

Epistemological Foundations Of Medical Education: Science As Myth Or On The Galilean Tradition

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ABSTRACT: Current trends in medical education face epistemic obstacles that generate tensions between scientific experience and common experience, derived from observation. To explore this line of reflection, a horizon of understanding that contributes to the epistemological foundation of medical education is reconstructed. The myth is analyzed in the construction of scientific knowledge and the Galilean tradition. In science as mythos, the mythos/science relationship is thought through the thought of Mircea Eliade, Plato, Martin Heidegger, Paul Feyerabend and Hans-Georg Gadamer to define it in terms of a complex explanatory system with auxiliary hypotheses of particular cases that are confirmed through observation. In relation to the Galilean tradition; following the line of reflection of José Ma. Mardones; the Pythagorean-Platonic origin is rehabilitated, emphasizing as fundamental principles the mathematical expression, objective and experimentally verifiable of the phenomena of nature. The participation of positivism, logical positivism and critical rationalism is briefly reviewed in order to keep updated the positivist paradigm linked to the Galilean tradition. It is concluded that the Galilean tradition represents the social, cultural and historical position of the scientific method in the natural sciences, which has dominated the generation of knowledge and the teaching of medical sciences.

KEYWORDS: Epistemology, medical education, science, myth, Galilean tradition.

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I. INTRODUCTION

Medical education goes through innovative processes that aspire to overcome the Flexnerian tradition. This has led to the analysis of the importance of basic sciences in medical training (Badyal and Singh, 2015; Pawlina, 2009) and aspires to integrate the knowledge of the basic sciences with clinical sciences (Kulasegaram et al, 2009), in addition to incorporating the medical humanities into the educational process (Pfeiffer et al, 2016). In this sense, medical education faces the challenge of building in the student the ability of clinical reasoning from the knowledge of the basic sciences of medicine, integrate the knowledge and clinical skills (Kaufman et al, 2009), and acquire the social and humanistic sensibility that characterizes to the medical profession.

However, the basic, clinical and socio-medical sciences and medical humanities have their own epistemological foundations as well as research logic inherent to their object of study and that respond to a pedagogical tradition. This contrasts with the need to train students in the context of evidence-based medicine (Kyriakoulis et al, 2016) and incorporate the focus of patient-centered medicine (Miles et al, 2015). This implies that medical training involves epistemic positions related to the production, transmission, acquisition and justification of medical knowledge; so that we are in the field of medical epistemology.

To look epistemically at current trends in medical education, we turn to the concept of epistemic cognition (Eastwood et al, 2017) to refer to “how people acquire, understand, justify, change, and use knowledge in formal and informal settings” (Green et al, 2016). In this sense, the pedagogical relationship in introducing new approaches to the teaching of medicine generates tensions between the Flexnerian tradition of the 2 + 2 model (two years of basic training and two years of clinical training) with the model of evidence-based medical education, and the model centered on the patient.

The tension that is generated when operating these models is explained through the concept of epistemic obstacle developed by Gaston Bachelard (2002) to account for the reproduction of scientific knowledge associated with "scientific experience" (experience) and "common experience" (observation), placing then the epistemological problematic in the existing relation between experience and observation. That is to say, medical education resorts to the link that arises between experience and observation so that the student

develops the knowledge, skills, attitudes and values for the practice of medicine, which implies placing us in the epistemological debate between explaining and understanding in the field of medical sciences.

To explore this line of reflection in order to reconstruct a horizon of understanding that provides essential principles for the epistemological foundation of medical education, two categories of analysis are presented below: the recovery of myth in the construction of scientific knowledge, and Galilean tradition as model of explanation of the phenomena of nature and society.

II. SCIENCE AS MYTHOS

Every day, the term *mythos* is used in its usual meaning as a fable, invention, fiction, attributing to it the sense that was given in primitive societies in which the myth designates a "true history" of priceless value, because it is sacred, exemplary and meaningful by acquiring the sense of sacred tradition, primordial revelation, exemplary model (Eliade, 1963). From the myth it can be said at the beginning of the Greek culture the theogonic and divine myth was developed, but it was also enunciated in the mythical narrative, the heroic myth and the allegorical myth.

Western philosophical tradition indicates that from the criticism of Xenophanes to Homer, the Greeks begin to eliminate the religious and metaphysical content to the term *mythos* opposing it to *logos* (García López, 1986), reason why the meaning is attributed to it to indicate everything that can't exist in reality. In this sense, the myth is a story about the gods by which the principle of life was explained, expressed the worldview and exposed the constant struggle between good and evil. This conception will be cultivated during the Middle Ages through the Judeo-Christian tradition and will permeate the realm of Western culture. Thus, the Greek *mythos* provides a model to human behavior and confers meaning and value to existence.

To say of Mircea Eliade (2002): the *mythos* has life; and affirms that the *mythos* is an extremely complex cultural reality, that can be approached and interpreted in multiple and complementary perspectives, since it tells a sacred history, it tells an event that has taken place at the beginning of when reality has come into existence and, therefore, it is a "true story", since it always refers to realities. Thus, the mythical narrative is configured as the instrument that to explain the incomprehensible of those natural processes that area beyond the reach of the reflective and practical power of man. To clarify the educational content transmitted by the myth, mainly the allegorical myth, a physical, psychological and ethical explanation, will be development.

It will be until the mid-twentieth century when it comes to revaluing the conceptualization of *mythos* in the structure of human knowledge as a true word; for which he returned to the analysis of *mythos* in the thought of Plato (Morgan, 2004). The investigations in this sense have been multiple and contradictory, although it has become clear that the term *mythos* is used by Plato in three senses: in everyday speech, the Platonic connotation and as an allegory (Lisi Bereterbide, 2009).

Through the study conducted by Lisi Bereterbide (2009), the term *mythos* in everyday speech means "word", "story", "story"; pointing out that at the level of discussion and scientific reflection in the intellectual circles of Greece at that time, it is radically opposed to the *logos*. On the other hand, the properly Platonic connotation refers to the *mythos* as a story made from rational data, embodied by the subject from noetic principles, a form of meta-history, a philosophical reflection on the development of humanity, a true philosophy of history. Finally, for Lisi Beretenide (2009) he will point out that the term *mythos* is also used by Plato as an allegory that states the need to follow the mandate of reason and law.

In this context, it is shown that the *mythos* is a story, linked to the *logos*, that derives in dialectical dialogue that comes from the memory, from the anamnesis, which aspires to seek the original meaning of truth. In this aspiration, highlights the thought of Heidegger (1992) that exposes the *mythos* as a legend in the initial sense of saying, of the word that recalls, and in the memory will be linked to the *aletheia*, the truth as unconcealed and in which "the basic feature of the way -method- is that by conveying along the course, underway, its open up a view and a perspective and hence provides the disclosure of something" (Heideger, 1992:66). In this line of thought, Gadamer (2000) assumes the myth as said, is legend then, although in the old use Homeric language does not mean anything other than "speech", "proclamation", "notification", "make known a news", so the myth will be known, the news that is spread without it being necessary to determine its origin or confirm it.

The *mythos* as an essential part of the *aletheia*, will be the encounter with oneself, with that of what one knows in secret or like the word that we are told (Gadamer, 2001); so it awakens dimensions of past experiences, which happened in the world of life, in a real and concrete way. These dimensions are not found in the experience of the present, leaving behind it all experience, so that the *mythos* will retain the substance of the life of a culture (Gadamer, 1987). This conception of the *mythos* is opposed to the illustrated scheme of the transit of the myth to the *logos* that exposes the unleashing of the world and with it, the disenchantment of reality; so the mythological has no value against the concepts of fact and reality assumed by modern science and the question arises: what role plays the myth in a society dominated by scientific reason?

The answer to this question will be provided by Paul Feyerabend bluntly. In his book *Against Method*, published in 1975, indicates:

“Thus, science is much more similar to the myth than any scientific philosophy is willing to recognize. Science is one of the many forms of thought developed by man, but not necessarily the best. It is a conspicuous, resounding and insolent way of thinking, but only intrinsically superior to others for those who have already decided in favor of a certain ideology, or who have accepted it without having examined its advantages and its limits. And since the acceptance and rejection of ideologies should be left to the individual, it turns out that the separation of church and state must be complemented by the separation of state and science: the most recent, most aggressive and dogmatic religious institution. Such a separation may be our only chance to achieve a humanity that we are capable of realizing, but which we have never fully realized (Feyerabend, 1986:289)”.

As Feyerabend (1986) puts it, science as *mythos* becomes an instrument of domination and exploitation, of a truth that is proper but dogmatic, and unattainable for the rational explanation of the world. Inserted in the Galilean tradition, the mythical of modern science is represented by the monological scheme of the natural sciences and is concretized in the paradigm of reductionist positivism. In this context, science as a myth requires recognizing the truth of other modes of knowledge that are outside of science; so that the Galilean tradition helps to perceive the myth as having a truth of its own that rehabilitates it and refreshes it from the dogmatism to which it has been induced by instrumental rationality.

In this process of rehabilitation of the myth, the original sense of science and also of the *mythos* is recovered, allowing it to be placed next to the *logos* and, in many occasions, it could function as its culmination. The *mythos*/science relationship constitutes a complex explanatory system that contains numerous auxiliary hypotheses constructed to cover particular cases and to reach a high degree of confirmation based on observation. As Gadamer (2002) points out, the affinity of the *mythos* with the reflective consciousness is so close that the philosophical reflection in the "language of the concept does not bring anything essentially new to that constant oscillation between discovery and concealment, between reverential fear and freedom of spirit that accompanies the whole history of the Greek myth" (Gadamer, 2002:126); for what then deepens in this line of reflection through the galileana scientific tradition of the causal explanation, following the thought of José Ma. Mardones (2003), and remembering with it the sentence of Xenophanes: human beings have created gods in their own image.

III. GALILEAN TRADITION

The Galilean tradition, although it receives its name from Galileo Galilei, has roots in the philosophy of Pythagoras and Plato. In relation to Pythagoras, the interest of mathematically reading the book of nature transcended to Western culture (Martínez, 2012). In the Galilean tradition the experiment is shown as the contemplative, but active, way to question nature, so for Alexandre Koyré (1943), the scientific revolution starring Galileo is a platonic response to the needs of the sixteenth century.

Before the influence and use of the inductive-deductive method used by Aristotle from antiquity to the Middle Ages (Milton, 2011), in the thirteenth century it is questioned and introduced different precisions through the philosophical work of Robert Grosseteste, founder of the Oxford scientific thought; Roger Bacon, Joohn Duns Scotus, William of Ockham and Nicholas of Autrecourt, who are setting the stage for the emergence of modern science.

Grosseteste studied astronomy, geometry and optics; from the Aristotelian thought proposed to extract from the particular observations a universal law that would enable to foresee particular situations, also pointing out the need to use experiments to verify theories (Oliver, 2004). Roger Bacon establishes the guidelines of the scientific method, articulating observation, hypothesis, experimentation and independent verification of natural events (Thorndike, 1914). For his part, Duns Scotus defended the separation of philosophy and theology (Vos, 2006), enabling Ockham (1964) also delineate elements of scientific method and reductionism in science, noting that to explain a phenomenon must be selected the simplest explanation of all the that are equally valid; this is what is known as the "Ockham's razor" (Gernert, 2009). Finally, through the thought of Nicholas of Autrecourt, skepticism developed and Aristotle's causality was denied (Beuchout, 2002).

Already in the sixteenth century, during the late Renaissance and the Baroque era, the mechanistic-causalist approach to the understanding of the world emerged when the work of Copernicus *Dè revolutionibus orbium coelestium* was published; the time in which the "Copernican turn" takes place, which will have consequences on the conception of the world as a flow of events that follow one another according to natural laws (Mardones, 2003; Neuber et al, 2014). The conception of events chained and regulated by natural laws will lead Galileo and Bacon towards a functional and mechanistic perspective that aspires not only to understand nature, but to control it, so that nature and its phenomena are reduced to a simple object of study, reifying it in accordance with the needs of the human being and for the utility of their interests (Mardones, 2003).

From 1543, 100 years passed in which the pragmatic mechanical-causalist interest of the most immediate and practical "how" of the phenomena and their consequences was gradually configured

(Applebaum, 2000). This interest was concretized when Galileo published, in 1638, the Discourses and mathematical demonstrations concerning two new sciences, mechanics and local movement, known as the Discorsi (Mardones, 2003). In this threshold of the new science in which the mechanization of the image of the world was configured (Dijksterhuis, 1961), the modern scientific method is also articulated and concretized; and with it, a new way of considering the requirements of should meet the scientific explanation, to which they contributed, as Mardones (2003) points out, three historical-social processes that were changing the direction of the development of the life of the human being. These processes are:

- Renewal of the Pythagorean-Platonic tradition recognizing that the book of nature was written in mathematical language, so we search for the physical and mathematical laws that underlie the structure of the world.
- The incipient capitalism that emerged in the thirteenth century accompanied by the strengthening of the bourgeoisie, promoting the explanation of concrete facts, useful for the enhancement of capital and the domain of nature, which highlights the utilitarian and pragmatic sense of modern science oriented to the technological context of knowledge and its applications.
- Systematic linking of academic knowledge with technical and craft empirical knowledge.

The success of modern science through the ingenuity and work of Galileo was to synthesize the Pythagorean and Archimedean mathematical tradition in the dyad induction-mathematical formula to construct explanations of the properties of a phenomenon, so that the hypothetical assumption was transformed into an essential element of the abstraction and idealization of science (Nothan, 1985).

The Galilean tradition is the tradition of mechanistic science; where the scientific explanation of a phenomenon is elaborated through natural laws that relate two phenomena mechanically to each other (Casadevall and Fang, 2009). Suspecting a direct causal relationship, it is analyzed if it meets the condition that both phenomena are causally determined and can be expressed mathematically through scientific hypotheses. The mathematical expression of natural phenomena as a semiotic representation of causal hypotheses of a mechanistic and functional nature, are valued through the experiment, so that it provides the explanatory power to the hypothesis (Nagel, 1961).

Analyzing the construction of causal hypotheses that prevail in the Galilean tradition from the field of semiotics leads to the reflection of the triadic relation of the referent, meaning and signifier; and consequently, to the revision of the epistemological models that underlie both the generation of medical knowledge and the teaching of medicine. In this sense, the experiments that are built within the Galilean tradition constitute the intellectual and empirical tool that makes it possible to compare hypotheses and deduce consequences to determine the explanatory value of the causal hypothesis; so that the Galilean tradition has developed in terms of the causal explanation, or simply, explanation (Erklären) (Mardones, 2003).

The historical development of scientific ideas shows that they are circumscribed, grouped and linked to create scientific traditions. For Mardones (2003), in the rehabilitation of the scientific tradition that has developed from the Galilean perspective, Augusto Comte's positivism, logical positivism, the neopositivism of the Vienna Circle, the critical rationalism of Karl R. Popper and analytical philosophy have participated, among other contemporary philosophical developments.

Positivism is a current of thought closely related to the foundation of empirical science that emerged during the eighteenth century under the influence of Newtonian physics, the Cartesian mechanism and British empiricism. The scientific positivism, elaborated by Augusto Comte during the XIX century, is added, and represents since then, the Galilean tradition, contributing the following elements to rehabilitate it (Mardones, 2003): the methodological monism, the model of the physical-mathematical natural sciences, the causal explanation (Erklären), reduction of reason, and reification of the subject by strengthening instrumental reason.

Comte assumed the "law of the three stages" in the historical evolution of knowledge and that included: the theological, the metaphysical and the positive; where the positive was synonymous with the scientific. From this perspective, he elaborated the "encyclopedic law" to order the sciences in the following way: astronomy, physics, chemistry, biology and physiology, and sociology. In a generic way, the current positivist that lasts until our days postulates: the objective of science is to explain and predict, the generation of scientific knowledge must start from empirically observable facts where induction makes possible the development of experimentally demonstrable hypotheses; In addition, the axiological neutrality of science is proclaimed (Sousa, 2010).

In the field of social sciences, emphasizes the position of Durkheim, expressed in the rules of the sociological method, published in 1895, which incorporates a highly objective, epistemological and systematic approach to the study of society, based on evidence that is obtained from of social facts and that, consequently, shows pedagogy as a general science of education (Bulgaru, 2013). In the context of the medical sciences, positivism will be reflected in the studies of Françoise Magendie and Claudio Bernard, who will introduce the experiment to the study of medical physiology, highlighting both the observation and the previous knowledge to

achieve a plausible and demonstrable hypothesis to Through the experiment, ideas widely expressed in Introduction to the study of experimental medicine, published in 1865 (Lain Entralgo, 1943; Normandin, 2007).

In the first decades of the twentieth century, logical positivism (now grouped in analytic philosophy) arises with Bertrand Russell, the first Wittgenstein (or the *Tractatus lógicus-philosophicus*) and the neopositivism of the Vienna Circle represented primarily by Rudolf Carnap. The logical positivism affirmed that only the statements submitted to the logic and the empirical verification can be qualified like scientists so that they aspired to a systematic reduction of the human knowledge to logical foundations derived from the scientific method; what led to the Vienna Circle, on the one hand, to try to overcome pseudoscience through the logical analysis of language, and on the other, exposes the need to base the scientificity of all statements in empirical verification and verification; postures that will be reflected in *The Vienna circle: Its Scientific Outlook*, manifesto published in 1929 (Friedman, 1999).

Through critical analysis of the position of the Vienna Circle, Karl R. Popper exposes the impossibility of empirically verifying all scientific statements, a perspective already shown by Hume to argue that a general statement can never be verified with observation (Ott, 2006). This implies the uselessness of the inductive method in the foundation of science, so that science will be deductive in its justification (Popper, 2002). In this sense, Popper argues that scientific knowledge is conjectural, hypothetical, deductive, subject to review frequently for what is falsifiable, it is not possible to check all cases involved in a scientific hypothesis. Faced with the impossibility of verifying the hypothesis (Popper, 2002), he proposes the falsification of the hypothesis; that is, a denial of a general statement has been followed from a singular statement, and if the hypothesis resists attempts at falsification, it will be provisionally accepted until the contrary hypothesis is proved as scientific (Popper, 2005).

For Popper, science is an incessant and critical search for truth that begins with the formulation and delimitation of problems. This demarcation is made possible through the critical force of reason, so the scientific explanation takes the form of a basic logical scheme, where the phenomenon that must be explained (*explicandum*) will be the conclusion of a deductive logical inference whose premises are constituted by the theory and initial conditions (*explicans*) (Popper, 2005). This will be reflected in the epistemological method of trial and error that consists of a tetrahedral scheme that begins with the demarcation of the problem, continues with the tentative solutions to continue with the elimination of errors, persisting in this dynamic until finding a new problem, object of our interest

To explore the causal explanations of the real world in which man develops, Popper will elaborate the theory of the three worlds: world 1 corresponds to the physical universe; world 2 to conscious experience and world 3 will refer to the world of the products of the human mind. In the interactive dynamics of the three worlds, Popper will show his tendency to reduce reality to intellectual, epistemological and mental problems, through the use of methodological monism that appropriates the model of natural sciences as a canon of science; so the force of reason will show if the scientific statements can be or not, keep linked to the empirical facts (Popper, 1972). Thus, the facts, the given, are the ultimate criterion of truth; the objectivity of science lies in the scientific method of falsification and rational explanation is based on the nomological-deductive scheme.

The discussion, analysis and development of the Galilean tradition at the beginning of the 21st century in the field of medical sciences are oriented towards the epistemological foundation of evidence-based medicine (Howick et al, 2010). Focusing on the philosophy of evidence, but following Bertrand Russell and Willard Van Orman Quine; Djulbegovic et al. (2009), Delimit three fundamental lines of reflection: the rational thought of the evidence, the evidence as a guide to the truth, and the evidence as a neutral arbiter to deliberate between conflicting points of view. Recognized as one of the main advances in medical science, the analysis of clinical evidence to regulate medical practice caused a strong impact in medical education (Rajashekhar, 2002), favoring the adoption of educational models in terms of evidence-based medical education (Masoomi, 2012).

IV. CONCLUSION

Medical education in its different scenarios develops in the student the link between observation and experience, so that it may appropriate the knowledge of medical sciences through the reconstruction of relationships between knowledge derived from basic sciences and clinical skills, which will translate into clinical reasoning to establish an early diagnosis, as well as timely treatment.

The transition through the training process carried out by the student generates tensions between their beliefs and previous knowledge with the scientific evidence that is shown to them. On this occasion, the paradigm of the Galilean tradition is analyzed in which it subscribes to the view of science interpreted as the myth that prevails in the 21st century. In the transition from this perspective to the reconstruction of the Galilean tradition we recognize the limitations of having briefly exposed the main philosophical currents that include this tradition, which would require a specific and specific development that would exceed the purpose of this communication. However, it fulfills the intention of exposing a narrative and interpretative panorama that would

make it possible to construct the scales of a comprehension horizon of an epistemological nature applicable to medical education.

Having clarified these clarifications, the axes of analysis of the understanding horizon include the following epistemological foundations: science as myth, insofar as it has a truth content, so that medical science appropriates myths that derive from particular cases, positivism, logical positivism and critical rationalism that lead to the conception of clinical evidence as the transforming axis of medical education in the 21st century. In this sense, it is concluded that the Galilean tradition represents the social, cultural and historical position of the development of the scientific method in its application to the natural sciences and on which the contemporary medical education turn.

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