

SCTCMG 2022
International Scientific Conference «Social and Cultural Transformations in the Context of
Modern Globalism»

CATEGORY OF TIME AS A CROSS-DISCIPLINARY CONCEPT
IN RESEARCH ACTIVITIES OF STUDENTS

Vera Alexandrovna Makarova (a)*

*Corresponding author

(a) Moscow Aviation Institute (National Research University), 4, Volokolamskoe shosse, Moscow, Russia, belief-
m@yandex.ru

Abstract

Time is one of the most studied and discussed, and at the same time one of the least understood categories. The paper considers a category of time as an interdisciplinary concept in the process of education of tertiary school students. During the research, the authors analyzed existing concepts of time and classified approaches explaining the nature of time. Correlation between the concepts of time with functional areas of post-graduate students during their work on their masters degree thesis, allowed revealing principal mistakes on behalf of the students, largely caused by incorrect understanding of the nature of time. A suggested classification of approaches to the nature of time will help avoid limited views of the problem of time, forming a complex understanding of the time phenomenon among the post-graduate students, thus preventing mistakes in their work on their theses. Introducing such integrated understanding of time as a cross-disciplinary category into the subject of Philosophy of Science may increase efficiency of scientific research.

2357-1330 © 2022 Published by European Publisher.

Keywords: Category of time, cross-disciplinary category, nature of time, writing master thesis

1. Introduction

Time is one of the most studied and discussed, and at the same time one of the least understood categories. Both technical sciences and humanities involve the aspect of time in their research sphere. Every branch of science uses the category of time differently, variously interpreting its nature and properties. Thus, time is undoubtedly an interdisciplinary category, which is indispensable for research in any branch.

2. Problem Statement

Complexity lies in the absence of a unifying unitary definition of time, as each branch of science tries to provide its own definition and to understand the nature of time looking through its own lens. Currently there is no exact definition of time, as it is often described through other values, which are more customary and understandable, but such a definition does not provide us with a clear understanding of what time is. It is as if we are shifting focus and are describing time through space, movement or human perception. Detailed analysis of the problem of time shows that the existing concepts and definition do not cover the whole scope of the concept of time.

3. Research Questions

We are of an opinion that in studies of the category of time, one shall remain committed to a complex approach, that is consider time as a cross-disciplinary foundational category of scientific knowledge and try to gain insight into the nature of time following various aspects provided by both technical sciences and humanities. Generalization and analysis of the existing interpretations of the nature of time will allow for a broader outlook of the problem of time and, which is more important, will help in correct formulation of question to be answered as a result of understanding the nature of time. As it is known, new things arise from comprehension, elaboration and new structural combination of existing knowledge. The results of this research are going to be of importance to post-graduate students in both STEM and humanities during their work on their theses, as the correct understanding of the nature of time will help them perform efficiently at all stages of scientific research, from data collection to presentation and defense of research results.

4. Purpose of the Study

In this study, we will attempt to generalize the main approaches to understanding time by various branches of science with the aim of presenting the complex nature of time and foregrounding the leading issues existing at the current level of development. Thus, the goal of this research is to develop a classification for approaches to understanding the nature of time; the resulting classification may be then used by master's degree students in their research work.

5. Research Methods

This study applies the procedure of classifying approaches to the nature of time and a procedure of relating concepts to functional zones of master's degree students during working on their theses. The object of this research is a total of knowledge on the nature of time, the subject of the research is to identify similar properties for the purpose of classification of approaches attempting at explaining the nature of time as a category. At it is known, writing a master degree thesis assumes performing the following functions: creative process, data collection, data analysis, presentation of information (with mandatory process organization for each of the stages listed). In this study, the authors analyzed the relation between the existing concepts of time and the above-listed functions in writing a master's degree thesis.

6. Findings

The authors analyzed existing concepts explaining the nature of time and identified the principal approaches to understanding the phenomenon of time as an interdisciplinary concept, as shown below. In this research we list only main concepts within each approach to the nature of time, as listing all the concepts is impossible within a single paper; also, compiling an exhaustive list was not an objective of our research.

6.1. Time as a measure of duration

From the moment humans invented time keeping, time at a natural level become equated with seconds, minutes and hours used to measure it. This is a substitution of concepts, as time as a concept is substituted with an interval measured by clock and expressed in common time measurement units. It is a manifestation of a quantitative approach of classical physics, according to which only measurable things exist.

As the measure of duration, time finds expression in all branches of science: temporal parameters are an integral element of physical, chemical, biological, psychological, anthropological, social, linguistic and many other phenomena. So, we are measuring the duration of certain processes or phenomena, but not the abstract time itself, as "each time interval is related to a certain process, otherwise it would not have been perceived at all" (Reichenbach, 2009, p. 24). But duration of a process or phenomenon is just a universal characteristic of time, it cannot be equalized to the objective time as it does not explain the nature of time. "I am looking at my watch and see: it is three minutes to seven. Where is time in this? Go find it" (Heidegger, 2012, p. 7).

6.2. Time as an entirety of times from the different branches of science

In our opinion, time cannot be considered in the context of a single science. The category of time embraces all the knowledge areas and exists in theoretical models and empirical generalizations of each and every scientific discipline. There are two points of view among academics: one group acknowledges existence of multiple times, such as physical, anthropological, chemical, social, literary, textual, etc.,

while another group denies such identification of times, justifying their opinion by a statement that there is only physical time expressing duration and this is the time that extends into every other discipline (Lolaev, 2015). We assume that it is impossible to reduce everything to the physical time alone. For example, the chemical time reflects reactions, which are non-specific for physics, as well as other functional features. Psychological and literary times reflect primarily not the duration of action per se, but its perception and resulting human feelings. In our opinion, the literary time serves as a complex text-forming phenomenon, bounded by the limits of its author's perspective and plot perspective (Koshevaia & Makarova, 2017).

In our opinion, only a complex analysis of time in the context of all the branches of science may provide a comprehensive description and understanding of the nature of time. By limiting ourselves to a single scientific discipline, we limit the selection of phenomena to study, their properties and characteristics, thus, limiting our understanding of the nature of time. By studying properties and characteristics of time within different disciplines, we may find regularities in process functioning as considered by various disciplines, which is of important practical value.

6.3. Time as a set of past, present and future

Division of time into past, present and future is commonplace. Basically, the very etymology of the word past (what already happened) and future (what will happen) is the same in all the European languages and is explanatory about the meaning of the words. During the evolution of philosophical and scientific thought, many thinkers, such as Plato, Aristotle, Marcus Aurelius, Augustine of Hippo, Hegel, E. Levinas came to a conclusion that past and future do not exist objectively, what exists is only a moment of here-and-now. For example, Augustine of Hippo, identifies present of the past, present of the present and present of the future, speaking of non-existence of past and future (Augustine, 2012). This idea was later developed by Heidegger (2012).

It is interesting to look at how various thinkers understand the concept of now. Aristotle (1981) stated that “now includes simultaneously the beginning of the future and the end of the past” (p. 49). Augustine of Hippo talked about the present “through which the future is diverted to become past. (Augustine, 2012) According to Aliushin and Knyazeva (2007), “now” is defined by certain events, thus it does not correspond to a moment of time, but to a time interval, and “the interval of now may be whatever long”. Levinas (2000) was of an opinion that present is a moment devoid of duration and existing at the boundary between the past and the future; at that, this moment is understood as a birth, a beginning of new.

It should be noted that there are such theories as presentism, possibilism and eternalism, which variously interpret the reality of past, present and future. Presentism accepts that only present is real; possibilism considers only past and present as real, but not future; eternalism postulates reality of past, present and future. It is also interesting to look at how the issue of relation between past, present and future is solved by followers of A-theory and B-theory, which have currency in foreign literature: the former admit reality of past, present and future, while the latter speak in such temporal categories as “before” and “after”.

Einstein postulated a unity of past, present and future reality, stating that the difference between the past, present and future is nothing but an illusion. In our opinion, time exists as an integrated whole, a total of its parts, and division of time into present, past and future is possible on condition of human perception of time, which is discussed below.

6.4. Time as a subjective human perception of reality.

From antiquity till present, philosophers and scientists have been attaching a great importance to the anthropological factor in understanding the nature of time. Thus, Protagoras' postulate "human is a measure of all things" is to a certain degree reflected in most concepts of time. Many scientists, starting from Plato, have been raising the question of whether objective time exists beyond the human perception. (Plato, 1936). As for our perception, there is only the here-and-now moment, the past and the future live only in our consciousness: one as a remembrance, another as something desired and expected.

Among ancient philosophers relating time to its subjective perception, one shall note Aristotle, Marcus Aurelius and Seneca. Augustine of Hippo was of an opinion that time is a duration of the soul, its property and thus, analyses it only within the boundaries of human perception, as something subjective. (Augustine, 2012) His ideas were interpreted and developed in philosophical concepts of the 19th and 20th centuries authored by such philosophers as Descartes, Bergson, Husserl, Kant, Hegel. So, according to Descartes, time exists in our thinking, because duration is an attribute of matter, while time is a "way in which we think of this duration" (Descartes, 1989, p. 78), Hegel understood time as a "pure form of sensuality and contemplation" (Hegel, 1975, p. 62), while Kant understood it as a "subjective condition necessary for coordination ... of all that is perceived sensually" (Kant, 1964, p. 99)

Besides, as the very process of perception and comprehension of time is linked to human thought, evaluation of properties of time related to a certain specific phenomenon includes subjective criteria: duration, speed, correlation to past or future, continuity of a process are perceived differently by different people.

6.5. Time as a measure of movement

Philosophers as far back as Parmenides, Heraclitus and Plato related time to movement and change. Definition of time as "the amount of movement with respect to preceding and subsequent" (Aristotle, 1981, p. 51), but as it was not supported by a scientific theory, it was more of a philosophical musing on the nature of time: "Movement is impossible without a location, emptiness and time." (Aristotle, 1981, p. 51). In this way he stipulated that there is no time without movement and matter. Newton also understands time as a "measure of duration determined by means of movement" (Newton, 2017, p. 80). Many philosophers and scientists tried to develop his idea, but a breakthrough took place only in the 20th century, when Einstein suggested his vision of global processes and brought space and time together to a unified space-time continuum. Later, Lorentz transformation that includes a universal constant c for the first time provided an opportunity to express time through space, namely, to measure it by means of spacial lengths. In addition to exclusively physical models that explain the nature of time, philosophers have also been developing the idea that time and movement are related. For example, Hegel also held that time is movement itself (Hegel, 1975).

Modern science understands time as objectively existing, along with other physical values, such as mass, length, width, etc. According to the Einstein's relativity theory, time serves as the fourth dimension to our three-dimensional space and forms a unified space-time continuum. Matter is moving along the time axis from the past to the future through the present moment. But, as we live in three dimensions, we are unable to see or touch the substance of the fourth temporal dimension. It is like a flat creature living in a two-dimensional world is unable to see a three-dimensional object. Such a creature may only see an impression, a flat projection of the object. Basically, just as we may live through and feel only the present moment, as an impression of time as a whole but are unable of moving along the line of time into the past or the future, as only one moment of present exists for us, while everything else is an illusion of our mind.

6.6. Time as a continuous or discrete process

Time flows, runs, drags. The feeling that time is moving from the past to the future through the present moment is natural for human perception and thus is applicable to subjective time. But what is the matter with objective time? Currently, there are two common points of view on existence of objective flow of time, forming two radically different concepts, static and dynamic ones (Levich, 2009). The static concept of time denies the phenomenon of the flow of time, while the dynamic concept accepts the objective nature of the flow of time. According to the static concept, past, present and future exist simultaneously, as frames of a film, and only one of them, corresponding to the present is in the focus of our attention, while temporal relationships are expressed through the "before-after" relations. The dynamic concept accepts existence of the time arrow and emphasizes difference between moments of past, present and future. Only present exists: past is no more here and future is not here yet. At the same time, development and succession are noted, namely, the influence of the past onto the future and formation of the new (Molchanov, 1977).

Supporters of both concepts appeared as far back as antiquity. So, Heraclitus supported the dynamic concept, while Parmenides and Aristotle supported the static one. Time either does not exist at all, or just barely exist being something ambiguous according to Aristotle (1981), while the moment of *now* he completely excluded from time modes, as time is likely not formed from *nows*.

European science *en mass* developed the static concept of time, but some individual theories of time pertained to the dynamic understanding of the time flow. In the context of the dynamic concept development, we shall name Augustine of Hippo, McTaggart (1927), Bergson (2020). Propagation of the static understanding of the nature of time through various branches of knowledge is related to appearance and wide adoption of Einstein's relativity theory, where space-time has a static nature.

As far as discussion of the static and dynamic concepts goes, one shall note existing foreign classifications. A-theory of time and B-theory of time explain relations and distinctions between past, present and future. It is accepted that the A-theory expresses the dynamic character of time, while the B-theory expresses its static character (Zima, 2019). The above classification shall not go unmentioned as it identifies such models of time as presentism (close to the dynamic concept), possibilism and eternalism (sometimes identified with static B-theories).

6.7. Time as an objective phenomenon

The problem of objectivity of time is one of so-called time paradoxes. There are two main concepts that look at the nature of time in the context of its objectivity: substantialism and relationism. Substantial concept of the nature of time understands time as an independent entity, an element of being, along with space and matter. Mach (2003) described time and space as “primal, independent variables, ...directing and regulating everything in the world” (p. 24). The same approach was followed by Democritus, Newton, Einstein, Wheeler and many other philosophers and scientists. Basically, the modern scientific world view is based upon the substantial approach that explains existing of the space-time continuum. Relational concept denies independence of time and understands time and space as a system of relations between events (elements), that is, time serves as a certain temporal characteristic of events and phenomena taking place. In other words, in the relational approach time is a “derivative from relations between elements” (Zima, 2019, p. 12). The relational concept was supported by Leibniz, Mach, Bošković, Narlikar and many others. That same Mach (2003) believed that “time and space exist in certain relations of physical objects and these relations are not just introduced by us but exist in relations and mutual dependence between phenomena” (p. 27). It should be noted that despite the idea of objectivity of time dominating in physics (due to spread of Einstein ideas based upon substantial concept of space-time), both physical and metaphysical debates on its objective nature continue.

During their work on master's degree thesis, students run into a number of difficulties due to having a low level of analytical skills and insufficient experience in scientific activities. The classification of concepts of time and their identified relations to functional areas of post-graduate students are necessary and needed for further improvement of efficiency of these students' research work. In order to study the efficiency of master's degree student activities, the following aspects of time were identified: duration, speed, linearity, subjectivity, perception of past-present-future. In our opinion, they are related to mistakes that master's students make during their work. Let us analyze several examples where understanding of time influences appearance of mistakes in scientific research activities of tertiary students.

Creative function in the process of writing a master's thesis includes a skill in generation new ideas while solving research and practical problems. The main problem for actualization of student's creative potential is a limited nature of discourse. When a master's student think linearly, their imagination is boxed inside their limited discourse, which does not facilitate the creative pursuit. That is why actualization of master's degree student creative function shall mandatory be accompanied by application of all the approaches to the problem of time, as they cover both scientific understanding of the nature of time and academic ideas, thus allowing avoiding local outlook of the problem of time and facilitating synthesis of the new by valid problem statement. A recipe for success in research starts with the correct problem statement, as correctly formulated questions create an accurate vector for development of scientific thought. If gnoseological problem cannot be solved, maybe it is because the questions and the problem itself were misworded.

During data collection it is important that the master's student understands the topicality of the information found. In this context, time may become a cause to refocus the topicality of the data in question. For instance, engineering sciences show the most vivid example of a situation where the

dominating concept is held as current and correct, while previous ones are understood as obsolete and useless. Thus, in order to prevent possible mistakes in understanding the currency of information, it is necessary to have a clear delineation between the past, the present and the future, as well as a skill to identify in the total of knowledge the ideas that define the modern paradigm.

During data analysis, mathematical tools are applied, thus, depending on specialist field and research interests of the master's student, certain concepts of time will be applied to solve specific problems, where emphasis will be given to anthropomorphic factor of time or duration, depending on the problem. In its own turn, selection of the concepts will define the research tools and methods applied to solution of both research and practical tasks. For example, accepting time as continuous or discrete determines methods to be applied in mathematical and logical analysis of information.

Presentation of research as a coherent text also poses a certain problem to post-graduate students, as at this stage, confusion of human temporal consciousness manifests. When master's students are writing their theses, they already know the end results of their research, thus, the future is already determined: it is as real to them as the past and the present. Due to the future determining the past and the present to the master's students, the sequence of information treatment within the logic of the thesis is contravened. To rectify such mistakes in construction of the temporal line of narration, the students shall clearly understand the concepts of time that explain the nature of past, present and future.

At the final stage of thesis presentation and defense, it is important to take into account the factor of subjective perception of time. When explaining a complex concept, one shall allocate enough time for good presentation in order to avoid misunderstanding. As the student understands the matter, they may cut short the explanation time, thus making it insufficient for the percipient side.

In process arrangement at all the above listed stages of master's thesis development, effective results are determined by understanding on behalf of the student that time perception is a subjective process. For a good reason many concepts see time as a result of subjective human perception of reality. At that, during the work on one's thesis, time management is important. While a student may think that they have more than enough time, it is inadvisable to postpone things to the last moment. Correct organization of each and every stage in the work on one's thesis and strict compliance with the time requirements increases the efficiency of research work.

7. Conclusion

As a result of analysis of existing concepts of time, a classification of approaches to the nature of time has been developed, with a subsequent attempt to include this classification in the functional activities of master's degree students developing their theses. Further analysis of this correlation may allow dividing student functional areas into smaller subareas in order to provide a more detailed outlook with the aim of increasing the efficiency of student research activities. As a result of this research, the authors came to a conclusion that increasing the efficiency of post-graduate students requires forming their integral understanding of the category of time, which may be taught as a section within the Philosophy of Science subject.

References

- Aliushin, A. L., & Knyazeva, E. N. (2007). Multilevel temporal structure of reality. *Questions in Philosophy*, 12, 84.
- Aristotle. (1981). *Physics*. Mysl.
- Augustine, A. A. (2012). *Confessions*. Canon.
- Bergson, H. (2020). *An essay on the Immediate Data of Consciousness: Time and Free Will*. URSS.
- Descartes, R. (1989). *Meditations on first philosophy*. Mysl.
- Hegel, G. W. F. (1975). *Encyclopedia of the Philosophical Sciences*. (Vol. 2). *Philosophy of Nature*. Mysl.
- Heidegger, M. (2012). *Time and Being*. Republic.
- Kant, I. (1964). *On the Ultimate Ground of the Differentiation of Regions in Space*. Mysl.
- Koshevaia, I. G., & Makarova, V. A. (2017). Literaty tense category as a functional dominant idea of text formation. *Annals of Moscow Oblast State University Series: Linguistics*, 4, 8–15.
- Levich, A. P. (2009). Modeling natural time references: metabolic time and space. In: *On the way to understanding the phenomenon of time: time structures in natural science. Part 3: Methodology. Physics. Biology. Mathematics. Systems theory*. Progress-Tradition.
- Levinas, E. (2000). *Selected works. Totality and Infinity*. University Books.
- Lolaev, T. P. (2015). *The Nature of Time or Time in Nature: theoretical and experimental foundations for objective existence of time*. Lenand.
- Mach, E. (2003). *Cognition and Error*. Binom.
- McTaggart, J. (1927). *The Nature of Existence*. Cambridge University Press.
- Molchanov, I. B. (1977). *Four Concepts of Time in Philosophy and Physics*. Nauka.
- Newton, I. (2017). *Mathematical Principles of Natural Philosophy*. URSS.
- Plato. (1936). *Theaetetus*. Transl. from Greek and with commentary by V. Serezhnikov. SOTSEKGIZ.
- Reichenbach, G. (2009). *Philosophy of Space and Time*. Librokom URSS.
- Zima, V. N. (2019). *Issues with time objectivity in philosophy*. Prometey.