Logical Positivism and its Contributions to Science Teachers Education

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Abstract

The present work sought, through bibliographical research, to present questions about assertive or counterproductive aspects from the point of view of Logical Positivism's legacy for aspects consistent with the initial and continuing education of future science teachers in the interior of Bahia, Brazil. Such notes have as background arguments about a quality scientific education under the watchful eye of meta-scientific contents, such as epistemology, history of science, and sociology of science, present or not in their respective training. However, under many severe criticisms, we can still enter this universe and present nuances of this period (logical positivism) for a quality epistemological debate with today's students.

Keywords

Logical Positivism; Teacher Training, Scientific Education, Epistemology.

1. Introduction

The present work sought, through bibliographical research, that is, conceived from previously published documents (such as articles or books), to present questions about assertive or counterproductive aspects from the point of view of Logical Positivism's legacy for aspects consistent with initial and continuing education of future science teachers in the interior of Bahia, Brazil.

This notoriety that lends itself to the function of epistemology for the teaching of science comes with its most outstanding attribute, the reflection on debates about the processes of scientific knowledge and its justification, which is why it is so important. Logical positivism was the first institutionalized epistemological program with Moritz Schlick and the Vienna Circle.

For that, bibliographic research is used here, which is "developed on the basis of material already prepared, consisting mainly of books and scientific articles" (GIL, 2002) [1].

The adopted methodology seeks to answer two guiding questions: What are the recent and current most significant epistemological trends (since the 20th century), and how can we communicate them to science teachers? What specific epistemological productions can be of the highest value for the teachers' training?

From this, a cut of the state of the art type is made concerning Epistemology and its function, whether as a grounded and institutionalized knowledge or as a metascience that takes care of dealing with another science, as suggested by KLIMOVSKY (1994) [2]. Science has its object to be studied, and, analogously, epistemology is the science that deals with science. Epistemology is the science that studies the foundations and methods of scientific knowledge.

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It is undeniable that the significant impacts caused by logical positivists, whether in the way of thinking or doing science, bring to the present certain nuances in form and method. One of these examples is reported by Verhaegh (2020) [3], especially what happened in American society, with an internal approach that affects the way that American philosophers came to perceive logical positivism.

It is worth noting, according to ADÚRIZ-BRAVO et al. (2006) [4], epistemology can be considered a somewhat young academic discipline. However, since the time of Aristotle, philosophers and scientists have already occupied themselves with reflecting on science.

There are several ways to start such an analysis. In the present work, we chose to undertake a broad path to address pro and contrary factors of Logical Positivism and Inherited Conception to the training of science teachers, especially those in initial training in the context of Nature Sciences Course held in Senhor do Bonfim and continuing education that takes place in Juazeiro, both in the interior of Bahia.

2. Development

2.1. Logical Positivism and Inherited Conception

According to Demos (1953) [5], for example, all enchantment of positivism resides in its clarity, which is something demanded by human beings, and within logical positivism, for him, the rules of scientific procedure are unambiguous and well defined.

The core of Logical Positivism was to suppress all assertions of metaphysical content from what was considered scientific discourse at the time. In such a way, a statement only makes sense if it is essentially formal (basically, mathematical and logical) or subject to empirical verification.

Even if these are not considered false, for the positivists, it could be something that would not be endowed with a certain scientificity and, therefore, should not bring an approximation of those "vulgar" conceptions (common sense), for example.

Carnap (1965) [6] "Many anti-metaphysicians have declared that occupation with metaphysical questions is sterile. But, whether or not these questions can be answered, it is at any unnecessary rate to worry about them; let us devote ourselves entirely to the practical tasks which confront active men every day of their lives!".

The above shows that the project mentioned above sought to provide further relevance to analytical and synthetic propositions to the detriment of the metaphysical ones. With this, verificationism is taken as a starting point[2].

The obstacle for such tests was precisely the amount of empirical tests to be carried out. Nevertheless, since this trend held the assertive security of the propositions so that the scientific status was corroborated, and given the impossibility of infinite experiments, they elaborated the confirmation criterion which, in turn, dealt with a certain number of proofs that, to the number of assertions increased, the propositions analyzed there would reach a greater degree of reliability and, therefore, would achieve the credibility required by such statute.

Now, the way is paved for Hempel and Carnap to suggest the hypothetical-deductive model to settle questions about theoretical terms. From a perspective, from then on, any theory that passed its tests would have, in an analogous way, all its propositions validated.

The main reason for such a model is exposed, yet, it is preponderant to deal with this in practice. The hypothetical-deductive model has the mission of attributing a logical structure to the theories, and these should present in their body a general law (at least), besides a set of initial conjunctures.

[2] Verificationism, also known as the verification principle or the verifiability criterion of meaning, is the philosophical doctrine which maintains that only statements that are empirically verifiable (i.e. verifiable through the senses) are cognitively meaningful, or else they are truths of logic (tautologies).

A crucial aspect in this regard is to understand the question of *explanans* and *explanandum*. The first can be understood by-laws or else by explanatory theories. Explanandum, in turn, would be the fact to be proven.

Here, there is a degree of repudiation of metaphysics, mainly based on logicism, typical of influential authors such as Bertrand Russell and Wittgenstein. Therefore, the followers of this critical mindset state that deductive logical designs could not produce any misunderstanding, which characterizes indefectible processes. According to Lorenzano (2011) [7], this phase of epistemology (or philosophy of science) can be called the "classical phase," where the inherited conception and its precursors are established (Carnap, Reichenbach, Popper, Hempel, Nagel, among others).

Yet for Adúriz-Bravo *et al.* (2006) [3] prudently highlight an essential difference between an image of "*empiricpositivist*" science that can present itself as an obstacle to quality science education and contributions from the epistemological school known as logical positivist (mid-twentieth century), which provided rigorous conceptualizations regarding the present-day nature of science that can serve as valuable points of ponderation for teachers of natural sciences.

The whole intention here is to demonstrate, despite the "empiricpositivist" image, as a school, there have been unequivocal collaborations up to the present day and, therefore, the training of science teachers is functional whether initially or continuously.

2.2 For a quality scientific education

For Adúriz-Bravo (1999) [8], with the objective of significant improvement in scientific education and science teaching, there was a concomitant development of new scientific and private didactic disciplines in various parts of the world. Since then, these new areas of knowledge have concentrated efforts in two specific areas: curriculum settings and teacher training.

Here, then, it contemplates the core of our concern regarding the formation offered by the Federal University of Vale do São Francisco – UNIVASF, in the interior of Bahia. Analyzing its curriculum, a more recent, latent concern concerning a scientific education advocated in the scope of the Nature of Science (NOS – for its acronym in English) is not noticeable. At least not directly, established in the field of its curriculum, for example, a discipline of teaching practices in natural sciences or something like that. Similarly, the continuing education provided by the Juazeiro-BA pole of the National Professional Master's Degree in Physics Teaching – MNPEF also seems outdated in this role.

It is essential to highlight that the work carried out by these groups, both the group of professors from the undergraduate course in Nature Sciences and those responsible for the MNPEF course, both taught in the interior of the state of Bahia, is of utmost importance for the care of the teacher training that heroically transforms lives and prepares future generations.

This is precisely the concern raised here because the meta-knowledge of the knowledge/science teaching is a common point among several authors who recognize this as preponderant for the improvement of the practices of natural science teachers and that a good part of these meta-theoretical components is provided by Epistemology and History of Science. Among these authors, we highlight Driver et al. (1996); Duschl (1997); Mellado (1997); Acevedo (2000); Adúriz-Bravo (1999, 2001) y Adúriz-Bravo *et al.* (2006).

Intending to answer the initial questions, Adúriz-Bravo et al. (2006) claims: "*in the task of teaching science, the epistemological contents can support and give structure to the images of science that are currently considered as valuable contents for the education of "scientifically literate citizen*."

In what is presented, the authors draw attention to issues intrinsic to meta-scientific contents, such as epistemology itself, which reminds the provisional character of science. Moreover, the history of science whose presentation constantly seems to affront somehow the epistemic values concerning Whig's interpretations, so insistently contemplated, especially in textbooks, determines a mistaken attribution, from the point of view of the development of science itself. And, finally, science sociology notably does not even seem to play any role in the "progress" of natural sciences, even if performed by human beings or a research group.

3. Conclusions

This article brings the dimension of the impact of this classic phase in some aspects consistent with Science Teaching.

It cannot be denied that the Vienna Circle overvalued the empirical sciences to the detriment of a broader philosophy of science. There are, for example, some scientific claims that are neither analytical nor experimentally verified; however, claiming that they are meaningless cannot be accepted from an epistemological point of view.

Regarding positive factors, from the point of view, these can be analyzed from the question raised at the beginning of this work when we embraced it as a critical epistemological trend - *how can we communicate them to science teachers?*

When looking at it from this perspective, one can occasionally see some possible and significant approaches to science teachers in training (pre-graduate or continuing). For example: i. the relentless search for formal and empirical knowledge (from a rational perspective, the techniques adopted here are based on language and mathematical analysis); ii. scientific humanism (using positivism as a scientific method) can be used indirectly in education. For example, the relationship between objectives sought through applied educational methods can come from a developed philosophy by positivism itself. Since the positivists established that the relationship between ends and means must be scientifically determined, the term scientific humanism can be attributed a new posture of this school because, in this way, it no longer believes in the search for absolute truth as the main motto, opening the way to allow the attempt to discover that relative truth that can be empirically examined).

Notably, the Vienna Circle had a unique stance towards the philosophy characterized by empiricism, the only way to reach knowledge, and symbolic logic as the chosen method to settle problems of philosophical nature. It is the role of everyone involved in the educational process to take such debates to the classrooms and foster a critical and pondering spirit on such issues, without forgetting rigorous epistemological surveillance and systematic contextualization.

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