Education and Learning in a World of Accelerated Knowledge Growth

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Edited by

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Cambridge
Scholars
Publishing

Education and Learning in a World of Accelerated Knowledge Growth

Series: European Studies in Process Thought

Edited by Franz Riffert and Vesselin Petrov

This book first published 2022

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN (10): 1-5275-8381-3
ISBN (13): 978-1-5275-8381-8

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INTRODUCTION

FRANZ RIFFERT & VESSELIN PETROV

Digitalization is rapidly interfusing our knowledge societies: the economy, culture, and administrational institutions. So, everyone will have to cope with this entirely new and challenging situation. (Bock-Schappelwein, 2018, p. iv) Or, as Ken Goldberg's AI research group from *UC Berkeley's Automation Lab* put it:

> With the increasing commoditization of computer vision, speech recognition and machine translation systems and the widespread deployment of learning-based back-end technologies such as digital advertising and intelligent infrastructures, AI (artificial intelligence) has moved from research labs to production. (Stoica et al., 2017)

The scientific-technological progress has been breathtaking, even if one doesn't side with Kurzweil's (Director of Engineering at Google) radical claim that technological change is "exponential" (2004, p. 381) and therefore "it is not the case that we will experience a hundred years of progress in the twenty-first century; rather we will witness on the order of twenty thousand years of progress" (Kurzweil, 2004, p. 382). Already today

> [w]e can search across billions of pages, images and videos on the web; mobile phones have become ubiquitous; billions of connected smart sensors monitor in real time everything from the state of the planet to our heart beats, sleep and steps; and drones and satellites the size of shoe boxes roam the skies. (Butler, 2016, p. 399)

Alfred North Whitehead, famous in his day for his three volumes of *Principia Mathematica* (written with his collaborator and former student Bertrand Russell), predicted that

> [m]odern science has imposed on humanity the necessity for wandering. Its progressive thought and its progressive technology make the transition through time, from generation to generation, a true migration into uncharted seas of adventure. (Whitehead, 1925/1967, p. 207)

The situation future generations will have to face will be very challenging for education: "[I]n the past the time-span of important change [of knowledge generation] was considerably longer than that of a single human

life" (1933/1967, p. 93); but for the first time in human history this has changed dramatically due to accelerated knowledge generation in the sciences and technologies. As a consequence, in the very near future, humankind will be confronted with all sorts of scientific-technological innovations and "accordingly our training must prepare individuals to face a novelty of conditions" (Whitehead, 1933/167, p. 93). Since traditional instruction techniques only lead to the cognitive construction of inert knowledge, radical innovations in this field are indispensable. In an effort to deal with this situation, Whitehead elaborated the basic features of such a radical new learning cycle approach (1929/1967, pp. 1–41, Riffert, 2018).

However, Whitehead also reminds us that in addition to a new teaching and learning approach, it is just as important to foster and sharpen the ability of students to integrate any actively constructed partial knowledge in a far-sighted and meaningful – i.e., valuable – way.

> You cannot be wise without some basis of knowledge; but you may easily acquire knowledge and remain bare of wisdom. … It [wisdom] concerns the handling of knowledge, its selection for the determination of relevant issues, its employment to add value to our immediate experience. This mastery of knowledge, which is wisdom, is the most intimate freedom obtainable. (Whitehead, 1929/ 1967, p. 30)

This enormous educational challenge of our times forms the background of this book, which investigates the possible role of Whitehead's process-organismic philosophy in an entirely new setting. The book is divided into four sections.

The first section deals with foundational and boundary issues. In the first chapter, Riffert and Gruber present a comparison between Whitehead's process metaphysics and Adorno's negative dialectics. Starting from an obvious accordance concerning the disastrous consequences of our current abstract-driven society, the paper deals with the interplay between empirics and scientific as well as metaphysical theories. In the final section, the position of both thinkers concerning the role of education in counterbalancing the negative consequences of our abstract-based society is sketched.

The second paper of section one presents one of Whitehead's proposed answers to our current society's obsession for output-oriented standardized testing in schools. First, Paschon, Kässmann, and Riffert sketch the current situation concerning standardized testing in many countries of the world, followed by Whitehead's view of the fatal consequences this test orientation has on the learning process and his call for autonomous schools as an answer to this dangerous situation. In the second part of this paper, the *Module Approach to Self-evaluation of School Development Processes* (MSS) will

be compared with Elinor Ostrom's eight *core design principles* (CDP) – a core concept in her approach to self-governance of the commons – and the synergetic results of connecting them will be evaluated.

In the third paper 'Indecision so Charged with Promise: Bergsonian Images of Life and Childhood', Costa Carvalho turns to a passage in Henri Bergson's book *Évolution Créatrice* and develops its educational consequences, which "contain references that, on the one hand, reclaim the creative and creating feature of childhood, while on the other hand accentuating the childlike nature of élan vital's movements".

Section two is devoted to what is probably Whitehead's most-detailed contribution to education – his three-phased approach to learning and instruction.

The section opens with Riffert presenting a detailed elaboration of an observation tool developed to allow for low-inferential observations of the different phases of a full learning cycle in science classes. Such an observation tool is indispensable for future research on the efficacy of this learning cycle approach, its further development and expansion beyond the domains of the (natural) sciences, and its implementation in teacher training.

The second paper by Kriegseisen, Hagenauer, Strahl, and Riffert presents three elaborated examples of learning cycles for science classes taken from a two-year research project on the efficiency of the learning cycle approach (Riffert et al., 2020): the periodic table of the elements, chemical bonding, and electrical appliances. It makes available some model learning cycles that can be used in the training of science teachers.

Finally, Röck and Kahn, in their article 'A Whiteheadian Process Perspective on Model-based Science Teaching' undertake a comparison between Whitehead's philosophically based ideas on learning and teaching and the model-based science teaching approach (MBT) by reference to a case study. They conclude that MBT "is an excellent approach to achieving just such creative and adaptive teaching" and add the "pedagogical reasons as to why such an approach should be pursued".

Section three deals with the interface of artificial intelligence and learning. The first chapter by Vesselin Petrov begins with a description of the functions of the teacher in process philosophy. Special attention is paid to the function of teachers as 'guardians of civilization'. Next, the chapter considers the functions of the human teacher nowadays. Here the question arises whether these functions will still be valid when artificial intelligence plays an ever-more important role in the process of education and learning. To answer this question, some basic ideas of machine learning and machine teaching and a broader definition of machine teaching are considered. Next, the topic of how education and learning will be affected (a) when AI in the

strong sense of the word enters these processes, and (b) when AI is applied for teaching humans. In this case, the function of the teacher as a guardian of civilization becomes even more important. Finally, the chapter stresses that the roots of the methodological principles of contemporary machine learning and machine teaching can be found in Whitehead's and Russell's writings on education.

Conceiving the *Personal Learning* (PL) approach as a system of systems, Mincho Hadjiski and Rossitza Kaltenborn undertake a comparison of Whitehead's process-organismic philosophy and contemporary systems theory in their paper to elaborate on their value for the necessary education transformations in our digital (big data, AI) epoch. Their analysis reveals that *Personal Learning* shows a "close congruence with a number of basic Whiteheadian concepts". As such, the authors argue that many of Whitehead's concepts – after being adapted and expanded according to the needs of big data and artificial intelligence research – can be used successfully for developing advanced personal learning systems that pay special attention to multi-modality in personalized learning.

In the third paper of this section, Roland Cazalis first discusses the importance of learning and teaching for our understanding of human nature: since humans are evolving beings, learning and teaching must be constantly re-adapted. This is particularly true for the digital age since the high speed of our cultural transition carries the danger that the new generations will be taught obsolete material. To meet this demand, Whitehead's ideas on learning and teaching are presented and analysed by referring to recent results from brain research. It is also investigated how Whitehead's ideas on education "could orchestrate the digital age technologies dedicated to learning". Finally, the potential of Whitehead's concepts in light of a contemporary movement that advocates an integrative vision of learning is discussed.

In the fourth and final paper of section three, Rosen Lutskanov reminds readers that the concept of 'concrescence' plays a critical role in Whitehead's philosophy, and also in his cyclical learning theory. He further undertakes a creative excursion in comparing Whitehead's term 'concrescence' and Minsky's concept of 'societies of mind'. He claims that there are obvious similarities between Whitehead's and Minsky's views on the mind, memory and self-identity which allow connecting both approaches in a productive way.

In the final section (four) – Music and Aesthetics – the two papers deal with aesthetics. Helmut Maaßen, in his paper 'Musimathics? Pythagoras, Aristoxenos, and Whitehead' takes up the old discussion of the interrelationship between music and mathematics. First, he focuses on the quadrivium with its four subjects – arithmetic, geometry, music, and astronomy –

and discusses the status of each by focusing on Pythagoras, Aristoxenos, and Whitehead. He concludes that music, because of its additional empirical character, is superior to the purely abstract science of mathematics. In Whitehead's philosophy, however, both are united in the concept of an actual entity.

Finally, Lennart Posch presents a discussion of Whitehead's theory of knowledge in the context of his theories of perception and symbolism. In particular, he combines Whitehead's theory of symbolism with Susanne Langer's semiotics to shed light on the relationship between aesthetic and intellectual knowledge. He demonstrates that aesthetics is fundamental to human experience, although aesthetic and intellectual knowledge are "closely tied together, mutually intensifying or inhibiting each other" in the advanced stages of complexly organized human beings.

The editors of this collection of papers hope that this book may contribute at least a little to preventing the mistakes of the middle class of the nineteenth century.

> The prosperous middle classes, who ruled the nineteenth century, placed an excessive value upon placidity of existence. They refused to face the necessities for social reform imposed by the new industrial system, and they are now refusing to face the necessities for intellectual reform imposed by the new knowledge. … [But i]n the immediate future there will be less security than in the immediate past. (Whitehead, 1925/ 1967, p. 207)

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SECTION ONE

FOUNDATIONAL AND BOUNDARY ISSUES

CHAPTER ONE

WHITEHEAD AND ADORNO ON ABSTRACTION: EMPIRICS, SCIENCE, AND METAPHYSICS

DOMINIK GRUBER & FRANZ RIFFERT[1]

Abstract

Alfred N. Whitehead and Theodor W. Adorno can be characterized as two eminent thinkers of the twentieth century. Whitehead is known for his impressive originality in different fields of research (mathematics, logic, philosophy of science, education, metaphysics). In particular his process-organismic metaphysics is breaking down long-standing paradigmatic borders and providing a new frame for interconnecting the single (natural and human) sciences among themselves and with philosophy. Adorno, on the other hand is widely regarded as one of the leading thinkers of what has been called "Western" or "Neo-Marxism". Despite their different theoretical starting points, for example, with regard to their understanding of philosophy and science and their societal roles, this article shows that Whitehead's and Adorno's thinking converges on certain central topics. With regard to their ontological convictions, for instance, both characterize reality, and thus society, as fundamentally processual; they both explicitly reject rigid, static forms of metaphysical thinking. Thinking itself must be understood as a process that cannot be completed. Also, the processes of abstraction, according Whitehead and Adorno, have their roots at very fundamental levels of reality and have the power to have disastrous consequences for human societies. Despite the parallels elaborated in this paper, there exist, of course, clear differences as well, one of the most fundamental being that while Adorno seems to hold a vague hope for final redemption concerning the fatal consequences of abstraction, Whitehead clearly claims that there is no getting away from abstractions and their dangers for humanity and, therefore, the only hope lies in a persistent, everlasting struggle to correct abstractions in all cultures.

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Keywords

Process philosophy, Frankfurt school, abstraction, empirics, theory, metaphysics, science, education

1. Introductory Remarks

Both Whitehead and Marx, as well as the followers of each of these schools of thought, like, for instance, the Whiteheadian Pomeroy and the Neo-Marxist Adorno, have drawn attention to the disastrous consequences of abstractions on societies. Therefore, it is not surprising to see proponents of each of these two schools of thought investigating the parallels and differences between the two approaches. Two publications illustrate this tendency: Pomeroy's book *Marx and Whitehead* (2008) and Toscano's article 'The culture of abstractions' (2008).

For Marx, the abstractions of the sciences are "driving both processes of intellectual fragmentation and the alienation of people from their labor and their lived, bodily experiences" (Butler, 2016, p. 4; see also: Marx 1975, pp. 322–334; and similar: Lukács (1971), Sohn-Rethel (1978), Žižek (1989), Postone (1993)). Whitehead writes:

> It is very arguable that the science of political economy, as studied in its first period after the death of Adam Smith (1790), did more harm than good. … [I]t riveted on men a certain set of abstractions which were disastrous in their influence on modern mentality. It de-humanised industry. (1925/1967, p. 200)

In this paper the current interest in comparing Whiteheadian and Marxist approaches will be taken up and carried on by a comparison of Whitehead's and Adorno's views on abstraction and empirics as well as scientific and metaphysical theory. First, Adorno's view will be presented (2) followed by a sketch of Whitehead's philosophical process (3). Then a short comparison will be undertaken (4) and, ending this paper, a few final remarks on the implications for education will be made.

2. Adorno on Scientific Theory, Empirics, and Metaphysics

It is not easy to reconstruct the relationship between theoretical thinking, empirical research, and metaphysical considerations in Adorno's work. This is not only due to the complexity of his thinking, which is – among other things – characterized by (negative) dialectics. It is also due to the repeated

shifts in emphasis that he made over time. For this reason, the following remarks must remain somewhat cursory and incomplete. The aim is therefore to highlight only a few central aspects of Adorno's theory, especially the relationship between theory, empiricism, and metaphysics, in order to compare them in their basic structure with some considerations of Whitehead. Nevertheless, if one wants to present the overall theoretical context of certain elements or a certain relationship, the famous Hegelian question arises: Where should one begin? In order to put it as simple as possible, we start with Adorno's well-known thesis that contemporary society is a processual (re)producing but "antagonistic totality" nevertheless (Adorno, 2003a, p. 274, translated by DG).

2.1 Social Totality, Theory, and Empiricism

In principle, Adorno does not conceive of the social as a rigid structure. On the contrary, society is to be understood – and here Adorno was inspired by Hegel[2] – as a historical process in which all elements, e.g., subjects or institutions, are 'mediated' entities. They are dependent on the total process of social reproduction. Without an awareness of social mediation – as Adorno writes,

> it is impossible adequately to understand any given individual situation without assigning to the part what really belongs to the whole. Just as social mediation cannot exist without that which is mediated, without its elements:

[2] Hegel's dialectical thinking is a processual one that pursues a phenomenon in its development as well as its contradictoriness, in order to unfold itself (see, for example, the introduction to the *Enzyklopädie der philosophischen Wissenschaften im Grundrisse*, Hegel, 1986, pp. 41–64). However, Adorno's dialectic differs from that of Hegel. Adorno characterizes Hegel's dialectic as "philosophy of identity" (Adorno, 2015, p. 15, translated by DG). For even though in Hegel's eyes the world unfolds in and through contradictions, in the end it tends to develop towards the 'absolute'. The 'absolute' is the unfolding, whole and general. Adorno's dialectic method, on the other hand, is a negative one that does not focus on the whole, an entity which is identical with itself. Adorno rather concentrates on the conceptless, the nonidentical, which can never be completely captured. In dissociation from Hegel, Adorno therefore writes in his main work *Negative Dialectics*: "The matters of true philosophical interest at this point in history are those in which Hegel, agreeing with tradition, expressed his disinterest. They are nonconceptuality, individuality, and particularity" (Adorno, 1973, p. 8). According to Adorno, a 'philosophy of identity' eradicates the nonidentical and therefore carries a moment of barbarism within itself.

> individual human beings, institutions, situations; in the same way the latter cannot exist without the former's mediation. (Adorno, 1989, p. 268)

However, contemporary bourgeois and capitalist society – this is how Adorno's diagnosis of society could be summarized – threatens to freeze almost completely. Its processes are merging into a totalitarian whole, into an increasingly "administered world" (Adorno, 1973, pp. 6, 281) and "integrated society" (see Adorno, 1998a, p. 46) in which individuals are increasingly comprehensively shaped and unified by social forms and society. Above all, behind this is the dynamic of accumulation of capital and the economic "valorisation of value" (Marx & Engels, 1964, p. 167, translated by DG), which – and here Adorno refers to Marx's *Critique of Political Economy* (1970) – exploits the individual and degrades them to an 'alienated' being. In the perspective of capital, the individual is just a means of production, not a purpose itself. "The whole business keeps creaking and groaning on, at unspeakable human cost, only on account of the profit motive and the interiorization by individuals of the breach torn in society as a whole" (Adorno, 1989, p. 272). However, this social analysis must not be hypostatized. Even if Adorno assumes that the path to a "liberated" or "reconciled" society, "in which the many could exist together peacefully and without danger" (Adorno, 2003b, p. 587, translated by DG), is currently blocked, for him it is the hope that at least keeps the idea of the 'better' alive. The existing society is not necessarily the way it is. Nevertheless, the present tendencies of society's development have taken on a life of their own and have taken a direction that is becoming increasingly inhuman – especially, considering the ever-more comprehensive productive forces that could, for example, eliminate poverty.

From what has been said so far, two aspects are relevant for the observation and analysis of society: (1) On the one hand, every fact must be considered in its 'mediation' with the present social 'totality'. A phenomenon can only be understood by referring to the social whole. Thus, for example, in the consideration of people's leisure time behavior – to draw on a well-known essay by Adorno (1998b, pp. 167–175) – it is impossible to ignore the function that leisure time fulfils in our society (including the reproduction of labour) and how this function shapes our everyday lives (including our habits of consumption). Theory has to be taken as primary[3], although it must always be transformed by experience. 'Traditional' social

[3] In his 'Introduction' to *The Positivist Dispute in German Sociology*, Adorno writes, "that what appears as a goal to scientific interpretation, namely fact-finding, is only a means towards theory for emphatic science. Without theory the question remains open as to why the whole enterprise was undertaken" (Adorno, 1977a, p. 18).

research methods have – if at all – an "auxiliary function" (Müller-Doohm, 2000, pp. 142–143, translated by DG) for theory. Empirical research can only examine society selectively and in "narrow parts" (Adorno 2003d, p. 358, translated by DG); (2) On the other hand, research should not stop at the facts. It should go beyond that. Sociology and philosophy must observe the social in consideration of a possible better society. Critical analysis must always be understood as a tension between the real and the utopian. This means that societies would have to be considered – as Adorno emphatically puts it – "as they present themselves from the standpoint of redemption" (Adorno, 2005, p. 247).[4]

2.2 Positivist Science vs. Critical Theory

The previous statements already indicate that Adorno rejects a form of sociology that concentrates on a "mere duplication" (Adorno 1977b, pp. 75–76) of reality. For him, a science that merely proceeds positivistically and is oriented towards the ideal of natural science changes into ideology (see Adorno, 1977b, p. 86). Such science not only disregards the possible but also stops at the mere appearances of the social, without penetrating through to the essence, to the antagonistic totality of society, conditioned by exchange and capital. Opinion research, which Adorno himself dealt with intensively during his time in the USA, can be cited here as an example. Most opinion research merely inquiries into the "necessary false consciousness" (Adorno, 1977b, p. 85) of the social actors without questioning the causes or the conditionality of the people's opinions.[5] The social demand for quantitative surveys and research already reveals something about the current societal conditions. The idea of the atomized individual, which is considered the "last unit" of a survey, expresses the current "second nature" of the human in "mass society" and the "administered world" (Müller-Doohm, 2000, p. 143).

This leads us to another of Adorno's theses: namely, the assumption that social sciences and their methods are anything but neutral. They are also

[4] In *Sociology and Empirical Research*, Adorno writes: "It [the theory] must dissolve the rigidity of the temporally and spatially fixed object into a field of tension of the possible and the real: each one, in order to exist, is dependent upon the other. In other words, theory is indisputably critical" (Adorno, 1977b, p. 69).

[5] "As soon as sociology opposes recognition of what is known as its 'fact' and remains content simply to register and order it – in so doing, mistaking the rules distilled for the law which governs the facts and in accordance with which they develop – then it has already succumbed to justification, even if it does not suspect that it has done so" (Adorno, 1977b, p. 81).

part of society and thus shaped by it. In contrast to Weber's assumption, for Adorno even the context of justification is not entirely free of values and valuations. Adorno thus rejects Max Weber's harshly urged idea "that extra-scientific interests are external to science" (Adorno, 1977a, p. 18). As indicated, which methods are used to approach a phenomenon under consideration is not irrelevant. Furthermore, it should be noted that the value problem in science is itself based on a normative premise. Because "[w]hat is referred to as the problem of value can only be constituted in a phase in which means and ends are split asunder for the sake of a functionless domination of nature in which the rationality of means advances with a constant or, if possible, increasing irrationality of ends" (Adorno, 1977c, p. 117). This means that evaluative decisions cannot be completely eradicated from the process of research. In order to prevent social research from congealing into ideology by following in an unreflective way the imposed purposes (Adorno, 1977a, pp. 59–60), (self-)reflection is needed. Furthermore – and this should have become clear through the previous explanations – sociology itself claims to be critical and value-loaded. Science does not stop at empirical facts. It also tries to uncover and criticize the badness in society, which finds expression in the suffering of individuals.[6]

This means that Adorno anchors his sociology in the pre-scientific and negative experiences of people. Negating the causes of suffering is the precondition for finding the 'better'. Adorno sums up this critical sociology, often referred to by the term 'negativity', as follows: "[T]he false, once determinately known and precisely expressed, is already an index of what is right and better" (Adorno, 1998c, p. 288). In order to get to the bottom of the 'wrong' and its causes, reconstructive interpretation is necessary. Individual phenomena are interpreted against the background of theoretical considerations. In order to do justice to the object, however, theory must not impose on it; in accordance with the idea of dialectical reconstruction, the concepts are confronted with the objects and vice versa. For this purpose, Adorno developed the method of "micrology" (Adorno, 1973, p. 407), which creates models and constellations that attempt to trace the generality, i.e., the social imprints in the individual. "Since the individual phenomenon contains the whole of society, micrology and mediation through totality act as a counterpoint to each other" (Adorno, 1977a, p. 39). Even if the resulting interpretation is always somewhat speculative, it is possible to trace the phenomena in a differentiated and precise way in order to correct theory

[6] The 'wrong' of a society can be recognized because it generates suffering. Adorno states: "The experience of the contradictory character of societal reality is not an arbitrary starting point but rather the motive which first constitutes the possibility of sociology as such" (Adorno, 1977c, p. 120).

(see Adorno, 1977a, p. 32–33). Additionally, the damage of the subjects and its reasons can be captured. Even if Adorno does not entirely reject quantifying methods, research must aim at the qualitative aspects and the 'essence' ('Wesen') of society (see, for instance, Adorno, 2003c, p. 539).[7]

2.3 The Particular, the General, and the Abstract

"Cognition aims at the particular, not at the universal", Adorno (1973, p. 329) writes. Even if the general or abstract is indispensable for thinking and everyday living, knowledge is not exhausted in conceptual and abstract thinking. Objects always have an unmediated residue, a nonidentical element that is not completely absorbed into the general or abstract concepts. Thinking that wants to force a concept and a phenomenon into a relationship of identity, as classical positivism aims to do, necessarily does violence to the object. It ignores and erases the nonconceptual. In Adorno's eyes, identifying is a mechanism of domination that does not acknowledge things in their particularity. It rather wants to manipulate and dominate the world and its subjects. It is this form of subjectivity, "the identical, purpose-directed, masculine character of human beings" (Horkheimer & Adorno, 2002, p. 26), that is the result and expression of the whole process of enlightenment and human civilization. In today's society, such thinking is dominant. It is a form of 'wrong consciousness'. In contrast, it takes a form of thinking that makes objects accessible in a self-reflexive, discontinuous, and loose way. In an emancipated society, humans would acknowledge the particular without denying generality or universality. Both are required. Adorno states that the utopian state would be "the realization of universality in the reconciliation of differences" (Adorno, 2005, p. 103).

Nevertheless, how does generality, i.e., these abstractions, come into the world? And what is its ontological status? First, it should be noted that Adorno – as the previous remarks suggest – regards abstractions as something real, as socially produced processes and categories that are able to dominate nature and people. Basically, different forms of abstraction must be distinguished. First, there are thought abstractions. They have their origins in people's conscious or unconscious mind. For example, most scientific categories belong to this type of abstraction. But for Adorno and

[7] For Adorno, the quantitative method also aims at qualitative aspects. This becomes clear when one considers studies on the authoritarian personality (Adorno et al., 1950), in which Adorno played a decisive role. Quantitative and qualitative methods were used to the same extent in these studies. Quantitative questioning attempted to uncover the unconscious and socially conditioned structures in order to be able to draw conclusions about the social whole.

other materialist theorists like Karl Marx and Alfred Sohn-Rethel, there are also real abstractions.[8] Society itself – so the assumption goes – executes abstractions. One example: The increasing division of labour and societal differentiation resulted in the fact that private labour becomes progressively abstracted from its target or target groups. People produce things but do not see the concrete goals and needs of others. Most of the time individuals produce for society in general, not for concrete persons and their properties. At the same time, work processes are becoming progressively more specialized. Here, too, an abstraction is taking place. Work abstracts from the manifold characteristics of a person and only takes on certain characteristics. In other words, the division of labour makes abstraction necessary in some way. Similarly, exchange can be seen as a real abstraction. In exchange, the actors predominantly pay attention to the exchange value. They largely disregard the use value of the object, the intentions of the counterpart, and the production process. As we will see, Adorno was particularly interested in the processes of abstraction in exchange.[9]

Another much-discussed example for 'real abstraction' is the Marxian theory of economic value or 'value-form' as he put it. Marx assumes the value-form is an abstract and real entity that is practically realized through the actions of people against the background of a complex social constellation. The value form can only arise in a capitalist society in which people privately produce goods and exchange them. In this process, the labour expended by people constitutes the 'substance' of value, which, however, only appears through market exchange (see Heinrich, 2005). We trade things because of their use value, but exchange is only possible through value, which equates goods on the basis of abstract labour. This happens without people being aware of it. Marx writes: "[B]y equating their different products to each other in exchange as values, they equate their different kinds of labor as human labor. They do this without being aware of it" (Marx, & Engels, 1964, p. 88). This means that the material world has a concrete dimension – the objects and their usability – and an abstract

[8] In his *Negative Dialectics*, Adorno affirmatively refers to Sohn-Rethel's materialist epistemology: Sohn-Rethel expresses his finding this way: There is "an abstraction other than that of thought" (1978, p. 102).

[9] Or, as Sohn-Rethel himself stated with great precision: "Wherever commodity exchange takes place, it does so in effective 'abstraction' from use. This is an abstraction not in mind, but in fact" (Sohn-Rethel, 1978, p. 25). Slavoj Žižek puts it this way: "Before thought could arrive at pure abstraction, the abstraction was already at work in the social effectivity of the market" (Žižek, 1989, p. 17, italics in the original text). Referring to Sohn-Rethel's concept of real abstraction, Toscano (2008, p. 70) said "*abstraction precedes thought*."

dimension – the values and their relations. In a capitalist society, individuals are to a large extent related to each other through the abstract category of value. This form of socialization has become hegemonic. Value has a life on its own. It is an "automatic subject" (Marx & Engels, 1964, p. 169) and thus an end in itself, which, nevertheless, dominates people's actions.

However, it should be noted that there are various theories and approaches to the question of which mechanisms or 'real abstractions' can be held as dominating contemporary societies (for an overview of the discussion, see, e.g., Kößler & Wienold, 2019). Adorno's work also provides various answers to this question. Following Lukács (1971), in their work *Dialectic of Enlightenment*, Horkheimer and Adorno (2002) focus on the moments of labour division and rationalization that are at the centre of domination. The accompanying process of increasing reification is only loosely tied to the *Critique of Political Economy*. There, domination is associated, among other things, with an increasing division of labour and necessary self-preservation and is thus located in the process of civilization as such. In his work *Negative Dialectics* as well as in other publications, Adorno especially identifies economic exchange as a reason for abstraction and social domination. Exchange equates things and people in an abstract way and neglects the particular and its qualities. "All qualitative moments whose totality might be something like a structure are flattened in the universal barter relationship" (Adorno, 1973, p. 88).[10] In Adorno's work, however, one can also find an explanation more closely related to Marx and his theory of accumulation of value or capital (see Weyand, 2001, pp. 79–82). To be able to reproduce themselves physically and psychologically, subjects must submit to capital accumulation. Supplemented by this basic Marxian consideration, it becomes clear why economic exchange – as an element of economic utilization – with all its consequences acquired such great significance. Nevertheless, the thesis of exchange as a central principle of domination exhibits a certain dominance in Adorno's work.[11]

[10] But also in *Negative Dialectics* Adorno tends to identify domination as a principle that passes from nature to humankind (see Breuer, 2019, p. 435).

[11] Adorno tends to accept exchange as the central element of domination. This is because – inspired by Lukács – he sees the commodity form and thus exchange as the historical reasons for capitalism. For Marx, on the other hand, exchange is a prerequisite for the development of the capital relation. However, it is the historically contingent phase of 'primitive accumulation' in which the preconditions were created – the concentration of property in a few hands and the 'free' worker. That made capitalism what it is today. By assuming exchange as primary, Adorno starts historically earlier in his analyses of domination. At the same time, Adorno also

This focus on exchange and the commodity form is also fundamental for Adorno's materialist critique on knowledge. In accordance with basic materialist assumptions, Adorno analysed cognition and theory formation as processes that are socially mediated. According to Adorno, social being influences not only the content but also the forms of cognition. Primarily, the commodity character takes hold of ever-more areas of society, which shapes thinking down to its deepest structures. The ubiquitous economic exchange promotes the principles of identity and abstraction as well as the exclusion of the particular. Even formal logic is affected by these social structures because logic also abstracts from particular qualities and circumstances. Among others, Alfred Sohn-Rethel (1978), who was influenced by the Heidelberg School around Alfred Weber and Karl Mannheim, affected Adorno in this context (see the correspondence between Adorno & Sohn-Rethel, 1991). Sohn-Rethel traced the roots of abstract and reifying thinking back to the ancient world. For him, it is, among other things, the mental distance from the object created by exploitation as well as by the appropriation of labour, as happened in the Greek slave societies, that made abstract thinking possible. Societal oppression is a precondition for abstract thinking because it ignores particularities. However, Adorno's relationship to Sohn-Rethel's theses remained ambivalent. Sohn-Rethel was never able to gain a foothold at the *Institute for Social Research*, partly due to Max Horkheimer's criticism of him (on Sohn-Rethel's relationship with the main proponents of *Critical Theory*, see Braunstein, 2016, pp. 79–89; Breuer, 2019, pp. 432–435).[12]

2.4 Metaphysics between Necessity and Critique

Having outlined the relationship between philosophically inspired, critical social theory and empirical research, as well as between the particular and the general as it appears to Adorno, it remains to be clarified what role metaphysics plays in Adorno's thinking. It can be stated that Adorno is, in general, ambivalent towards metaphysics (see Bertram, 2019). On the one hand, Adorno expresses criticism of metaphysical thinking and metaphysical theoretical concepts, such as those of Hegel. On the other

repeatedly emphasized that he rejects the question of a first or fundamental principle (on the ambivalent role of the exchange principle in Adorno's work, see Braunstein, 2016, pp. 271–290).

[12] According to Breuer (2019, p. 434), the bad relationship between Sohn-Rethel and some members of the *Frankfurt School* was maybe due to a different understanding of basic categories of Marx's *Critique of Political Economy* (1970).

hand, he is aware that his philosophy cannot do entirely without metaphysics. Adorno elaborates this clearly in his main work *Negative Dialectics*, in which he states in the final sentence: "There is solidarity between such thinking and metaphysics at the time of its fall" (Adorno, 1973, p. 408). What is the origin of Adorno's ambivalent attitude when it comes to metaphysics? Adorno understands metaphysics as statements and systems of statements about the "historically unchangeable" (Adorno, 2003f, p. 261, translated by DG). He rejects philosophies that postulate an abstract and perpetual 'being', such as those of Heidegger. Among other things, they contradict Adorno's dialectical thinking, which assumes that history is in a constant state of flux and that the terms used to describe society are therefore also in motion.[13] The "true philosophical determinations" of concepts can rather be "gained from the concrete objects" (Adorno, 2015, p. 26, translated by DG). Accordingly, truth always has a "temporal core" (e.g., Horkheimer & Adorno, 2002, xi). Metaphysics, a belief in unchanging matters, is thus always an identifying thinking since it places the enduring abstract above the particular, nonidentical, and changeable. That is also true for the process of enlightenment, which ultimately turns against itself by sacrificing freedom to the ever-expanding domination of nature and humankind – as Horkheimer and Adorno (2002) explain in their work *Dialectic of Enlightenment*.

However, Adorno himself cannot completely abandon metaphysics. His thinking also goes beyond the immanence of the given. Adorno strives to preserve the possibility and hope for transcendence and redemption (see Bertram, 2019, pp. 539–540). This moment is metaphysical not because it refers to something immutable – after all, for Adorno, the state of redemption is the reconciled coexistence of the different – but because it points and pushes beyond the given. This metaphysical aspect reaches deep into the contemplation and analysis of modern society because the chance of redemption also makes us look at what is given in a different way. As mentioned, the path to a liberated society is currently blocked. The Holocaust especially made it clear to Adorno to what extent injustice is possible. Emancipation is out of reach. The belief that there are historical laws of development, as Hegel and Marx thought, would rehabilitate metaphysical

[13] In his *Einführung in die Dialektik*, Adorno states, for example: "[T]here is actually nothing between heaven and earth that is simply so, but … everything that is, is actually to be understood as a moving and a becoming" (Adorno, 2015, p. 20, translated by DG).

thinking and thus domination – as exemplified by so-called 'real socialism'.[14] In Adorno's view, it is the nonidentical and, ultimately, the responsible subject that might be able to prevent further catastrophes – provided "neither the power of others, nor our own powerlessness, stupefy us" (Adorno, 2005, p. 57).[15]

3. Whitehead on Abstraction, Empirics, and Scientific and Metaphysical Theory

Whitehead focused on abstraction, empirics, and scientific and metaphysical theory as well as their interrelations. In doing so, he has drawn attention to the disastrous consequences which issue particularly from the abstractions entertained by the single sciences.

3.1 Whitehead on Science and the 'Fallacy of Misplaced Concreteness'

It is important to note from the start that Whitehead most clearly states: "You cannot think without abstractions" (1925/1967, p. 59). As soon as we use language or mathematical reasoning, the two major tools of human thinking, we are inescapably involved in abstractions.

According to Whitehead, of course, this also holds for scientific thinking since "a special science is confined to one genus of facts, in the sense that no statements are made respecting facts which lie outside that genus" (Whitehead, 1929/1978, p. 9). So the single sciences concentrate on selected aspects of concrete objects, thereby defining their specific domain of discourse, which separates them from other sciences as well as from domains of research such as philosophy, ethics, religion, and aesthetics. Therefore, Whitehead leaves no doubt that "the topic of every science is an abstraction from the full concrete happenings of natures" (Whitehead, 1938, 1968, p. 143).

In the final chapter, 'Requisites for social progress' of his book *Science and the Modern World* (1925/1967, pp. 193–208), Whitehead presents his most thorough discussion of the dangers of abstracting that underlie modern

[14] Adorno was aware of the regression in the 'east'; in *Negative Dialectics* he writes: "Materialism comes to be the very relapse into barbarism which it was supposed to prevent. To work against this is not the most irrelevant among the tasks of critical theory" (Adorno, 1973, p. 205).

[15] In this context, Adorno himself speaks of a "turn to the subject" (Adorno, 1998d, p. 193) in the course of his theoretical development.

sciences and the technologies they fuel. First, in the hands of Descartes, but much more so of his followers, the successes of the sciences of the 17th century, on the one hand, paved the way for a primitive form of a scientific-technological materialism in which nature "is a dull affair, soundless, colourless; merely the hurrying of material, endlessly, meaninglessly" (Whitehead, 1925/1967, p. 54). On the other hand, they produced the professionalism of specialists who, because of their limited abstract view, elaborated the system of false narrow abstractions, which in turn fed back to the production of increasingly specialized abstraction-dependent professionals. This process of the production of specialized professionals (in the sciences, technologies, and administration) starts in the schools with their disconnected subjects, and so schools are one of the most important and effective tools for the reproduction of the current culture of abstraction. Therefore, according to Whitehead, we are facing an eminent education problem. Taking all these components, which reciprocally reinforce each other, together, Whitehead concludes: "The world is now faced with a self-evolving system, which it cannot stop" (Whitehead, 1925/ 1967, p. 232). To give but one example, the political economy "deals with men under an abstraction; it limits its view to the 'economic man'" (Whitehead, 1925/ 1967, p. 75) with "a simplified edition of human nature" (Whitehead, 1933/ 1967, p. 94). Humans are reduced to nothing but a means of production in the economic process, which results in an "industrial slavery at the base of society" (1933/1967, p. 34) and therefore "constitutes the most massive problem of human relationships" (Whitehead 1933/1967, p. 62). Accordingly, Whitehead warns that "we must not fall into the fallacy of thinking of the business world in abstraction from the rest of the community" (Whitehead, 1933/1967, p. 98). Here Whitehead clearly sides with Marx.

> It goes without saying that political economy regards the proletarian, i.e., he who lives without capital and ground rent from labor alone, and from one-sided, abstract labor at that, as nothing more than a worker. It does not consider him, during the time he is not working. It leaves this to criminal law, doctors, religion, statistical tables, politics, and the beadle. (Marx, 1975, p. 288)

But despite the tremendous negative consequences that followed in the 19th century, and still follow today, from this reduced view of human beings, it is important to note that for Whitehead, the deeply rooted human habit of abstracting is not something entirely negative. Abstracting adds emphasis on certain thoughts, perceptions, or actions and brings these clear-cut aspects into the focus of our conscious attention from which we can "deduce a variety of conclusions respecting the relationships between these

abstract entities" (Whitehead, 1925/1967, p. 58). There is no scientific progress without such abstractions. And as long as we – the subjects – don't forget that we are dealing with abstractions and not with the concrete, living human, the risks are manageable. "You cannot think without abstractions; accordingly, it is of the utmost importance to be vigilant in *critically revising your modes* [emphasis added FR] of abstraction" (Whitehead, 1925/ 1967, 59). So Whitehead holds that we are able of criticizing and improving our abstractions.

It is exactly at this point that philosophy steps in since it is "the critic of abstractions" (Whitehead, 1925/1967, p. 59; see also Gambazzi, 1971). Therefore, we should look closer at philosophy, and particularly at metaphysics.

3.2 Whitehead on Metaphysics and its Function in Correcting Abstractions

While, as we have seen, the single sciences focus on selected aspects of concrete facts "[t]he study of philosophy [metaphysics] is a voyage towards the larger generalities" (Whitehead 1929/1978, pp. 9–10). It aims at "tentative formulations of the *utmost generalities* [emphasis added FR]" (1929/1978, p. 8) in terms of which "all *particular topics find their interconnections* [emphasis added FR]" (1929/1978, p. xii). This difference in scope is the decisive difference between the sciences and metaphysics; concerning methodology, Whitehead holds that both use the same general "logic of discovery" (Whitehead, 1925/ 1967, p. 67), which today is called the 'hypothetico-deductive method', even though "[e]very science must devise its own instruments" (Whitehead, 1929/1978, p. 11). (For arguments for this provocative claim, see Riffert & Cobb 2003, pp. 23–27; Riffert 2004 & 2012, pp. 250–255). Whitehead summarizes this hypothetico-deductive procedure in the following way

> The use of such a [metaphysical or scientific] matrix is to argue from it boldly and with rigid logic. The scheme should therefore be stated with utmost precision and definiteness, to allow of such argumentation. The conclusion of the argument should then be confronted with circumstances to which it should apply. (1929/1978, p. 9)

So, according to Whitehead, there is no difference in general method between the special single sciences and general metaphysics. Of course there are special, domain-specific instruments in chemistry, physics, biology and psychology, and so on, but these are tools for gaining factual knowledge about the (abstracted) facts in each specific domain. They

provide the empirical facts necessary for the implementation of the hypothetico-deductive logic of discovery.[16]

Whitehead characterizes his concept of metaphysics as "the endeavour to frame a coherent, logical, necessary system of general ideas" (1929/1978, p. 3) from which "true propositions applicable to particular circumstances can be derived" (1929/1978, p. 9). If the applicable propositions conform to reality, the system is confirmed; if not, it is falsified and must be modified or even completely given up.[17] As a consequence, metaphysical theories are only tentative formulations. Whitehead breaks with the traditional concepts of metaphysics that claim that metaphysical categories are products of a certain unique method leading straight to true undisputable, static, and therefore irrefutable statements. "Metaphysical categories are not dogmatic statements of the obvious, they are tentative formulations of the ultimate generalities" (1929/1978, p. 8). They must be tested and, if necessary, revised. According to Whitehead, even in the domain of metaphysics, there is no other way to the truth: "In philosophical discussion, the merest hint of dogmatic certainty as to finality of statement is an exhibition of folly" (Whitehead, 1929/1978, p. xiv). Metaphysics offers no security; its general statements can only be temporally accepted as true as they are soon shipwrecked on the cliffs of stubborn empirical facts. "Philosophy will not regain its proper status until the gradual elaborations of categoreal schemes, definitely stated at each stage of progress, is recognized as its proper objecttive. There may be rival schemes, inconsistent among themselves; each with its own merits and its own failures" (1929/ 1978, p. 8).

We will see (in section 3.3) that this common general method of discovery opens an interesting way for connecting the single sciences with an underlying metaphysical system, thereby challenging "the half-truths constituting the scientific first principles" (Whitehead, 1929/1978, p. 10).

Before we discuss this point, it is important for the purpose of this paper to look briefly at the content level of Whitehead's process metaphysics. The basic units of his metaphysics are the so-called actual occasions. These can be characterized as microprocesses which are constituted by growing together out of just formed actual entities that build the immediate past of the actual entity in the making. Whitehead coined the term "concrescence" (1929/1978, p. 7) to refer to this dynamic aspect of the growing together of

[16] This distinction between diverse science-specific instruments and the general method of research encompassing all types of science and even philosophy, aesthetics and (rational) religion may prove to be a key distinction enabling to tear down even the long-standing gap between humanities and (natural) sciences.

[17] For a detailed comparison of Whitehead's methodological position with Mario Bunge's concept of a 'scientific metaphysics' see Riffert (2004).

an actual entity. The actual entities of the immediate past concresce to form a new unity. Therefore, actual entities, in sharp contrast to Aristotle's *prote ousia* (first entity), are internally related and so truly participate in one another. The process of the biological assimilation of external elements (for instance, food) into a growing organism is probably the closest metaphor for this process. The consequence is an internal relatedness of reality.

This process of growing together, however, has an aim which consists of the realization of a specific pattern – here Whitehead speaks of "eternal objects" (1929/1978, p. 23). In order to realize a particular pattern (eternal object), the evolving actual entity cannot integrate all the elements of its immediate past; it has to exclude those elements that are incompatible with the aimed-for pattern. This exclusion of elements (other actual entities) Whitehead called "negative prehension" (1929/1978, p. 41), and is a consequence of the reaction of the evolving actual entity in order to constitute itself in a definitive consistent way.[18] In Whitehead's words: "An actual entity has a perfectly definite bond with each item in the universe. This determinate bond is its prehension of that item. A negative prehension is the definite exclusion of that item from positive contribution to the subject's own internal constitution" (Whitehead, 1929/1978, p. 41). So every actual entity mirrors its unique perspective of the reality; or, put differently, an actual entity is an abstraction of the world because it "neglects the influx of the factors omitted into the factors retained" (Whitehead, 1938/1968, p. 143). We see that abstraction – in a wider sense than abstraction in (symbolic) conscious thought – is built into the very centre of the fabric of reality. Without this subjective 'material' abstraction, there would be no actual entities at all and therefore no reality. Whitehead puts it this way

> Philosophy is the self-correction by consciousness of its own initial excess of subjectivity. Each actual occasion contributes to the circumstances of its origin additional formative elements deepening its own peculiar individuality. *Consciousness is only the last and greatest of such elements by which the*

[18] Of course, formulations such as the reaction of the evolving actual entity in order to constitute itself, or in Whitehead's words, "An actual entity is at once the subject experiencing and the superject of its experiences" (1929/1978, p. 29), sound like self-contradicting statements; but here the mathematical physicist Whitehead touches the domain of quantum physics and therefore is confronted with the problem of expressing sub-atomic processes within the constraints of subject-predicate language – a problem which also has been discussed by the quantum physicist David Bohm in his *Wholeness and the Implicate Order* (1980). Several quantum physicists have explored the relationship of their domain to Whitehead's process metaphysics: Shimony (1965), Stapp (1979, 1999, 2004, 2007), Hameroff & Penrose (1996), Malin (2002), Chew (2004), Epperson (2004), and Auxier & Herstein (2017) just to present a small selection.