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Tarso B. MAZZOTTI
University Estácio de Sá (Brasil)

Rhetoric, Science of Education

Abstract: This article examines the problem of the scientificity of pedagogy (education), the same as in the case of any science: validity of induction, while admitting the effectiveness of the rules of syllogisms in the form *modus tollens*. These rules do not entirely solve the problem of validation of inductive inference, because its premises are sustained in models, which are objects of dispute through negotiations of its meanings. These negotiations occur in rhetorical and dialectical social situations that result in the organized knowledge to expose or teach (*didascalia*). Thus, the rhetorical, dialectical and logical (analytical) techniques constitute, together, the necessary conditions, although insufficient, for the production and exposure of reliable knowledge. Besides, I say there are two types of sciences: the constructive and the reconstructive. The constructive operates with self-referrent signs and has as object the operations on a set of signs (logics and mathematics). The reconstructive sciences make comparisons to constitute a model, or a metaphor, that allows explaining and understanding of its object. Rhetoric is included in the reconstructive sciences having as object the limits of the modal axiom common to the intellectual techniques: it is possible to change beliefs, values and attitudes, therefore, it is also a science, or reliable knowledge of the educative practices.

Keywords: rhetoric; epistemology of sciences of education; reconstructive sciences

1. How the need for a science of education emerged

For centuries school education has concerned a restricted group of people: priests, philosophers, sophists and moralists. After the rupture between the state and the religious confessions that occurred in the

nineteenth century, particularly with the North-American and French revolutions, the schools maintained by the citizens became secular. The secularity put the issue of educability in the ambit of what is understood as science, since in it the arguments are neutral about theology and morality. That is why Alexander Bain (1879) and Edouard Claparède (1908) excluded the issues related to the purposes of the Science of Education, sustaining what they consider adequate to science: the use of logical and mathematical models. This wish, as it is known, was frustrated. The Science of Education was quickly replaced by an aggregate: the Sciences of Education.

Certainly the problem of scientificity is not solved through declarations, but through the examination of the necessary conditions, although insufficient, to produce reliable knowledge. The object of this examination is the rational justification of the inductive inference that tries to tell the reasons of the failure or the success of some practice.

The art of educating is based on the belief that it is possible to lead the student from a less educated to a more educated state. The recognition that the intellectual techniques sustain themselves in that modal axiom also presents the conditions of its realization. As these conditions are states of the subjects involved, it is said that the inferences about success or failure are necessarily subjective and they can only be investigated through qualitative procedures. Thus, it is proposed that the methods of evaluation of inferences adequate for the intellectual arts can only be qualitative, establishing a dissociation of the notion of scientific methods in two terms (the quantitative and the qualitative) that will be examined in the next section.

2. Quantitative versus qualitative

It is usually said that the research in education can only be qualitative due to the nature of its object. It is a mistake, since any science examines the qualities of what it takes as object. The object of a science is the subject of its propositions defined by a set of qualities considered adequate (categories or predicates). For example, in geometry the objects are figures that present qualities defined as geometric. In this and in other sciences, the object is determined by the properties that can be measured, assuming a certain intensity of the qualities that can be measured in some way.

The definition of the object is a moment in the process of establishment of a science in asking: what is *this*? As an answer, a set of categories or qualities is listed to delimitate *this* (the object of inquiry).

The meaning of each category is asserted, which leads to others and can result in an infinite circle.

Now let us consider the positions of Jean Piaget, who established the study of the necessary conditions for the constitution of scientific knowledge from the investigation of the logical mistakes presented by children. Little children do not recognize an elementary syllogism as A = B, B = C, then A = C, but older ones consider it obvious. There is, therefore, a distance between the two moments in cognitive development, which allowed to establish its measure: the variations or stages of the process that culminated in the formation of complete judgments from the logical point of view. But to tell the difference does not explain it and that is what matters, because a science exposes the reasons for the variations of some quality. Piaget proposed the best explanations, in the circumstances, for the process of cognitive (affective) development. It is not the case here to expose the theory proposed by Piaget. It is enough to say that the cognitive stages are a measure of the development process that culminates with the logical-mathematical one. It can seem odd to consider as measure the cognitive and affective stages, because usually it is only the ratio scales that are thus considered. Certainly, the serialization of the cognitive scales is not a ratio scale. The quality of the logical-mathematical conducts, which constitute concepts such as mass conservation, weight, volume, etc., vary in a measurable process in an ordinal scale, a serialization: stage I necessarily precedes stage II and this precedes stage III, with variations within each one. It is a logical quantification with the operator exists ∈.

In short any science derives the attributes (categories, predicates) of its object from qualitative procedures. The intensity of the qualities allows their measuring, and each science deals with theory of measures. But this would not apply to the mathematics, since it is considered quantitative.

3. Mathematics is qualitative

It is not hard to find those who emphatically say that mathematics is essentially quantitative. In the Einaudi Encyclopedia, the volume dedicated to the theme "Dialectic" examines the pair "identity/difference". Its author, Enrico Rambaldi, states that the analytical knowledge is mathematical, identifying the analytical knowledge, logic, with mathematics and this with the quantitative, saying:

> "Mathematics illustrates well this aspect of analytical knowledge: it represents objective aspects of the world, as "quantitative" relations between (and of) objects, true even if men did not exist; the quantitative relation between force and mass in the Earth/Moon system, for example, is certainly not only a human subjective way of conceiving the world, but rather an objective structure always identical to itself; and this is also true for the quantitative relations entirely in abstract, and not only for its physical valences: the geometrical relation between volume and radius of a sphere has a form of existence in itself, even if men did not exist…" (Rambaldi 1988, 13-14).

Saying that mathematical entities are in themselves and are simultaneously quantitative relations is a mistake, because being in themselves are absolute, not relative; and the quantitative relations are also defined according to their attributes and qualities. The geometrical figures, for example, are qualitative and can be expressed by different relations, such as the radius and the volume in the case of the sphere. The metric of geometry is a moment of exposure of the figure and it can only be achieved after the analysis of its qualities. After all, what is a sphere? In what does it differ from a hub; from a parallelepiped? What are its properties, attributes, qualities?

Besides, the author mixes the relations of the Earth/Moon gravitation that expresses a certain quality, the fall of bodies, in the case of Newtonian Physics, with the curvatures of time-space, in the ambit of Einstein's theory of restricted relativity in its algebraic expression. In fact, before establishing the calculation, it was necessary to determine the quality of the object: gravitation. Express the quality as a multiplicative relation and its inverse is to expose its relational quality, relative, not in itself and by itself (absolute), although, in the case of Newtonian Physics, space and time are considered absolute, therefore, separated. The author confuses the determination of geometrical figures (morphs) with the measurement procedures that serve to define certain qualities. In the same volume of the Enaudi Encyclopedia, René Thom, mathematician, indirectly contests the positions of Rambaldi in his entry Quality/Quantity (Thom 1988, 226-241). In his conclusion, Thom refers the readers to Enrico Berti, Aristotle specialist, when he says that the "highlight put in the quantity at the expense of quality comes from a unifying philosophical wish" (Thom 1988, 240), an ambition of the metaphysic and religion, therefore far from the desirable in the sciences.

If mathematics is quantitative, then it would be necessary to say what are the qualities of the quantity – beginning with the number that

serves to express it – one problem that existed through centuries and that, in the nineteenth century seems to have been solved by the axiom of Giuseppe Peano which says: "1.Zero is a number. 2. If *a* is a number, its successor is also a number. 3. Zero is not the immediate successor of any number. 4. Two numbers whose successors are equal, are equal. 5. If a set of numbers contains zero and also the successor of any number, then it contains any number".

This and other axioms try to establish the qualities of a mathematical entity, in this case, of the number and have nothing quantitative. In fact, the problem is not found in the adoption of mathematics as a "paradigm" of scientificity, even though this attitude has caused, and still causes, many mistakes. What will be examined next regards the usual comparison between natural and human sciences.

4. The invisible man and the visible atoms

Many people assume that natural sciences are quantitative, and therefore, incompatible with human knowledge, which can only be qualitative. This position, which seems to be widely shared, actually shows a lack of understanding of the investigation process used in the natural sciences, in particular of physics. Nobody sees electrons, neutrons and protons. It is feasible to observe, to see their manifestation in photographic plates, or in traces in the "Wilson's steam chamber" as well as by other means. As the "deep nature" of the matter only lets itself apprehended through its manifestations, it can be stated that there is no difference between the two orders of phenomena. Considering it any other way would be to affirm that the human is invisible and the atoms are visible.

The center of the contemporary debate about the character of the scientific knowledge and its dissemination was put by the invisibility of atoms and not by the invisibility of men. In fact, what is said about the atoms, as well as about any other phenomenon, does not express the "real" nature of the object, but of what is considered to be an adequate and relevant model for what is observed in a controlled way (by means of experiments). If what is said about the things is a model, an artifact, does it mean that its acceptance is nothing but a matter of fashion? Are there intersubjective (objective) criteria to validate the explanations? Would the new theories be an extension of the old ones? Would they break with the previous theories in such a way that they are irreconcilable?

5. The replacement of paradigms in reconstructive sciences

Thomas Kuhn, in 1961, claimed that the history of the sciences shows a succession of replacements of paradigms. These occur by increased adherence of supporters, who are the young scientists who have enough distance from the dominant paradigm (normal science). The new supporters, with time, start to control the university posts, laboratories, financial resources, as well as the teaching of the discipline, producing new manuals based on the emerging theory. This process excludes the participants of the "old theory", as well as those who adopt some "alternative theory" in relation to the "new". The scientists that disagree with the "new paradigm" have no way to put forward their voices, since the institutions are taken by the supporters of the winning paradigm, that becomes the "normal science", until new proposers emerge ("revolutionary science") and the cycle starts again. The reconstruction of the history of sciences proposed by Kuhn is sustained in a comparison with the processes of cultural and social transformations, the revolutions. The relevance of this comparison has been object of disputes that put the following set of questions.

What is understood by paradigm? Is paradigm the same as theory? If there is replacement of paradigms, can it be concluded that there are conceptual ruptures? Do these ruptures mean that scientific theories are incompatible?

If it is stated that old and new theories are incompatible, then there is not a process of accumulation of knowledge and the problem becomes the explanation of adherence to the new. In this case, would the adherence be a matter of taste? How can a paradigm be hegemonic?

In fact, the notion of paradigm describes social networks: a set of procedures, of institutional, interpersonal relations that sustain a theory, a canon, as Kuhn recalls (1996, 208). That is why paradigm is not the same as theory. Paradigm, or example, is the name of the social relations that sustain a theory, which is a conceptual structure, so that Kuhn (1996, 174-210), proposed to use the term *disciplinary matrix* instead of the polysemous word *paradigm*. Kuhn managed to show the relevance of interpersonal relations in the support of scientific theories, which goes against the position of the logical empiricists.

The logical empiricism, or logical positivism tried the unification of sciences. This philosophy sustains that the scientific knowledge does not depend on intersubjective relations, because the method of research is able to solve the conceptual problems and provide the explanations, i. e.

the method is what delivers the speech, not the scientists. If it is the method that delivers the speech, then the scientists cannot be considered rhetorical, or ideologists, because they express the truth of the arguments sustained in some logic, just as the founders of the Science of Education, Bain and Claparède, among others, intended to do. On this record, the scientific method excludes subjectivity, as well as intersubjectivity. Adherence to a new theory occurs through logical, rational statements whose validity can be proven, not because scientists belong to this or that social group. This philosophy of the sciences was questioned by historians since Kuhn, which led to a vision of science as a body of socially constructed knowledge and then to radical relativism, rejected by Kuhn (1996, 205-207).

6. The social construction of scientific knowledge

The Sociology of Scientific Knowledge held knowledge to be socially constructed. The most known sociologists of scientific knowledge are Barry Barnes, Davis Bloor, Steven Shapin, Harry Collins, Bruno Latour, Steve Woolgar, Karin Knoor Cetina. For them the scientific facts are made up by scientists, they are not an accurate exposure of the reality as the philosophical aphorism, i. e. the logical empiricism, wants (see, for example, Callon 1989; Pickering 1992).

Callon (1989, 173) showed that the Laboratory of Beauregard, dedicated to the study of fuel cells, sustained itself for a long time without presenting any valuable results. For this reason the sociologist concluded: "The construction of scientific facts is inseparable from social actors, simply because the researchers put simultaneously the question of statements manufacture or of new devices, and that of their dissemination and acceptance" (Callon 1989, 209). There is not, therefore, any criterion that allows to distinguish the adoption and dissemination of an ideology and of a scientific theory, except for their names.

It is undeniable that a scientific theory goes through the paths of co-optation of new members. Does this finding allow us to say that there are no validation criteria of scientific knowledge? The sociologists mentioned above respond affirmatively. Building on Kuhn's ideas, they get to relativism or radical skepticism. In this case, the same relativism leads to say that the knowledge produced by those sociologists also results from negotiations, without having any objective criterion to admit or reject it (Pickering 1992, 19). It ends up in an aporia: the statements of the

sociology of scientific knowledge are inventions of sociologists who built the multiple networks of social relations that sustain their positions.

How do these disputes present themselves in the context of debates about the scientificity of education (pedagogy)?

7. The war of paradigms in education

The debates around the so-called paradigms of researches in education were characterized as a "war of paradigms" (Gage 1989), that unfolds having as theme the critique of "positivism". This criticism has led to the emergence of streams that have been named "post-positivism," "critical theory" and "constructivism" (North-American), besides others such as those who called themselves "post-modern" or "post-structuralists".

Alves-Mazzotti (1998), in her review of the debate among the several methodological streams of research in education showed that the divergences between post-positivists, critical theorists and constructivists have as center the understanding of the possibility of generalization and accumulation of knowledge, as well as of "accommodation among paradigms". This accommodation cannot occur in the ontological ambit and in ambit of the theory of knowledge, because the theories are contradictory and incompatible. This lead us to ask if there is contradiction between theories. Can incompatible paradigms be reconciled? To answer this question, it is necessary to consider what is meant by contradiction and incompatibility.

8. Contradiction or incompatibility?

In fact, there is no way to establish contradiction between theories. The contradiction can only occur between statements or propositions. This is because there is only contradiction when the subject of a statement receives contrary predicates in one and the same situation. For example, there is no way to sustain that someone committed and did not comit a crime in the same situation of accusation.

On the other hand, arguments compatible in one situation may not be so in another. The incompatibility is not solved by means of arguments that aim to establish the truth, but by its relevance to the situation (Perelman and Olbrechts-Tyteca 2008, 262). Considering that paradigms are beliefs, attitudes and values in a given social relation, then the incompatibilities arise from what is intended to do in a situation. For

example, the mechanics established by Newton maintains its relevance and validity in a close scale and not in others.

Besides, the decision about the incompatibility is of the rhetorical situation ambit, of what people would rather do or have (so-called values), it does not refer to opposed statements that need to be eliminated in order to obtain a reliable piece of knowledge, what is proper of the dialectical situation, in which the problem of induction is raised.

9. The problem of induction

The core of the debate that emerged from Kuhn's work is in the radical relativist affirmation that it is not possible to establish some criterion for determining the value of truth or reliability of a theory. This because the adoption of a theory does not depend so much on the logical, methodological, and epistemic criteria, but on the co-opted subjects. The precariousness of the induction prevents the decision about the value of the statements that sustain themselves in it. It is a fact that the generalization from a collection of particulars is precarious, that there are limits for the inductive inference, however this does not imply the impossibility of achieving reasonable and reliable knowledge about something. This knowledge does not express the certainties of the so-called deductive categorical statements, which sustain themselves in signs used in calculation and proper of formal sciences that are different from reconstructive sciences, such as those that deal with natural phenomena.

In the case of reconstructive sciences, the premises of their syllogisms are propositions presented in the form of subject and predicate. The predicates are available in the language and allow us to say what are the limits of the subject (of the sentence, of the statement), individualizing it. In saying: "if man is mortal", it affirms, man belongs to the class (category) of beings that die and assumes there are those who do not die. As man is a general designation, a class of all beings that present certain qualities, then it is necessary to know what they are. The defining qualities need to be unique, not relevant to other beings. The quality *mortal* is shared by living beings, therefore is not specific of man. Which would be the specific qualities of the subject of the proposition: man is mortal? The specific difference of man is object of disputes. The decision about its definition, its specific differences, produces inconclusive debates around the first premises (principles). These first premises, in the ambit of reliable knowledge, sustain themselves in models or metaphors that allow to say which predicates are admissible in their syllogisms and the decision

about the relevance requires the use of the figure modus tollens, what allows us to find the best explanation, or tell the reasons or causes of the stated in the major premise.

I recall that in the form of *modus tollens* the major premise states something, for example, "The floor is wet", the minor premises are the multiple conditions that meet the condition "is wet", what requires the elimination of all the ones that does not adequately explain the stated in the major premise to conclude it in a safe way. This safety, however, is not complete, definitive, because eventually it was not considered some alternative that would explain better the stated, that is why the logical mistake is not definitely ruled out. This limitation of modus tollens requires the development of procedures that allow to control the maximum the fallacies that can emerge. But being limited does not mean being useless, since sciences have been able to identify the mistakes and, when this occurs, there is a process of reorganization of knowledge. Therefore, the criticism or the analysis of the arguments that sustain some theory is crucial, and this is made by the collective of scientists when they decide about the premises.

The decision about the premises involves a debate among the specialists, which can begin in a rhetorical situation, as when one argues having for evidence a sign, whose classical example is: if you have milk (sign), then you gave birth. If there is only a case that refutes the conclusion, then this can no longer be admitted. It was the case. That is why the best explanation for lactation through regulated (dialectic) dialogue that eliminated the competitor hypotheses was searched and isolated and this is a scientific knowledge, exposed in manuals of animal physiology.

Even though radical relativists disregard the *modus tollens*, the reliable knowledge depends on this procedure that is used in the dialectical situation, the regulated dialogue that seeks to establish the best possible explanation.

The key question becomes: where do the predicates used for the constitution of syllogism come from? The reconstructive sciences resort to statements whose premises are made in the form of dialectical and rhetorical syllogism, while the formal sciences operate through calculations on signs, a specific difference that needs to be further explored.

10. Constructive and reconstructive sciences

In formal sciences, mathematical and logical, it is argued through calculations on signs defined by scientists, that is why they are

constructive, their knowledge is self-sustainable. The others are reconstructive, once the phenomena are reconstructed through models considered relevant, which provide the predicates of the statements of their syllogisms, their premises. To constitute a model by comparison with some geometry, topology or network (latices), the scientists try to reconstruct a phenomenon in a concise and conclusive way, but its value is determined by the ability to describe and explain, not by the form, which can only have validity in the ambit of the mathematics.

When a model is obtained from some mathematics (geometry, topology, network), its exposure takes the form of arguments analogous to the ones of mathematics, from which comes the representation that it is the mathematization of science. For example, $F = m \times a$ is a particular definition (Newtonian) of force and the calculations appear as if they were the thing itself. In fact, it is a definition of the Cartesian product of mass and acceleration, which establishes that force is a relation, not something essential, in it and by it (absolute). Would this relation have the subject-predicate form? The relational definition says that the subject "force" is the same as the multiplication of "mass" and "acceleration," which operates as predicates, in a relational, relativistic ontology. This leads us to ask: What is mass? What is acceleration? These names are also defined through predicative relations. It is not, therefore, "mathematization", but the use of some concept produced in the ambit of mathematics, in this case the Cartesian product, to define and explain a phenomenon. This procedure does from the use of argumentative schemes capitulated in rhetoric, the specific difference is found in the demands of conciseness and conclusiveness required in each situation, i. e., argumentative rigour admitted by the scientists, what establishes a rhetorical genre, the one of sciences (Pera 1994).

Kuhn is right to say that scientific paradigms are replaced, but the problem is in the choice of the theory sustained by the paradigm. The criteria for this choice are in the analysis of the inferences used, what, in reconstructive sciences, is not a formal problem, but of choice of the metaphor (model) that provides the predicates used to constitute the terms of the syllogisms to tell the reasons, or causes, of some event. The history of sciences provides an illustration of what has been said above when one examines the debates about the essential qualities of the matter at the beginning of the twentieth century. On the occasion, Weinberg contended that the matter was composed by elementary particles that behave as if they were a "swarm of insects". His opponents ironically said it was "zoology". This objection led the physicists to compare the movements observed with the inanimate (Holton 1995; 1982). The best comparison is

with the set of random numbers, which allows to move away the vital forum and calculate the probability of the "particles" being in a zone of the space in observation (space of parameters).

In short, in the ambit of reconstructive sciences, as well as in others communicative situations, replacing their models changes the arguments, this is because the premises get their meanings of different metaphors from the previous ones. The models can continue to be used in a situation because what defines the relevance is not the model, but what it is intended to do; it is not a formal problem, but of the decisions taken by the collective of scientists in a situation of regulated dialogue.

Now it is necessary to recall the concept of structure that lies behind what is being presented.

11. Structure conception in the constructive science to the reconstructive sciences

The constructive sciences examine conceptual structures. The structure immediately comprehensible is the clause, which presents subject and verb, the verb being operator of language.

The constructive sciences have as object the mathematical and logical structures, in some base scheme and its transformations. What is called "structure" is the maximum of properties that an operator presents on a set of elements. It is the case of addition on the set of rational numbers. If the addition is applied to the set of rational numbers, then it will present the following properties: associative, commutative, neutral element (zero) and inverse element (-n), a structure called commutative group. If the addition is applied on a set of natural numbers without zero, then it will be a commutative monoid, because it only has the first two properties. These concepts of algebraic structure can be taken as models for studying operators on a non-numerical set. For example, the structure of kinship, as Lévy-Strauss did; as well as the cognitive structures, which are found in the proposal of genetic epistemology due to Jean Piaget.

Certainly there are significative modifications when the algebraic structures are taken as models to describe and explain relations distant from algebraic calculation, but the authors approximate the notion of algebraic operator to those they find in the relations they study.

Let us recall the case of the genetic epistemology in which the cognitive operations are presented in a process that starts in the sensory-motor schemes, they are not structures yet, and culminates in the logical-mathematical structures. It is affirmed that there is a construction, just like

it can be said that occurs in formal sciences. This is an illustration of the appropriation of the concept of algebraic structure by a reconstructive science. But the use of the concept of structure does not imply structural transformations analogous to the algebraic, except if there is some theorem that allows to affirm the equivalence, what was rejected by Piaget, to remain in the illustration. Piaget reconstituted a process using a model that allows to describe and explain it without assuming that it is an algebra or that it would be possible to calculate its transformations. It is not the case, here, to develop this affirmation that was theme of a debate between Leo Apostel and Jean Piaget (see, for example, Piaget and Garcia 1987, 168).

On the other hand, the developments of the constructive and reconstructive sciences go on their own way. In the constructive sciences it is made through structural transformations that allow wider generalizations that contain the previous ones.

In the reconstructive sciences the changes occur by replacing the models according to the necessities required by the situations. Thomas Kuhn, examining the history of a reconstructive science, namely physics, showed the replacement of paradigms, but this does not occur in the case of constructive science. In these, the limits of formalization, demonstrated by Gödel, led in another way to formalism, through *the algorithm* (Berto 2009).

The algorithm is a non-ambiguous and well-defined sequence of instructions that can be mechanically performed during a certain time and that can be carried out either by a human or by a machine. Algorithms allow to describe and to anticipate activities, which leads to the examination of the human practices.

The human practices present two aspects under which are evaluated: the effectiveness (efficiency) and the anticipation. The anticipation of the action, or inference, is sustained in what is said about the practices, therefore in the model or conceptual metaphor in use, from which the premises and their syllogisms are taken. What is said to be the premises of the syllogisms depends on the forum providing the meaning of the theme, on what it wants to mean or re-mean. The reconstructive sciences sustain their inferences in the conceptual frameworks that they consider relevant to the real. But there is a speech that presents itself as being beyond and below these disputes, which is sustained in the categorical or apodictic syllogism.

12. Speech for beyond or below the human

Usually it is considered that negotiation of meanings is the expression of the arguments' fragility, once it is conditioned to social

groups. It is said, then, that philosophy and science are defined by a speech that can persuade any person by the bond of reasoning that is beyond or below social groups, speech that is presented in the form of categorical syllogisms. When it is not so, radical relativism is affirmed.

The source of this conception is found in the Previous and Posterior Analytics in which Aristotle presented the technical instruments for the exposure that requires some independence from the éndoxa. It is the case of the speech of education (didascalia), in which the speaker speaks and the listener can only have the attitude of apprentice, of acceptance of what is stated.

A rigorous presentation is a technique that requires the systematization of the statements chaining them in such a way that each one is necessary to the other. The technique of exposure is, like many others, contingent and dependent on the audience. This results in a circularity: in order to learn a science it is necessary to know the science, just as in the Paradox of Menon. The solution is this: we learn the argumentative techniques by using them. They are not immediately and entirely learned, but progressively by imitation of technical acts, particularly solving the problems as they are put by imitation.

Besides, the examination of the premises of the arguments is conditioned by the institutions that determine its degree of freedom. Among social institutions there are those that consider that certain premises are founding principles and therefore not liable to being questioned. That is why, the greater the freedom of the members of an institution, the bigger the probability that many will question the principles admitted, since they will not be censored, as long as they follow the rules adequate for each type of question. As the universal rules are the rules of syllogism, there are those who propose that this is like a machine that discards the speaker and imposes itself to the auditorium. Once any argumentation relies on some kind of syllogism, it can be said that the syllogism is a proper tool of rationality.

The recovery of rhetoric by Perelman and Olbretchs-Tyteca has an origin: the procedures proper of logic are calculations that replace man in the production and development of knowledge or, paraphrasing Quine (1953), logic should replace the scientist, should conduct the thought in an automatic way, as a conceptual machine, which in fact it is.

However, inside the propositional logic an insolvable problem emerged, the one of material or conditional implication. In the judgements so-called “conditional”, from a statement in which the antecedent is false and the consequent is true, we get a true statement. For example: in “the

cows fly" (A) and "the cows are herbivore" (B) is a true conditional, form A — B is valid. Quine, for example, may suggest that we should abandon the expression "if...then", let the form dominate the thought discarding the material content, but in the scientific practice this would be absurd.

But this way of proceeding is unsuitable for value judgements, as the ones used in the judiciary, as well as in political decisions. Therefore, there was a need for "logic of value judgements", which already existed, but had been forgotten: the Rhetoric. This is the reason for the restoration of Rhetoric conducted by Perelman and Olbrechts-Tyteca.

The attempt to overcome the difficulties posed by the interior of logics gave birth to movement called "natural logic", where the premises of syllogisms result from a negotiation of their meanings (Berti 1997; Wolff 1995).

13. The rhetorical situation: negotiation of the predicates of premises

It is not the method that speaks but people, who question the answers in a negotiation of meanings held in a rhetorical situation. The negotiation starts by saying what it is from the examination of speeches that intend to establish their meanings looking for the occurrence of the argumentative mistake known as *petition of principle* (Perelman and Olbrechts-Tyteca 2008, §28). Saying what something is establishes the predicates (categories) that delimit what is negotiated through the contradictory. Anyone who says that the subject (theme) presents such and such qualities (predicates, attributes, properties) does it through the transfer of meanings of what is already known to what is not known yet, what can produce a metaphor or model.

The metaphor is not only an ornamental figure but cognitive, expressive and praxiological: cognitive by approximating an object to another not similar, through the transfer of certain predicates; expressive by exposing the desirable for a social group; praxiological by orienting what should be done (Chabornnel 1991a, 1991b, 1993; in particular, 1999).

Once a metaphor is admitted, an agreement is established that will determine the bond of reasoning. The identification of the cognitive metaphors requires the rhetorical analysis that exposes what the speaker and the audience consider established, as well as the reasons for the disputes about the meanings.

Then, it can be sustained that the techniques that seek, in some way, to affect men are not apprehended by logical analysis, because this limits

itself to expose the valid bonds of the speeches. Even if it is a relevant analysis, it does not allow us to understand the relations among the speaker, the audience and the speech through which negotiate their differences and the processes of influence or persuasion.

On the other hand, the procedures to produce reliable knowledge are not the ones used to expose them, which Aristotle dealt with in *Analytics* and which constitutes the horizon of education and puts pedagogy in scene. Would this be a reconstructive science of the educative practice?

14. Pedagogy, reconstructive science of the educative practice

If pedagogy, reflexive condition of the educative practice, is a reconstructive science, then its arguments are produced from comparisons, as in all sciences and any other knowledge, searching to establish the effective and efficient ways to change beliefs, values and attitudes of the students. This is not an exclusive territory of the Pedagogy, because the politics, the dramaturgy, the poetics, the music, the painting and the sculpture are techniques that aim to change beliefs, values and attitudes. However, there is a great deal of controversy about its efficacy and efficiency (effectiveness), which has its origin in the analysis of the modal assertion: it is possible to change beliefs, values and attitudes, once it does not say how, or if it is necessary, it only claims to be feasible. It is known that sometimes it is possible to lead others to certain thoughts, because it has already occurred to each one be affected by readings, debates, evaluation of some work and learning. But this conviction is questioned whenever one tries to go from the "possible" to the "necessary" and to the how to do.

The denial of the effectiveness of noetic technical acts assumes, then, its role. There are, at least, two skeptical attitudes: (1) one saying that it is impossible to change values, attitudes and beliefs of others, because words are interpreted in different ways; (2) one that sustains that people are influenced by forces that cannot always be fully grasped, which prevents deliberate actions from producing the intended changes.

Initially, as far as it is known, Górgias de Leontini proposed the assertion that the words were not capable of making the entire communication, that the others interpret them according to their conceptual frameworks, which is why one cannot be sure of the efficacy of the speeches. Górgias sustained the power of rhetoric to mobilize people, but also exposed its limits, limits that were presented by Sextus Empiricus in *Adversus Mathematicos* (Against the teachers or Against the

scholars) (Hankinson 1995, 83): "the speeches are not the things that remain", therefore, the word does not have the power of changing the conscience of listeners. There are limits for the action of the speaker: he is unable to modify the non-negotiable for the audience. Therefore, Górgias and others concluded that a true knowledge about the world is impossible and persuasive speech can only be a reconstitution of what is already known.

The second skeptical position envisages the deep essence of each person, which is not accessible to other people who may want to shape it by persuasive speech. In this case, the effectiveness of an educative action can only be explained by the coincidence (the joint incidence) of the speaker with the audience. The listeners do not modify their beliefs, values and attitudes by the action of the speaker, they just recall what already is in their spirit, as in the Paradox of Menon: it is not taught, it helps the other to expose what is in themselves. A contemporary version of this approach claims that the unconscious mind is inaccessible. In this perspective, the analyst reflects (in his meaning of speculating) what the patient presents helping them to be aware of the hidden forces that move them. The analyst does not modify these forces.

In any case it is stated the limits of the action that intend to modify the beliefs, the attitudes and values, which is sustained in the modal axiom, what puts in presence the constituted science based on the limits of the technique of negotiation of the meanings: Rhetoric.

15. Rhetoric, science of the limits of communication

Rhetoric is the science that studies the limits of the art of persuading or influencing people. Aristotle presented it in his treatise as the science that aims to find the persuasive in a situation from the spontaneously performed by the effective and efficient speakers. It is, therefore, a body of reliable knowledge capable of guiding the work of the speakers who want to deliver a speech that moves the audience in the direction they want it moved. And, as in any other technique, it is necessary to adjust the idealized to the conditions of its implementation. In other words, the incompleteness of the art is the condition for its science, the one that seeks to systematize its ways of doing, its knowledge, considering its limits. In short, from the conviction that it is possible to modify attitudes, beliefs and values, which has its origin in the experience of each individual, the categorical certainty is not reached because the modal axiom says a lot and almost nothing. The overcome of this limitation is feasible by the recognition that it is in a rhetorical situation, the

counterpart of dialectic, which is proper of any human group. In this case, the knowledge is validated by the observance of the argumentative rules established along the history and maintained in a permanent dialogue among members of the social groups.

Can it be stated that the educative practices are a particular case of the rhetorical art and that the rhetoric is the science of education?

16. Rhetoric, the science of education

The modal axiom of pedagogy is the same of rhetoric and makes it contingent character explicit. The contingency is not exclusive of the social techniques, in all of them there are limits set by particularities. The recognition of the contingency expresses the pragmatic position that it is always rehearsed to do something perfect and complete, but usually it is not accomplished. The rules for success are necessary, but they are not a logical calculation, they are algorithms and, as such, fallible. The art of persuading implies recognizing the reasons behind the resistance of the audiences, their good reasons to keep their beliefs, attitudes and values, as showed by Boudon (1990; 1995). The good reasons are not beyond or behind human, they express what is considered reasonable to believe or do, even though they cannot be immediately apprehended by those who observe them or interact with them, they can be apprehended through rhetorical analysis.

The rhetorical analysis of the pedagogical speeches produced by teachers and other people, as well as those produced by experts, researchers of education was proposed (e.g, Mazzotti and Oliveira 2000) as a way to establish a Science of Education. But there is no dialogue with the scientists of education, as it has been showed by Tardy (1989). It was presumed that from rhetorical analysis, an interdisciplinary dialogue would emerge. But, in fact, the object and the method that enables the emergence of an interdisciplinary form are the same as those establishing a discipline and, therefore, it is a vicious circle.

The solution is to consider that the modal axiom is a common object, the definition of limits of the actions being in charge of each science that deals with educative practices. If it is so, then that inter-discipline already exists: it is rhetoric. It is the discipline that considers the social situations limiting the accomplishment of what is desired by the speaker. On this record, school education is a genre of rhetoric, in which the institutional conditionings have been investigated by sociology, social psychology and anthropology, as well as history. These sciences provide

the means to understand the conditions under which social actors develop their relations, the school ethos, which sets the limits for the implementation of changes in values, beliefs and attitudes.

17. Conclusion

The scientificity of pedagogy is usually sustained in a theory of knowledge that has as its model the formal sciences, in which well-formed systems of statements are constructed from axioms. This way, no reconstructive procedure can claim to be scientific, even if it operates with models taken from some formal structure to describe and explain the phenomena. The relevance of the model does not derive from its formal truth, but from a negotiation among scientists by procedures considered canonical, based on the *modus tollens* syllogism. In this situation the models or metaphors are replaced if they do not meet the conditions of use, what they intend to do, since they are the ones that provide the premises of the syllogisms used.

Here it is stated that rhetoric is one of the reconstructive sciences established from the examination of techniques spontaneously used by the speakers and its object is the modal axiom that affirms the possibility of modifying the beliefs, values and attitudes. Since the art of rhetoric and the art of teaching, as well as other intellectual techniques sustain themselves in the same axiom, then all of them have the same object: the limits of the action asserted by the modal axiom, which are usually studied in the science named rhetoric. Thus, pedagogy is a genre of rhetoric, which also uses procedures of the analytic to organize what is taught.

However, pedagogy is not a rhetorical genre recognized by classics, especially by Aristotle for whom teaching is a sequenced exposure that does not consider the particularities of the audience, probably because it is constituted by adults reasonably educated. This organization of teaching was characterized as “logical” by its opponents, who have been gathered under the collective “progressivism”, which affirms the need of a way of “psychological” teaching. The progressivists resumed, in fact, a recommendation of rhetoric: the speaker’s action should (imperative) consider the audience. Taking the school audience into account implies getting to know its cognitive, affective and psychosocial conditions that pose limits to educationally transformative action. The research in the ambit of the rhetorical genre education has as implicit object the negotiations of meanings that involve the relation between the teacher (speaker or éthos), the students (audiences or páthos) and the subjects to be

taught (lógos). Making these negotiations explicit also exposes the limits of the modal axiom, expression of the contingence of the pedagogical action.

In considering pedagogy a genre of the rhetorical art enables us to think more realistically about the effectiveness of its techniques in school work. It enables the analysis of the systematized knowledge taught in schools according to the figures of thought, its logical and almost-logical forms, as well as the reasons behind the preferences for certain programs. It is, therefore, a research agenda that focuses on complementary rhetorical techniques, including the ones of dialectics, and the ones of logic, or of the chained exposure of already produced knowledge, which seems to be a reasonable way to overcome the current epistemological dispersion in the sciences of education.

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