (cp. Prigogine 1980). Their basic objective is to facilitate an anti-reductionist and anti-mechanistic *participatory view of nature* that is based on dynamics, self-organization, temporality, instability, and complexity. Today, such a view is shared by those scholars of the environmentalist tradition who see the environmental crisis as a deeper one, namely as a cultural, institutional, and knowledge crisis.

Prigogine and Stengers argue that, since the late 1960s, the way in which nature is seen has been undergoing a structural paradigm shift which, *first*, reveals the limitations of the modern concept of nature and, *second*, enables the integration of various knowledge fragments into a novel picture of nature. At issue is also, *third*, the modern understanding of knowledge, which can be traced back to Plato's thinking. Although the criteria defining scientific knowledge have been subjects of major dispute, scholars have reached a consensus that the central criteria encompass predictability, reproducibility, testability, and explainability (cp. Schmidt 2011a, 2015a). According to Prigogine and Stengers, these criteria are now undergoing modification since they are based on mistaken assumptions about nature and the natural objects under consideration—specifically, the assumption of stability: Framing nature through the lens of stability is erroneous. To give substance to their claim, Prigogine and Stengers point to recent advancements in the theory of dissipative structures and nonlinear thermodynamics far from equilibrium and also in general to nonlinear dynamics, complex systems theories, chaos and catastrophe theory, synergetics, autopoiesis theory, fractal geometry, and the like. These interdisciplinary concepts are based on instabilities—as will be shown in Chapter 7: In nature as well as in the social sphere, instabilities turn out to prevail as the main source of self-organization and evolutionary processes. Instabilities exhibit sensitive dependence on initial or boundary conditions. This observation supports Prigogine's argument that the stability assumption made in traditional sciences is nothing but a metaphysical presupposition or a "dogma." Despite there being some rationale behind it throughout the history of science, the stability presupposition inhibited progress with regard to understanding nature in the 20th century (cp. Schmidt 2015a).

Today, instabilities prompt criticism of the well-established criteria defining (and defending) knowledge: predictability/calculability, reproducibility/experimentation, testability/confirmability, and describability/explainability. Weaker criteria are gradually replacing the rigorous requirements that previously qualified knowledge as *scientific* knowledge. A novel view of science that can be called "late modern" is emerging (Schmidt 2008a, 2011a) and may serve as an example of a critical-reflexive version of interdisciplinarity. This kind of science enables self-awareness, self-critique, and self-reflexivity. Interdisciplinarity emerges within the scientific disciplines, when and if disciplinary boundaries are transcended and societal problems are addressed in a critical-reflexive process. Framed from this angle, disciplinarity and interdisciplinarity are not mutually exclusive or contradictory but instead go hand in hand.[14]

In sum, the critical-reflexive approach of problem-oriented interdisciplinarity does not view inter- and transdisciplinarity primarily in terms of the problem–solution schema consisting of (a) goals/intentions, (b) means/instruments, and (c) consequences/solutions. It does not fall into the trap of *instrumentalism* or *solutionism* with their respective shortcomings, namely their belief that the challenges of global change and the threats to the environment

in the Anthropocene ultimately can be managed and mastered. More fundamentally, the critical-reflexive approach of problem-oriented interdisciplinarity aims to address problems on a deeper level of our culture. In the following sections, some pathways towards a critical-reflexive perspective and case studies will be presented.

Notes

1 My approach shares much with that of Becker and Jahn (2006), Jahn (2013), Frodeman (2010), Frodeman (2014), and Hummel et al. (2017).
2 This is a notion taken from Morozov (2013) but used here with slightly different connotations.
3 Consider, for instance, the definition of "wicked problems" by Rittel and Webber (1973) (see previous chapter).
4 My translation from German (J.C.S.).
5 The instrumentalist bias can also be shown for the object-, theory-, and method-oriented types of interdisciplinarity.
6 For a critique, see Latucca (2001), Holbrook (2013), and Frodeman (2014).
7 This includes what was branded the "naturalistic fallacy."
8 See Chapter 2 in this book: The thesis of value-freeness states that only epistemic values (e.g., empirical correspondence, consistency, coherence, explainability, objectivity, and fruitfulness) have to play a role in the sciences. Other (non-epistemic) values such as economic, social, religious, or personal ones must be excluded.
9 See, as a synopsis, Merton (1973).
10 Putnam (2002, 133) stresses—by referring to the ideas of Habermas—that "ethical values can be rationally discussed."
11 My translation (J.C.S.). See also Chapter 6.
12 Instrumental or means/ends rationality does not only arise through the sciences; it is also an ambivalent precondition that is highly interwoven with the sciences.
13 My translation (J.C.S.).
14 This is in line with von Hentig's (1972) approach, in which he identifies an interdisciplinarity-focused "good or sound disciplinarity."