Role of epistemology in scientific production

Papel de la epistemología en la producción científica

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Abstract

The essay analyzes the importance of epistemology in scientific production. Epistemology seeks to understand things in their essence and causes, reflecting on the creation of knowledge and scientific disciplines. This approach transforms ontological and gnoseological convictions into scientific work standards, linked to different scientific communities. Thus, it enables the management of perspectives to conceive, develop, and evaluate scientific processes, encompassing the production of research and epistemological trends. Science, in constant evolution, has developed an intimate relationship with epistemological reflection. The positivist paradigm is applied through the hypothetico-deductive research system, while the dialectical-critical and interpretative approaches are applied through hermeneutic research. Scientific production, a social process that occurs in an organized or institutionalized manner, has scientific communities as its main protagonists, highlighting the relevance of epistemology in this context.

Keywords: Epistemology, research paradigms, scientific production..

Resumen

El ensayo analiza la importancia de la epistemología en la producción científica. La epistemología busca entender las cosas en su esencia y causas, reflexionando sobre la creación del conocimiento y las disciplinas científicas. Este enfoque transforma convicciones ontológicas y gnoseológicas en estándares de trabajo científico, vinculados a distintas comunidades científicas. Así, posibilita manejar perspectivas para concebir, desarrollar y evaluar procesos científicos, abarcando la producción de investigaciones y tendencias epistemológicas. La ciencia, en constante evolución, ha desarrollado una relación íntima con la reflexión epistemológica. El paradigma positivista se aplica a través del sistema de investigación hipotético-deductivo, mientras que los enfoques dialéctico-crítico e interpretativo lo hacen mediante la investigación hermenéutica. La producción científica, un proceso social organizado e institucionalizado, tiene a las comunidades científicas como protagonistas, resaltando la relevancia de la epistemología en este contexto.

Palabras clave: Epistemología, paradigmas de la investigación, producción científica.

Introducción

Epistemology as the science of knowledge, philosophy of science, or theory of research provides us with the tools and guidance in research processes to seek new knowledge that answers the many questions we have about our reality. Many authors have defined epistemology as the part of science that aims to construct scientific knowledge, which must be recognized by the scientific community itself.

Human beings, as protagonists of universal existence, develop explanations of the objects and processes that make up their reality; for this reason, we can say that humans are knowing subjects who constantly contrast metaphysical explanations and empirical knowledge to find answers to the present realities of their existence.

Science seeks truth through rigorous and exhaustive procedures, but it is also known that science is not objective by nature. It originates from a knowing subject and requires something to monitor, control, and thus ensure that it approaches reality. It is within the framework of achieving this goal that epistemology emerges. Epistemology relies on and is supported by scientific analysis, as it studies scientific practice. Since science is an accumulative process, studies conducted must be conceived as being in a "process of becoming," or in the "making of science," that is, a science in construction.

Scientific production is conceived as the way through which the knowledge resulting from intellectual work through scientific research in a specific area of knowledge is expressed, whether published or unpublished; it contributes to the development of science as a social activity. Scientific production is a social process that occurs in an organized or institutionalized manner only, and its main actors are the scientific communities, that is, the physical or virtual collectives formed by scientists from different disciplines who interact with each other to generate, disseminate, discuss, and critique ideas, data, problems, hypotheses, theories, questions, and answers.

The process of scientific production encompasses a wide range of activities, including the development and discussion of theoretical concepts and propositions, the acquisition of empirical analyses and data, and the circulation of all this among scientists in the form of formal documents that contribute to scientific communication. Therefore, this essay aims to analyze the importance of epistemology in scientific production.

Epistemology: Concepts

When referring to epistemology, it is necessary to briefly review the basic concepts that explain it, since there is a general minimum agreement that it is related to knowledge. For some, epistemology studies knowledge in general, from a philosophical point of view, making the term roughly synonymous with "gnoseology." For others, epistemology is restricted to one type of knowledge - scientific knowledge - making it synonymous with expressions such as "Philosophy of Science," "Theory of Science," "Theory of Scientific Research," among others.

Epistemology, or philosophy of science, is the branch of philosophy that studies Epistemology is a reflection on the production of scientific disciplines and scientific knowledge. In this regard, Brunet & Morell (2001, p. 32) define it as:

> Reflection on what scientific disciplines is producing, it seeks to evaluate the nature and quality of their scientific knowledge, the truth or falsity of their theories, how they provide adequate explanations, what the formal and conceptual structure of their theories is, and what relationship should exist between the explanation and the prediction of a phenomenon. Additionally, it addresses the problem of choosing between different methods and questions the nature of scientific regularities and laws.

Considering that the first step in scientific research is to delve into the background of the chosen topic, knowing epistemology will put us one step ahead. Nonetheless, the scientific utility of

epistemology lies in the role it plays in the scientific research process, and since this process has many parts, epistemology shows a correlation with at least the majority of them.

In this sense, Cazau (2011, p. 111) states that one of the most important meanings of the term epistemology is related to the study of science, and he affirms:

> An epistemologist studies what scientists do to study reality and what distinguishes them from non-scientists, how and why they construct their theories about the world, what methods they use, how they try to test their hypotheses, what special characteristics scientific language has, what reasoning they employ, and to what extent research is influenced by the worldviews of each era and by political, economic, and other determinants. The epistemologist studies the tools of the scientist, their methods, their logic, among other aspects.

Epistemological Approaches

Within this epistemological journey, Padrón (2007, p. 5) synthesizes epistemological criteria into two variables:

> One of a gnoseological type, referring to convictions about the source of knowledge, simplified into two values: empiricism/rationalism; and another of an ontological type, referring to convictions about the relationship between the subject and reality, deriving two values: idealism/realism.

From the perspective of the cited author, the intersection of these variables leads to four Epistemological Approaches: the empiricist-realist approach (measurements, experiments, controlled induction...), the empiricist-idealist approach (ethnography, cohabitation designs, reflective induction...), the rationalist-realist approach (abstractions, logical-mathematical systems, controlled deduction...), and the rationalist-idealist approach (free interpretations, broad languages, reflective argumentation...), as shown in the table.

Table 1
Epistemological Approaches

	Gnoseological Variables	
Ontological Variables	Empiricism	Rationalism
Idealism	Ethnography, cohabitation design, reflective induction...	Free interpretations, broad languages, reflective argumentation...
Realism	Measurements, experiments, controlled induction	Abstractions, logical-mathematical systems, controlled deduction...

Note: Padrón (2007).

In this context, the epistemological approach translates into a function that transforms certain fundamental convictions, which are unobservable and of an ontological and gnoseological nature, into specific scientific work standards. These standards are associated with different scientific communities, as these epistemological approaches enable the management of perspectives from which scientific processes are conceived, developed, and evaluated. This includes the production of research as well as trends in epistemological evolution.

Epistemology studies the historical, psychological, and sociological circumstances that lead to the acquisition of scientific knowledge, as well as the criteria by which it is invalidated. It also involves the clear and precise definition of the most commonly used epistemic concepts, such as truth, objectivity, reality, and justification. Epistemology analyzes, evaluates, and critiques the set of problems presented by the process of scientific knowledge production. For example, it addresses issues concerning the definition and characterization of scientific concepts and the problem of constructing the theoretical terms of science.

Idealism

Idealism is generally the school of thought opposed to materialism and realism. Contrary to realism, idealism maintains that physical objects cannot exist apart from a mind that is conscious of them. Throughout its long history, idealism has taken on many different forms and expressions, but all of them can be characterized by the central importance given to consciousness, ideas, thought, the subject, and the self in the process of knowledge.

According to Ferrater (1985), idealism refers to any doctrine or attitude in which the most fundamental aspects, and those by which human actions are supposed to be governed, are ideals, whether realizable or not, but almost always imagined as realizable. From this perspective, idealism contrasts with realism, which is understood as the doctrine or simply the attitude in which the most fundamental aspects, and those by which human actions are supposed to be governed, are realities, tangible facts. This sense of idealism is often ethical or political, or both.

When referring to idealism, we encounter two tendencies. On the one hand, there is objective or logical idealism (of Plato, Leibniz, Hegel, and other philosophers), in which objects are generated, in one way or another, by factors, causes, beliefs, or ideas that are independent of human consciousness. On the other hand, there is subjective idealism (of Berkeley, in particular), which holds that the objects we know correspond to our sensations: the existence of objects consists in being perceived. They are only ideas; hence the term idealism.

Kant, for his part, based his transcendental idealism on the argument that knowledge relies on sensations related to a world composed of phenomena (which he calls things in themselves). However, while the mind and reason cannot impose a structure on reality as such, they can do so on appearances since reason possesses certain a priori categories (such as substance and cause) that are independent of all sensory experience. According to these assertions, Kant insisted that his position did not cast any doubt on science and that, on the contrary, it was the only way to save

it from skepticism. Science tells the truth, he claimed, but only the truth about appearances.

Rationalism

There are various forms of rationalism, such as metaphysical (all reality is of a rational nature), psychological (thought is superior to emotions and will), and epistemological or gnoseological rationalism, whose central concepts are more relevant to our topic of the philosophical assumptions of social sciences. In this form, rationalism asserts that it is possible to know reality through pure thought, without the need for any empirical premise. Essentially, this is the position of three of the most prominent representatives of rationalism: Descartes, Leibniz, and Spinoza. For example, Descartes proved the existence of God and the physical world based on the rationally indubitable premise "I think, therefore I am."

Knowledge is genuinely such when it has logical necessity and universal validity. Only reason can allow one to say that something is as it is and cannot be otherwise. Only reason has the capacity to obtain, by itself, through deduction from innate ideas, other types of knowledge such as "every effect has a cause," which is evident as it establishes a necessary relationship. Such concepts are known as synthetic judgments, which, having their origin in reason, are a priori knowledge!

It is important to recognize the various forms that modern rationalism has taken; however, these differ from the more extreme pretensions of rationalism that emerged in the 17th and 18th centuries. Nonetheless, the importance of reason in the knowledge of reality remains relevant within the various uses of the term "rationalism." Among these are the epistemological positions of Gaston Bachelard and Karl Popper, which highlight the role of reason and empirical experience in scientific investigation.

Empiricism

Empiricism is a philosophical school which holds that all knowledge is based on experience, a claim that directly opposes rationalism, for which knowledge derives largely from reason. For radical empiricism, the mind is like a "blank slate" that merely records information from experience. There are three types of empiricism: 1) psychological empiricism, which asserts that knowledge originates entirely from experience; 2) epistemological empiricism, which maintains that the validity of all knowledge is based on experience; and 3) metaphysical empiricism, which posits that there is no other reality than that which comes from experience, particularly sensory experience. This school of thought was developed by several English philosophers, notably Locke, Hume, and Mill.

Empiricism denies the existence of innate ideas, invoked by rationalists, who argue that these can be broken down into simpler concepts derived from experience or that these concepts are not genuine since no meaning can be assigned to them. In this same order, according to rationalists, empiricists deny that there are necessary truths a priori; but based on experience, unlike rationalists for whom such judgments would be self-evident truths, valid independently of experience. Finally, empiricism rejects all metaphysics and, conversely, gives high value to science

as a superior means of acquiring knowledge.

It is noteworthy that a significant part of research in social sciences is based on some of the main assumptions of empiricism, notably the value placed on experience as the origin of knowledge and as the ultimate criterion for testing theories. This is why, in recognizing that science is composed of theories, scientific empiricism acknowledges the role of reason in scientific practice and the development of science. One of the most prominent thinkers in this position is Emile Durkheim, who, for his opponents, is one of the most notable empiricists within the social sciences, also recognized as a positivist due to the importance he gave to the methods of natural sciences in social research.

Realism

Just as in the philosophical schools discussed earlier, it is possible to distinguish several types of realism. As metaphysical realism, the term was first used to denote the position that general or universal ideas, as they were called, have real existence independent of being thought of or not. As epistemological realism, it asserts that knowledge is possible without the need for consciousness to impose its own categories on reality. Among contemporary philosophers and epistemologists in this tradition are Bertrand Russell, Moore, and Mario Bunge, all of whom oppose all forms of idealism.

Within the context of epistemological realism, three versions are distinguished: 1) naive realism, which holds that knowledge is an exact reproduction of reality; 2) critical realism, which asserts that we cannot uncritically accept the knowledge provided by the senses and must examine such knowledge to determine to what extent it corresponds to reality as it is; such examination aligns this type of realism with rationalism; and 3) scientific realism, which posits that science provides the best knowledge of reality, where reason and experience are both necessary to know the truth. According to its basic principle, scientific rationalism rejects other types of knowledge that claim to have truth value, such as ordinary knowledge, religious knowledge, mystical knowledge, and metaphysical knowledge.

From these considerations, Bunge (1981, p. 29), from the position of scientific realism to which he adheres, tends a bridge to materialism in the following way: "All this material is changeable at least with regard to its position relative to other material entities. To put it negatively, at no time has science affirmed the immutability of matter." Hence, contemporary science can be characterized as the study of material objects through the scientific method to find and systematize the laws of such objects. In other words, scientific research presupposes a materialist ontology and also enriches it.

Materialism

In general terms, materialism is the doctrine (or doctrines) according to which everything that exists is matter; that is, ultimately, there is only one type of reality, which is material reality. Matter is thus the foundation of all reality and the cause of all transformations that occur within it. In

the 20th century, materialism is mainly represented by dialectical materialism and physicalism. Dialectical materialism is the philosophical position of Marx and Engels.

Dialectical materialism has as one of its central concerns the change of reality. Consequently, it considers the world as a process in which historically new and increasingly complex phenomena emerge from simpler ones, following the laws of dialectics: a) the law of transformation of quantitative changes into qualitative changes; b) the law of interpenetration of opposites, which recognizes the existence of contradictions in nature; and c) the law of the negation of the negation, meaning a given situation is replaced by another, so that the new emerges from the negation of the previous situation, which is then negated and replaced by another new situation.

The term dialectic in the philosophy of Marx and Engels derives from Hegel's concept to refer to the process of change in history and nature. But whereas for Hegel the basis of such a process was the spirit, for Marx and Engels that basis was matter. Hence, it is said that Hegel's dialectic was turned on its head by Marx and Engels. Physicalism is a form of materialism that emerged in the 20th century, whose proponents come from logical positivism, known as the Vienna Circle. According to their views, a statement only has meaning if it can be verified. When referring to psychological statements, they only have meaning if they are expressed in bodily behavior. Thus, it is noteworthy that behaviorism, which admits only observable data, is a form of physicalism.

Paradigms of Social Research

The term paradigm constitutes one of the most debated and analyzed categories that has been incorporated into the discourse of the scientific community, which, over time, has experienced significant growth and development. In the particular case of social research, as a scientific inquiry process, it has made considerable advances. This term became widely known and was particularly assimilated by the social sciences starting in the 1960s with the publication of Thomas Kuhn's work "The Structure of Scientific Revolutions." In this work, despite introducing the term paradigm to the debate, it presents, from its very appearance, a great polysemy of meanings and applications. To the extent that its author, in an expansion of the mentioned text edited in 1978, titled "Second Thoughts on Paradigms," attempts to delimit and clarify its sense and meaning.

Regarding this, Kuhn (1975, p. 13), when referring to the term paradigm, states:

> (...) The most important thing is that, spending a year in a community composed mainly of social scientists, confronted me with unforeseen problems about the differences between such communities and those of natural scientists among whom I had received my training. Primarily, I was amazed at the number and extent of the apparent disagreements among social scientists about the nature of accepted scientific problems and methods (...) In trying to discover the origin of this difference, I came to recognize the role played in scientific research by what I have since called paradigms. I consider these to be universally recognized scientific achievements that, for a time, provide model problems and solutions to a scientific community.

Kuhn's referenced work has had significant repercussions and has generated ongoing discussions that have grown since its appearance. Consequently, there have been criticisms, clarifications, interpretations, and reformulations revolving around the term paradigm. This does not diminish the importance, impact, and recognition it has had within the social scientific community.

Considering the interest in the concept of paradigm manifested by some researchers in the social and human sciences, there has been a proliferation of diverse positions regarding it. In this regard, Paz (2003, p.78) argues:

> Since Kuhn, an evident relativism in the criteria of demarcation between science and non-science has been accepted. Against the rationalist assertion that there are logical, universal, and ahistorical criteria to assess the scientific nature of theories, the conviction that the only possible criterion is the consensual approval of the scientific community is increasingly gaining strength.

Knowledge of research paradigms helps us to better understand the methodological model or models in which we intend to frame an empirical study. Conducting research requires understanding the phenomena being developed to generate proposals for continuous improvement within a context of professionals, researchers, and students who share similar conceptions about the approaches chosen for the research. In this sense, one starts from a reality, and its approach is made from a determined paradigmatic position. Regarding this, Pérez (1994, p. 15), states:

> Reality involves a methodological process that must be understood [...]. The investigation of social reality should be a systematic and planned activity, aimed at providing information for decision-making with the goal of improving or transforming reality, facilitating the means to achieve this.

From these positions, science and philosophy redefine their roles within the frameworks of knowledge, as the idea of identifying science with certain and demonstrated knowledge is established, in contrast to common knowledge, religion, and speculation. In line with this, some key elements of the fundamental paradigms for scientific production in the social sciences are presented: positivism, interpretive, and socio-critical.

Positivism

Positivism began as a research model in the physical or natural sciences and was later adopted in the field of social sciences. It was Auguste Comte who marked the birth of positivism when he published his "Discourse on the Positive Spirit" in 1849, which heralded the significant start of the positivist paradigm in research.

The positivist paradigm is also known as: quantitative, empirical-analytical, rationalist. It has become the dominant paradigm, and despite the emergence of opposing paradigms, it remains the hegemonic paradigm due to its strong presence in research processes in both natural and

social sciences, with particular emphasis in educational sciences. This paradigm is considered a philosophical school that upholds certain assumptions about the conception of the world and the way to understand it. It is important to recognize that this research paradigm accepts only verifiable, measurable, and observable knowledge as valid. Additionally, it is worth noting that positivism does not acknowledge the relevance of other perspectives, methodological procedures, or types of knowledge for interpreting reality; from this worldview, quantification is what matters.

Ricoy (2006, p. 14) states that the "positivist paradigm is characterized as quantitative, empirical-analytical, rationalist, systematic, managerial, and scientific-technological." Therefore, the positivist paradigm supports research aimed at testing a hypothesis through statistical means or determining the parameters of a specific variable through numerical expression. Positivism began as a research model in the physical or natural sciences and was later adopted in the field of social sciences.

In this same vein, the methodological question arises. From the positivist paradigm, the answers to a research question are of interest only if measurements can be made on the phenomenon under study. In this perspective, experimental methods are valid, where independent variables are intentionally manipulated at various levels of experimentation.

Interpretive Paradigm

In the context of studying epistemology as scientific knowledge, we find a series of paradigms understood as a set of beliefs and attitudes with a theoretical framework for pursuing and understanding the world, used by a group of scientists. Within this context, the interpretive paradigm emerges as an alternative to the limitations of the positivist paradigm in the field of Social Sciences and Education, considering the differences between these fields and the Natural Sciences. This paradigm has its historical antecedents in phenomenology, interpretive symbolic interactionism, ethnography, anthropology, and more. Its proponents originate from the German school, with Husserl considered its founder. Among its most representative authors are Dilthey, Baden, Berger, Schutz, Mead, Blumer, and Lukman.

The qualitative nature that characterizes the interpretive paradigm seeks to delve deeper into research, proposing open and emergent designs from a holistic and contextualized perspective. The most common data collection techniques include participatory observation, life histories, interviews, diaries, field notes, profiles, and case studies, among others. According to Ricoy (2005, p. 136), "Both the conclusions and the discussions generated by research adhering to the interpretive paradigm are fundamentally linked to a specific educational setting, also contributing to understanding, knowing, and acting in other situations." As Pérez (2004, p. 26) expresses, the interpretive paradigm emerges as:

> ...an alternative to the rationalist paradigm, as the disciplines in the social domain encompass various problems, issues, and restrictions that cannot be fully explained or un-

derstood through quantitative methodology alone. These new approaches primarily stem from anthropology, ethnography, symbolic interactionism, and so on. Several perspectives and currents have contributed to the development of this new era, whose premises coincide with what has been called the hermeneutic, interpretive-symbolic, or phenomenological paradigm.

The reason behind the multiplicity of terms used to refer to the interpretive research paradigm is perhaps its constructivist epistemological basis. Its focus is qualitative, aiming to develop concepts that help understand social phenomena in natural settings, giving due importance to the intentions, experiences, and opinions of all participants.

Socio-Critical Paradigm

This paradigm is contextualized in a research practice characterized by action-reflection-action, which implies that the researcher seeks to generate change and liberation from oppressions in a specific social context. According to Ricoy (2006, p. 23), "the search for social transformation is based on participation, intervention, and collaboration from critical personal reflection in action."

The aspects that characterize the critical paradigm, according to Escudero (1987), are: (1) having a holistic and dialectical view of what is conceived as real, (2) the relationship between the researcher and the phenomenon under study is characterized by the active and committed involvement of all participants in the research process towards social change, (3) the research process is generated in action, that is, in practice, and from this point, the social understanding of the needs, problems, and interests of the human group under study begins, (4) the pursuit of a transformation of social structures, based on the liberation and emancipation of the individuals that make up the social research context.

This Critical or Socio-Critical paradigm is defined by Jiménez (2003, p. 197) as: "a strategy that man has devised for himself not only to describe, explain, predict (positivists), interpret, and understand (hermeneutics), but also to act and transform that world in order to make man and his world more just and free."

From this perspective, the author asserts that the socio-critical paradigm is grounded in critical social science and the critical social theory proposed by, among others, Habermas (1987), Carr & Kemmis (1988). It transcends interpretation as it aims to contribute to transformations in the realities under study. Therefore, it is essential to explain the underlying socio-political conditions in the problems studied to incorporate alternatives beyond the interpretive and seek the roots of educational problems with the aspiration of transforming social structures that impede the development of equity and social equality.

Currently, the epistemological debate tends towards a point of clarification regarding the relative scope of quantitative and qualitative approaches. When situating recent research processes, it

is observed that there is a progressive overcoming of both approaches, integrating them to favor the selective and qualified use of the different procedures, techniques, and instruments that comprise them. This situation, which is general in the field of social sciences, is especially strong in the field of educational research.

Under the denomination of the socio-critical paradigm, a range of research methods born in response to neopositivist and naturalist traditions are grouped. Aiming to overcome the reductionism of the former and the conservatism of the latter, it proposes the possibility of a social science that is neither purely empirical nor solely interpretative.

The socio-critical paradigm includes neo-Marxist positions, critical approaches, and participatory research in general. Some authors place it as a particular proposal within the naturalist paradigm, but its orientation towards solving practical problems and its marked emphasis on social change and the participatory nature of research processes give it a particularity that justifies understanding it as a distinct paradigm.

Conclusions

Epistemology is highly valuable in the scientific research process, as it endows us with a unique critical capacity linked not only to the deployment of a specific methodology but also to the foundational principles of scientific research.

Traditionally, epistemology has been considered a philosophical discipline responsible for, among other things, the analysis and critical evaluation of the products derived from scientific activity. In this sense, it has been regarded as a second-level theory, given that its object of study consists of scientific theories, which correspond to a first level and refer to a certain ontological domain. However, new perspectives and fields of application of epistemology have emerged in the social and human sciences, contributing to the development and production of knowledge. Among the most significant developments are those from Marxism, psychoanalysis, and genetic psychology, as well as educational and sociological theories. These theories, due to their broad explanatory power, have managed to encompass scientific knowledge itself. This explains the importance of epistemology for social researchers in the context of scientific investigation.

Epistemology, as the science of knowledge, guides us in our research processes. Through it, we can be led towards scientific production, thereby finding justification or validity for the answers discovered. This facilitates the understanding of our disciplinary actions and enhances the development of our thinking structures. The role of epistemology in scientific production is of great significance, and its application should be continuous and permanent within the scientific community. This is essential if we aim to contribute to new scientific achievements necessary in the modern world.

The processes of knowledge production point to the consideration of the epistemic models required for scientific production, which can be approached from a scientific culture. Therefore, it is relevant to consider the importance of researcher training, based on the development of

transdisciplinary, epistemological, and experiential knowledge, enabling scientific production through knowledge creation.

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