The End of Objectivity and Subjectivity in Educational Sciences

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Abstract

Education Sciences have a recent institutionalization, contemporary with influential epistemological views based on the natural and exact sciences (Popper, Kuhn, Lakatos, Feyerabend, Longino, Bourdieu and Harding). This may have led to the direct importation of principles and discourses, which suggests the need to debate such influences regarding the coherence of their meanings with the complex nature of education.

For this purpose, we analyze the arguments “objectivity” and “subjectivity”, commonly mobilized in research, which some understand to be epistemic virtues. Therefore, what characterizes the “objectivity” and “subjectivity” arguments in influential epistemological proposals? What is its meaning in Educational Sciences and, in particular, in qualitative research?

Methodologically, an instrumental, comparative, and reflective analysis of influential epistemologies is carried out (in terms of the meaning attributed to the objectivity and subjectivity arguments), to discuss the epistemology of Education Sciences.

The results suggest different purposes and conceptions of objectivity and subjectivity, based on (a) the researchers’

neutrality in relation to social values, (b) the values that allow integration into a paradigm, (c) the retrospective look at the knowledge produced, (d) the creative capacity, (e) the representativeness of groups that may have an interest in knowledge, (f) the elements of scientific prestige and (g) the dominant/oppressed position at the origin of knowledge.

This suggests questioning the virtue of the “objectivity” and “subjectivity” arguments, since they have dispersed meanings and can lead to incommensurability, when the scientific meaning of education is, on the contrary, to be situated at the confluence of various sciences and methodologies.

In conclusion, it is relevant to debate the epistemic virtues of Education Sciences that support the commensurability, and it is proposed that this process begins in the inter-subjectivity, inter-coherence and inter-necessity that emerge from the complexity of education.

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1. Introduction

Education has an extensive past, perhaps primordial, because it is a process of construction of the human being (Boavida & Amado, 2008; Charlot, 1995, 2020) and, in this sense, has witnessed the origin of the human species. Despite this, the academic and scientific formalization of Educational Sciences is recent, rooted in a process of emergence that became more pronounced in the first half of the 20th century.

So, by the criterion of time and if we want to compare with scientific areas that are sustained by countless generations of accumulated knowledge, Educational Sciences are in their infancy. However, if we want to use the epistemological criterion, it is important to note that they were instituted at a time when an intense and mature debate about science and knowledge was taking place (for example, Karl Popper’s book “The Logic of Scientific Discovery” has the first edition in English in 1959 and “The Structure of Scientific Revolutions”, by Thomas Kuhn dates from 1962). Although these epistemologies had little to do with education, they were references for what was and wasn't science, so it's natural that they influenced the foundations of the emerging Educational Sciences. However, the starting point of this debate was the exact and natural sciences, and, to a certain extent, this subjected Educational Sciences to epistemological expectations (Class, 2022; Rohstock, 2015) that differ from their nature[1].

This influence from the natural and exact sciences may have contributed to a certain epistemic mimicry and to the importation of concepts without, necessarily, having had a debate about their coherence for Educational Sciences.

To that extent, it is important not to postpone this discussion, in order to establish the meeting and emancipation points in relation to the set of epistemological influences present at the time of Educational Sciences institutionalization. This debate gains importance when we consider the human character of this scientific area: the knowledge produced is intended to be used by students, teachers, parents, and politicians, instead of being locked up in specialized laboratories. Thus, the subject becomes relevant for the communication that allows connecting all these agents – virtually all of humanity!

Here I intend to contribute to the analysis of the objectivity and subjectivity arguments, because they are often mobilized in discourses about knowledge in education and, in particular, as an argument in the debate on the epistemology and methodology of the Educational Sciences (for example, in Horsthemke, 2019; Pallas, 2001; Rata, 2012; Siegel, 1998; Smeyers, 2019).

So, what are objectivity and subjectivity in Educational Sciences? What are their meanings? What expectations do they create?

To respond, I'll start by establishing the concepts of education and Educational Sciences that will guide my analysis, presenting the conceptualization of objectivity and subjectivity and then, the characteristics of the complex nature of education. In the next step, I dedicate myself to summarizing influential epistemological proposals – which I analyze with a comparative, critical, qualitative and inductive approach, in an instrumental orientation (Stake, 2009), from which it is possible to deepen knowledge about Educational Sciences – and to place them in an inductive dialogue with the complexity of education. I end with conclusions about the implications of this dialogue for Educational Sciences.

2. Education and Educational Sciences

I'm using a notion of education that is linked to the evolution of humanity (Charlot, 1995), as a process in which the human being is constructed by the human being. In this sense, what defines education in human history is the interaction between learning, teaching (Gärdenfors & Högberg, 2017; Högberg, Gärdenfors, & Larsson, 2015), the intersubjective coordination that has allowed humans to share feelings and expectations with other humans (Gärdenfors, 2007) and to project – meaning the orientation towards the non-immediate future, the pursuit of dreams – and the ability to record knowledge, in the sense that everyone has access to knowledge relevant for equitable development.

Education, then, is founded as the congregation of human beings - when the human being that was being renewed transcended innate behaviour and imitation - around the coordination of individual experiences and knowledge with the vital experiences of other human beings (Boavida & Amado, 2008), which implies decisions and choices about what knowledge to create, conserve and transmit, to regulate life's path and innovate, equitably, in the pursuit of dreams and desires, and the intersubjective awareness that the decisions made have consequences for themselves and others which, although they can be imagined, are impossible to anticipate.

From here, it is possible to characterize Educational Sciences as the scientific field that scientifically investigates the

interacting elements that historically define education.

So how did the field become scientific? What allows us to say that Educational Sciences exist)?

There are three elements that seem relevant to defining Educational Sciences: the establishment of a network of people and debates (the social conditions), the presence of institutions that support the emergence of the disciplinary area (the institutional conditions) and the development of research (the scientific conditions).

With regard to the gathering of people and interests around education, I take the view of community proposed by Philippe Meirieu (1997), as a non-arbitrary space in which agents meet because they share affections and dreams and, therefore, which translates into adherence.

Now, what seems to have been at the beginning of joining this "education" community was the reforms and innovations in the education system (Hofstetter & Schneuwly, 2002; 2010) at the end of the 19th century and the beginning of the 20th century in some European countries and in the United States of America, such as the expansion of school networks (therefore, formal education) and the growing need to train teachers in effective teaching techniques, as well as the inspiration of people (such as Maria Montessori) from several scientific fields who sought to improve children's lives. This created the conditions for the establishment of congresses, journals, and teacher training schools, which are at the origin of the conditions for debate, controversy, and the aggregation of knowledge.

However, there was a certain initial focus on child development and schooling, and therefore not so much on education as an equitable and complete process. It seems to me that the completion of the object of the Educational Sciences emerged throughout the 20th century, with an important milestone in the work of Coombs in 1973 (Coombs, 1973) and, in the 1960s, Paulo Freire (1963), who definitively broadened the focus to informal and non-formal education.

Even so, this renewed interest in education, which saw the emergence of a social network of agents, was also at the origin of the emergence of professorships/chairs in the field of education which, in turn, signalled the academic institutionalization and recognition of an area of scientific knowledge (Hofstetter & Schneuwly, 2002) – this happened partly because of a political decision and partly because education professionals and agents in society began to demand better schooling and act to make it happen

As far as the scientific component is concerned, it seems to have emerged precisely because of this interest in teacher education, child development and the role of school in social development, which led some teacher training centres to start research and to integrate it into universities. This scientific research was therefore carried out in the context of the influences that became stronger in the twenties and thirties of the twentieth century and then, with the end of the Second World War, under conditions of peace, in some universities in France, Germany, Switzerland, the United States and Canada, with the transition from a philosophical to an empirical orientation to education (Hofstetter & Schneuwly, 2002).

It seems to be a still incomplete process, in which Educational Sciences have been wandering through plural epistemologies, perhaps resulting in a confusing set of orientations about what it is to do science (Hoppers, 2002), since these epistemologies inform researchers about purposes, attitudes, methodologies and techniques and, above all, shape

researchers' ability to understand, value, debate and use the research of other researchers (Pallas, 2001). Despite this difficulty, it is precisely the commensurability that emerges from the dialogue between different epistemologies that makes it advisable to analyse the virtues and epistemic arguments used.

Therefore, there is still a need to deepen the epistemic foundations of Educational Sciences, not least because several influential epistemologies were based on the natural sciences. What profile would they have had if they had started in education? - This is still a central question.

In any case, these steps (community, institutionalization, research) have resulted in a discipline, in the sense that methods are in place and there is a research tradition, as well as a community of scientific peers and communication channels that underpin a reflexive self-awareness of the scientist's role in collaborating with others and in interpreting and judging research processes (Smeyers, 2019).

However, two characteristics that are very present in education research should be highlighted: firstly, the plurality of agents, and the inherent heterarchy (for example, sociology, psychology, pedagogy, philosophy, economics), which makes knowledge possible only when the different contributions are able to complement each other; and the fact that the knowledge produced leads to changes in reality and therefore challenges exactly what was produced – knowledge, by changing reality, changes the validity of knowledge itself. In such a complex system of interactions (Silva, 2019), the only way to operate in this sea of epistemic differences and plural ways of studying education (when there is something that is not comparable) is through trust (Longino, 2002). Therefore, we need to look for conditions that foster the values of trust and, in this sense, that is what I am trying to do here, by analysing and proposing epistemic virtues on which we can base our work.

3. The arguments objectivity and subjectivity

Objectivity and subjectivity are expressions frequently used in education research, but also in discourses that influence education, its agents and, therefore, the interactions that are the subject of research in Educational Sciences.

Objectivity refers to the idea that science is not influenced by personal, moral or social values and is therefore neutral, insofar as there is a reality (or, at least, an invariant) that is independent of human perceptions (Daston & Galison, 2010; Nagel, 1986). So, it rests on the idea that the knower and the known are separated, and that the researcher stands outside of history and culture. As an argument, it justifies the authority of science by translating guarantees of impartiality and certainty, regardless of the feelings of scientists, from a priori criteria that establish what is, or is not, objective.

Subjectivity, on the other hand, is often understood as the opposite of objectivity (Daston & Galison, 2010), that the researcher is immersed in a time and a society and that he or she integrates values that influence the interpretation of the data and, therefore, that all knowledge is relative. Therefore, its authority comes from the person, their choices and the suggestion that reliability ends in individuality.

However, these arguments are also linked, in education, to hidden synonyms that highlight and feed an opposition of

meanings – for example, I find it (or it is denounced) in texts on the organization of universities (e.g. Idalgo, Correia, & Medina, 2019), external and internal evaluation of schools (e.g. Conselho Nacional de Educação, 2015), academic rankings (e.g. Nunes, Reis & Seabra, 2015) and countries educational comparison policies (e.g. Grek, 2009).

In this opposition, objectivity is often connoted with the ethics of justice (Shapiro & Stefkovich, 2005), aimed at ensuring that all agents should be treated with the same degree of dignity and respect; while subjectivity is linked to the ethics of care rooted in supporting the fulfillment of the needs of each human being. This dialogue supports and is supported by another opposition, in which objectivity is related to equal opportunities (everyone has access to it) and subjectivity to equity, the guarantee that agents are able to take advantage of the opportunities that are available to them (Flores, 2017).

Objectivity is often related to what is quantifiable, unambiguous and whose interpretation is similar from agent to agent; and subjectivity is related to the qualitative approach, essentially the stories, narratives and feelings that, supposedly, cannot be compared and can be interpreted differently, depending on the observer and time.

Therefore, objectivity is also sometimes presented as something comparable, since it has stability over time; and subjectivity is something that cannot be compared, because it is based on changeable and reinterpreted elements.

Such and other connotations contribute to determining frameworks for interpreting reality and, therefore, guide agents in their decisions (table 1).

Table 1. Oppositions of objectivity and subjectivity

Objectivity	Subjectivity
Neutral	Personal
Invariable	Variable
Justice	Care
Quantitative	Qualitative
Comparable	Not comparable
Product	Process
Object	Subject

Note: author's elaboration

This is, by the way, why Lorraine Daston and Peter Galison (2010) consider that objectivity and subjectivity are epistemic virtues, as they are internalized norms, which are applied by appealing to ethical values and demonstrate pragmatic effectiveness in ensuring knowledge.

It is precisely this virtue that should be challenged. On the one hand, there is evidence that researchers do not attribute practical effectiveness to it; on the other hand, it is important to ascertain the nature of the reality that supports the objectivity and subjectivity arguments when mobilized in education, since the dichotomy that I tried to highlight suggests

that one and the other assume opposite realities, and that each of these assumed realities excludes, reciprocally, the characteristics of objectivity or subjectivity. Therefore, a suggestion emerges that we can inhabit different and perhaps opposite, contradictory, incommensurable, and conflicting realities and this is what is challenged by the complex nature of education.

4. Complex nature of education

What I emphasize here is the complex nature of education, which many authors have come to remember (e.g. Cilliers, 1998; Fullan, 2001; Morin, 1990, 1999; Silva, 2019), in the logic that this nature precedes knowledge, that is, that knowledge that we can aspire to know and the methodologies we use to do so are dependent on the characteristics of reality.

Complexity assumes that each agent has freedom of action and therefore can interact with others, influence the system and, through this, lead to self-organized adaptations, which emerge because agents spontaneously collaborate with each other, due to critical sensitivities to which they respond and that may be hidden (Cilliers, 1998). Here, it is necessary to consider that an agent should not be understood as a person, but as a set of something capable of interacting and influencing others. Thus, social groups, associations, and research centers are agents. But so are ideas, visions and desires.

Table 2. Two ontologies: order and complexity

	Order	Complexity
Future	Predictable.	Unpredictable.
Causality	Linear.	Non-linear and dispositional.
Stability	The system is stable.	The system is co-evolutionary.
Modeling	Reduction of reality to models.	Reality cannot be reduced to models.
Knowledge	It is possible to know the whole system.	There are hidden elements that are impossible to know. There is modularity (agents know part of the system, but not all of it).
Structure	Organization.	Self-organization.
Action	Implementation.	Emergence.
Power	Hierarchy.	Heterarchy.

Note: author's elaboration

The main point is that complexity has impacts. They may become clearer when comparing the characteristics of complex systems and ordered systems (Table 2).

In complex systems, once agents are able to self-organize, surprises often emerge. Therefore, there is no future that can

be anticipated.

On the contrary, in ordered systems (we can think of a factory), it is relatively easy to predict the future, because agents are constrained to a known set of interactions and to causal and linear relationships: the actions they take systematically lead to the same results.

In complexity, on the contrary, relations do not have linear causality, but dispositionality (there is a disposition for something, but not a certainty that the something will happen), which means that even if the initial conditions are the same, the results can be different, because agents change and cause the system to change as well (there is coevolution). Thus, power is distributed since each agent is free to intervene with the others and leadership assumes a local and heterarchical character.

The same does not occur in ordered systems, where, given predictability, leadership can be hierarchical and personal, because it is possible to implement actions that lead to the intended future (or actions that correct the current path) (Silva, 2019).

In this picture of differences, it seems to me that the complex nature of education is evident. If it were ordered, we would long ago have implemented a teaching and learning system, perfectly functional for everyone. Thus, education includes the essential characteristics of complexity, that any action taken can have unforeseen and impossible-to-anticipate consequences. and that, since it is not possible to determine the future, the relevant actions are those that are based on coherence with an expectation, rather than those that aim for linearity.

We can find vast evidence of this contingent knowledge: in India, where a policy to promote school attendance led to some children having less access to school (Szekely & Mason, 2018); in the Netherlands, where inspection actions aimed at improving the quality of schools led to the disrepute of some of the intervened institutions and to their closure (van Twist et al., 2013); or in South Africa, after the end of Apartheid, where the end of universities for people of a certain race led to reduced access for those who were the main victims of the segregationist system – exactly the opposite of what was intended – because they began to compete on equal terms with people who had better socioeconomic and learning conditions (Sehoole & Adeyemo, 2016).

So, the emerging question is about the epistemology that is consistent with these characteristics of uncertainty, emergence and heterarchy of education.

5. Objectivity, subjectivity in the context of complexity

What I now try to do is dialogue between the characteristics of complexity and influential epistemological perspectives, focusing (a) on what in them can be interpreted as objectivity and subjectivity and (b) reinterpreted as a challenge or epistemological complementarity with the Educational Sciences.

Historically, the characterization of objectivity as neutrality seems to have emerged when photography replaced scientific

drawing and freed the representation from any interpretation of the subject (Daston & Galison , 2010), because the machine was considered capable of capturing reality as it was, without any variation, which it did not happen when scientific images were drawn, since the hand of the designer (often the scientist himself) could translate the personal interpretation of a fact.

This place of authority of accuracy metaphorically assumes concerns about demarcating science from common sense, which places the thought of Karl Popper (1902-1994) as a good analytical starting point. Then, I follow a historical timeline – in order to try to understand the influences today – around influential epistemologies selected in the course of a narrative analysis of the bibliography and interactions with experienced researchers in the field of education, who advised. Inevitably, choices have to be made depending on the space available and, in this case, mine were to value the creative interaction that arose in Europe and in Canada and the United States of America between Popper, Kuhn, Lakatos, and Feyerabend and to bring perspectives that, because they were constructed from contemporary contributions make them represent or criticize them (that's why I chose to analyze the works of Helen Longino, Sandra Harding, and Pierre Boudier), and constituted an ecology of debate. Other authors could be included, but these ensure the necessary conditions for the debate I am holding here.

5.1. Objectivity and subjectivity in influential epistemologies

As for **Popper**, the author's motivation for demarcating science from common sense was the finding that people tend to find *ad hoc explanations* for anomalies (that there is always justification for maintaining known and comfortable cognitive patterns), which, for Popper, calls into question the objectivity of science and its ability to innovate (Popper, 2019).

In this sense, he argues that what demarcates science from pseudoscience is the possibility that a given theory can be falsified through rigorous and replicable processes (Popper, 1998) – and not the extensive gathering of confirmatory evidence. So, authority comes from scientists who are celibate in their beliefs (and therefore objective) and who intentionally question their own creation and provide conditions for others to do the same. This possibility of interaction will be relevant, since Popper considers that individuals, even if they don't want to, are always trapped in reminiscences of beliefs and, therefore, objectivity is an ongoing process that benefits from the intervention of different agents so that the influence of beliefs and values are constantly confronted and reduced - the logic is that knowledge must pass through many scientists who are verifying the errors of objectivity of the previous colleagues, which gradually diminishes the influence of beliefs and personal values.

In this perspective, it should be noted that Popper's proposals opened the era of uncertainty - as João Amado (2013) pointed out -, in which current knowledge can be falsified at any time and is, therefore, unstable, something for which perhaps no proper credit has been given – Ilya Prigogine said it in a more systematic way, towards the end of the 20th century (with Isabelle Strengres, 1997), which carries the relevance of Karl Popper's thought to our days.

However, **Thomas Kuhn** looks at the same problem (the functioning of human beings based on patterns) and criticizes Popper, because he understands that scientists do not want to falsify the knowledge they themselves have built, but to deepen and improve it. This will be the basis for the author to point out that science does not have the objectivity that

Popper proposed, since the work of scientists takes place in a historical and social context that brings agents together around expectations about what to expect from scientific work and how to interpret the data (the paradigm), a process that is not entirely rational and is given to social dynamics of reconversion and sharing of values. In this case, scientific knowledge is what the scientific community itself recognizes and validates, and objectivity is translated into sharing an interpretative framework of reality that, however, excludes agents who do not accept or do not convert to the paradigm.

It is this dynamic that will be at the base of what Kuhn called incommensurability, in which the paradigms are incompatible with each other (two different paradigms cannot serve to explain the same reality). For the author, it is scientific work itself that gives rise to the emergence of anomalies that will tend to accumulate and push science towards a moment of crisis that could lead to the emergence of a new paradigm capable of resolving anomalies (Kuhn, 2009, 2014) – and science advances through qualitative leaps validated within a social and historical relationship.

Therefore, the idea emerges that science is based on social interactions between agents and that this interaction will result in a moment when knowledge ceases to be recognizable to others. Therefore, objectivity will be the sharing of theories and beliefs that allow integration into the paradigm and subjectivity the divergences that will jeopardize the robustness of this paradigm.

However, **Imre Lakatos** (1922-1974) does not find, in contemporary science, those moments of discontinuity and revolution that Kuhn talks about. Lakatos argues that science is based on continuities and cannot just be left to the criterion of the social relations that are formed between scientists (this would be a dependency on group psychology) and that there is a central place for reason in determining method (Lakatos, 1989).

So, he proposes a structure in which scientific evolution occurs by aggregating scientists into more common structures, which he calls research programs. They are made up of a hard core of strongly established propositions/theories and that, when anomalies arise, scientists find explanations for the moment, which generates a line of adaptation that makes a protective belt of the hard core of knowledge - which is not put into question.

In this process, science develops gradually, sometimes progressing (when the theory adapts to anomalies and is capable of making new predictions), sometimes regressing (when this capacity ceases to exist) – however, this evaluation is carried out in historical time and not immediately.

In this view, objectivity occurs by associating scientists with a central knowledge that they consider unshakable and as the ability to rationally make history about the impact of the research program; and subjectivity emerges as an anomaly to be resolved – because scientists believe in the hard core and will resolve the anomaly without calling it into question.

Lakatos' position will be directly challenged (in reality, by agreement between both) by**Paul Feyerabend** (1924-1994), who argues that if scientific knowledge can only be validated in a future that allows understanding its effects, then at the present time no one knows what science is. In addition, he points out that scientific developments have historically resulted from moments of creative challenge to established methods and theories (in which, sometimes, evidence was scarce and science was based on intuitions), which means that if they had not occurred, several innovations would have

been silenced and knowledge would rest in the hands of agents with similar perceptions (he also argues that theories are, in fact, incommensurable) and then there would be no incentives for advancement. From there, he proposes the thesis that scientific work should not be rationally and procedurally limited and that a significant part of the work of scientists is to be creative and to break the rules (Feyerabend, 2010).

Therefore, Feyerabend argues that objectivity cannot be the only, nor the most important, means of science and that subjectivity has an emergent capacity and is expressed in risky initiatives, in which the researcher puts his own reputation in check to pursue theories that may not be supported in existing data. In this case, subjectivity emerges as a scientific value and objectivity as an obstacle.

Helen Longino (1990), will call into question the incommensurability that Kuhn and Feyerabend embraced, since, in her view, it is challenged by debates and collaborations between scientists from different theoretical areas. For the author, evidence and hypotheses are linked by the values and assumptions that researchers carry (this is what makes it possible for similar evidence to support different theories) and so scientific practice must be seen as a social process. Thus, it must be acknowledged that science is subject to the biases that agents carry (resulting in bad, limited, and oppressive science) and, therefore, the best way to ensure good science is by ensuring that production is based on novelties capable of reducing bias to limited interests, and of respecting and being useful to the human species considering its great heterogeneity and resulting in an effective reduction of inequalities.

This suggests another way of looking at objectivity: it is conceived as a participatory and democratic debate, ensured by critical and cooperative interactions that blur the personal values of the researcher and, in this process, science starts to be based on the objectivity that can be offered by the consideration of the interests of very different agents in society. To that extent, hypotheses become scientific knowledge when they are subject to scrutiny and criticism from different perspectives.

A comparison with Popper is inevitable, who defended that knowledge should be exposed to as many agents as possible, so that any subjectivities are identified and diluted, “[...] therefore, that the objectivity of scientific statements resides in the fact that they can be intersubjectively tested” (Popper, 2005, p.22).

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However, **Pierre Bourdieu** (2017) will look at science from the social game of values and powers that are in the field. The author suggests that science constitutes a field in which agents interact competitively to accumulate capital of scientific prestige and, through this path, assume epistemological supremacy. In this process, deeply interested and social, the field becomes autonomous if it proves to be independent of non-scientific influences and more heteronomous if it is permeable to external authorities. Thus, objectivity translates into factors that contribute to this prestige and that coerce agents (such

as formal positions of power or leadership of research programs) and subjectivity is the manifestation of marginal or challenging identities of the field and resistance to coercion.

Finally, **Sandra Harding** (1991, 1992, 2004, 2015) questions the expectations of the neutrality of scientific knowledge based on the rationale that if knowledge is neutral and its producers are free of interests, then the result of science is free from marginalization tendencies. However, Harding finds the opposite, that science has led to partial and distorted reports and products about the regularities of the real world, capable only of revealing the thinking of socially dominant groups and, therefore, the objectivity that underlies it has not satisfied its own purposes (Harding, 1991).

To that extent, she proposes that the strong objectivity of science is that which considers that oppressed groups can have epistemological advantages, because they gradually became capable of knowing the point of view of dominant groups (after all, they were subject to their ideas) and, simultaneously, are aware of their own needs. In this view, relevant knowledge is that which begins from the point of view of marginalized agents; welcomes cultural differences in the construction of knowledge; and makes it possible to discuss totalizing tendencies.

In short, if there is any tendency for objectivity to be an argument used in the sense of the neutrality of those who produce knowledge in relation to beliefs and values, the analysis of influential epistemologies suggests that such a notion is residual, incomplete and of little use (Table 3) and that possible oppositions related to objectivity and subjectivity as epistemic arguments seem non-existent. What is suggested is that the emergence of knowledge – understanding – results from the interaction of factors (for example, quantitative and qualitative; the product and process; justice and care) and not the opposition.

Table 3. An integrative analysis of epistemological thoughts in the context of complexity

Authors	**arguments**	
	Objectivity	**Subjectivity**
popper	Independence of values and beliefs, which ensures scientific knowledge.	Dependence on values and beliefs, which is close to common sense.
Kuhn	The paradigm that defines the borders of relationship, acceptance and language. It becomes impossible to communicate with other paradigms.	Parameters shared by epistemic peers that allow for an interpersonal understanding of phenomena, within a paradigm
Lakatos	The central and permanent core of the theory. It is retrospective coherence: looking at the past, knowledge is validated or not.	It emerges as a present doubt, to be treated marginally (as an anomaly to be resolved).
Feyerabend	Restricted and static line of action within a way of thinking that impedes scientific advancement.	Creative ability and ability to challenge practices and theories, which promotes scientific advancement.
Longino	It is the guarantee of representativeness of the diversity of influences.	It is the non-existence or repression of the influences of the various interest groups.
Bourdieu	Factors of scientific prestige and capacity to coerce agents.	Marginal or challenging field identities and resistance to coercion.
Harding	Objectivity is strong when knowledge begins with those who understand its reality (the oppressed) and that of oppressive groups (because they were subject to its knowledge).	Represents dominant groups.

Note: author's elaboration

5.2. Challenges and epistemic complementarities of the complexity of education

I now follow the line of questioning about the complementarities and challenges of complexity in the debated epistemologies. I recall that the complex nature of education is characterized by unpredictability, heterarchy, co-evolution, modularity, self-organization, critical sensitivity, and emergence. So, what are the contribution and challenge relationships between these features and the foundations of influential epistemologies?

As for Popper's proposals, there is something that can be reinterpreted, regarding the concern about the validity of knowledge: if, in complexity, the reality is altered by the interaction of agents and, therefore, knowledge is provisional, falsification will be surveillance over knowledge, in the early search for signs that suggest its bankruptcy (the moment when knowledge loses its meaning on the spot). In this case, it is not those who do science who seek to falsify, but the interactions between agents, who, acting, alter the conditions on which knowledge is based – which challenges epistemic individualism.

On the other hand, in a more challenging sense, it is important to ask how it would be possible for science agents to operationalize Popper's proposal of actively seeking to falsify theories and discoveries. It seems to me that they would have to resort to creativity to find (at least imagine) beliefs that would antagonize theories and hypotheses and that is a movement of dependence on personal values (which challenges the objectivity that Popper defends) and approaches a proposition that everything must be valid in order to falsify, in a surprising approximation to Feyerabend's thought.

And, on a deeper, ontogenic level, it should be noted that Popper is right about the nature of human beings, because he had the intuition to understand that individuals form patterns and act on them. This integrates the inter-relational core of the human being and was important for the survival of the species, as these regularities allowed functioning in the face of nature (for example, to deal with the seasons or harvest food) and were being developed through intersubjectivity (Gärdenfors, 2007), therefore in sharing and coordinating beliefs and learning. However, Popper's error is precisely in following this intuition, since active falsification (the rejection of standards) intends to break what allowed the development of the human species, which translates, then, into the dehumanization of science and, therefore, the loss of ethical capacity.

As for Kuhn, the complementary thought to the complex nature of education is that science is based on social interactions and the historical implications that are involved.

The challenge arises with the idea that this interaction will result in a moment when knowledge ceases to be recognizable to others. Here the emerging question is what happens to scientists who do not recognize themselves in a paradigm or any competing paradigm? Apparently, if the paradigms are mutually exclusive, there is nothing left for the scientist to do than to be placed on the margins of a community or self-exclude. In this case, the complexity of education poses a clear challenge: the acceptance of values and beliefs (I'll call it obedience) leads to the exclusion of agents who continue to act and, therefore, are influencing reality. So, the paradigm that intends to explain this same reality assumes a strong

component of ignorance.

It is evident that, in complexity, coherence can be a stronger instrument of science. We can understand it as an appeal to the shared sense of reality, capable of originating collaborations, regardless of belief – which can reduce the field of ignorance.

There is another emerging challenge. Kuhn starts from expectations that scientists are peers with each other, in terms of methodologies and bases of knowledge, but Educational Sciences challenges this position, since its agents may not have the same object of study, not even the same ideas on the appropriate methodologies to achieve knowledge and, in the complexity, each agent has the power to influence the others and to promote innovations, because it responds to critical sensibilities (what, at a given moment, threatens) that other agents also share. Therefore, in complexity, there is commensurability and agents collaborate despite different and even contradictory positions (otherwise, there would not even be Educational Sciences).

Next, it is interesting to note the complementarity that emerges in Lakatos' thought, of a non-linear causality, in which it is not possible to know today what the impacts of knowledge are - therefore, that it is not possible to affirm a cause-effect relationship, but that it is acceptable to maintain an expectation of dispositionality. This is a characteristic that emanates from complexity and that serves Educational Sciences, translating the idea that it is easy to explain the past with current evidence, but that the impact of current actions is unpredictable – which is accommodated in the definition of complexity. Therefore, it suggests that it is more important to create conditions for interaction between agents, in order to influence the coherence between social objectives and knowledge (and its practical impact) than to determine a future to be achieved.

What remains challenged is the hard and stable core of knowledge that Lakatos proposes. This does not mean that, in education, there are no solidly-based and lasting theories; only that they remain in that condition because their meaning remains updated in the context and not because it results from defense movements.

Incidentally, this seems to be why Feyerabend argues that objectivity emerges as an obstacle to the development of science and that subjectivity has, precisely, the value of being able to advance it. It is up to me to emphasize the coherence with the complexity that this suggests, in particular, the establishment of conditions for interactions capable of leading to innovations and, therefore, through a liberating heuristic of action and not through a prescription for hegemonic practices; and also supports that science should be attentive to what is unexpected, which respects the emergent characteristic of education. The challenge that complexity poses to Feyerabend's thought lies in the incommensurability that he (and Kuhn) defends, since changing the conditions of an agent has impacts on the conditions of the rest and can lead to co-evolution, which translates a system that is not watertight and, therefore, capable of welcoming and participating in the adaptations that make sense.

Interestingly, for Longino, objectivity cannot be constituted except through the mobilization of subjectivities. To that extent, it welcomes divergences and encourages the challenge and transgression of borders. And this assumes an evident complementarity with the complex nature of education (also in Idalgo, Correia, & Medina, 2019), in particular because it recognizes the power of each agent and the modularity to which knowledge is subject. In complexity, agents always have

limited information, and no element can understand and predict all the actions and effects that operated in the system and this characteristic seems to be the basis of Longino's proposal to guarantee representativeness.

So, it is necessary to question whether in a scientific area that necessarily aggregates humanity, the capitals in dispute are only those of credibility and reputation, as sustained by Bourdieu. I note that Educational Sciences – if we want to consider them a field – cannot dispense agents who are not qualified with training and research methods, but who, interacting with each other, produce knowledge and change the reality that Educational Sciences investigate and, in this movement, they are not always interested in their prestige – they are also guided by more related desires (the happiness of their children, relationships with peers).

To create an image, in education knowledge is intended to be used by agents for whom reputation is of little relevance and utility for the situation takes precedence, which suggests that any pursuit of prestigious knowledge will have to be connected with other critical sensibilities. and needs – and individuals and communities not only receive the benefits of the scientific production of Educational Sciences, but they also use them, resist them, change them. So, it is possible that Educational Sciences are the most autonomous area, as its agents are clearly delimited: the whole of humanity (or the group of people who inhabit an interested position in a given educational context).

This is the heterarchy that complexity embraces and that is, in essence, one of Sandra Harding's arguments: any agent can interact with others and, therefore, can be at the beginning of adaptations that change reality. To that extent, if one of the agents is left out, one is leaving out what could explain the functioning of the system, which translates into a process of ignorance. Harding (2004, p35) says that the standpoint theory...

> *[…] demonstrates how social inequality can damage the reliability of scientific hypotheses that look most interesting to dominant groups, and it shows how different cultures will tend to produce different patterns of knowledge and, equally importantly, of ignorance.*

The challenge that complexity poses to standpoint theory has to do with the consequences of this sharing of power, in particular with the disregard for the potential for distributed control and modularity that are inherent in the complex ontology of education. For example, we have seen many times when educational policies and top-down programs fail (Fullan, 2009). This suggests that marginalization processes are reciprocal. In terms of complexity, any action has effects that are impossible to anticipate and, therefore, the groups on which knowledge acts will interact due to their critical sensitivity to this knowledge and may modify their context in a way that is incompatible with the conditions that led to the initial knowledge. Therefore, the groups that Sandra Harding calls the oppressed are also responsible for knowledge and, therefore, capable of reciprocally marginalizing what does not interest them, which means that the epistemic discourse should be more centered on transferences and countertransferences between the various agents. and not so much in the expectation that there is a group that, because it has been marginalized, has a more advantageous epistemic position.

In short, what emerges is a set of complementarities and challenges that neither integrate Educational Sciences from any epistemological perspective, nor reject contributions consistent with their nature (Table 4).

Table 4. An integrative analysis of epistemological thoughts in the context of complexity

Authors	Complexity	
	Challenges	**Complementarities**
Popper	Knowledge is called into question by interactions and not by the individual scientist.	Knowledge is provisional, because it acts on the system and modifies it. There is bankruptcy of knowledge.
Kuhn	The community of agents lacks epistemic parity and establishes relationships that defy incommensurability.	Knowledge originates in an interested community and within shared values.
Lakatos	Any knowledge is a provisional construction of agents without epistemic parity that interact and, therefore, without nuclear stability.	Retrospective Coherence: Much of what happens can only be understood later, due to non-linear causality.
Feyerabend	There is no incommensurability and, therefore, agents interact and can produce adaptations based on shared needs and coevolution.	Knowledge is challenged by the emerging creativity of interactions between agents and, therefore, is not limited by pre-established frameworks of interpretation.
Longino	Power is distributed, which can lead to hidden elements that may not be represented.	Useful knowledge emerges from the critical interaction of diverse and unique agents.
Bourdieu	The field of Educational Sciences is purposely shared (if it weren't, it would cease to exist) and some of its agents act out of love (or other unconditional feelings) and not prestige.	Knowledge results from the interaction of interested agents who fulfill their own objectives, in search of something to which they have a critical sensitivity.
Harding	Reciprocal Marginalization: The groups that Harding calls the oppressed also have the capacity to marginalize.	Knowledge as a process of ignorance, meaning that there will always be hidden elements operating and influencing reality.

6. Conclusions

I proposed to contribute to the understanding of what we accept today about the arguments objectivity and subjectivity, based on the epistemological past that may be influencing Educational Sciences. My questioning was about the meanings and relevance of the arguments objectivity and subjectivity in Educational Sciences.

What I did, then, was cross-reference the characteristics of the complex nature of education with influential perspectives on what knowledge is and how it can be achieved. What emerges is that the arguments objectivity and subjectivity have different meanings in each of these perspectives and that complexity poses challenges and summons complementarities.

The divergences are such that using the objectivity argument to describe the research, the conclusions or the method could mean that there were expectations of independence from social beliefs, or that creativity in defiance of dogma was actively sought, or the representativeness of whoever was identified as a research stakeholder.

Furthermore, the epistemic context in which scientific discourse develops is, in Educational Sciences, one in which we can anticipate that knowledge will fail (and it is necessary to watch over it), based on free interactions of a spontaneous community (often provisional) of agents without epistemic peerhood, brought together by critical sensitivities, which lead to the emergence of adaptations (therefore, in uncertainty) that will influence the other agents and lead to effects that are impossible to predict. Inevitably, time gains meaning (how to learn if you don't keep memories of what happened?) and is perpetually renewed (the context changes).

This suggests two epistemic heuristics – I use the word in the sense of principles of action – for Educational Sciences.

The first is that Educational Sciences are not limited to a patchwork epistemology that takes advantage of excerpts from

the various epistemological contributions. It is, on the contrary, about recognizing that this scientific area has an epistemological singularity – of plurality, dialogue, and commensurability between different ways of doing science – that cannot be merely adopted from them, but also about recognizing that some of them can be coherent and reinterpreted for the Educational Sciences.

The second is that the objectivity and subjectivity arguments have different, sometimes contradictory forms, depending on the worldview that is embraced by each of the epistemological proposals I discussed earlier. The analysis suggests that objectivity and subjectivity do not have an argumentative value in Educational Sciences because their meanings vary and are challenged by interactions between agents and by the emerging uncertainty of education. What emerges is the contradiction that a commensurable scientific area can be influenced by epistemic elements that hinder debate. To that extent, I characterize them as epistemic vices, which increase or hide the processes of ignorance, by excluding agents and inhibiting and decontextualizing interactions. I announce, therefore, its end.

So, what epistemic virtues should we assume in Educational Sciences? What arguments are useful in thought and discourse in such a way that they can be internalized, embrace the complex nature of education, appeal to ethical values that are inexorable in contexts of uncertainty, and at the same time be effective in promoting understanding?

This is the debate that must begin and to which I can only contribute (figure 1), for the time being, superficially and based on what I have discussed.

The key point will be this: education is emergent, self-organized, surprising and indivisible (everyone influences), even if these processes take place with the intervention of formal agents of knowledge production. It is, therefore, a matter of accepting the prefix “inter”, in any epistemic virtue that addresses the understanding of a reality that is and will be to come.

Is it intersubjectivity? Intersubjectivity can be understood as the sharing of feelings and thoughts and played a central role in the development of the human species, because it allowed coordination around common goals and, at the same time, respect for divergent feelings (Gärdenfors, 2007). It is easy to understand the importance of these sharings in the context of collaboration between scientists from the areas of economics, politics, psychology, sociology, pedagogy... who come together around education. It is, therefore, the epistemic content that each agent carries to the relationships and shares with the others and the degree of acceptance and understanding of what was made available by the others.

Is it intercoherence? I argued earlier that in complexity the future is unpredictable and therefore the expectation that a linear action will produce expected results is very little viable in educational inquiry. This means that the predictability of patterns and the accuracy of responses to problems become less important and that coherence becomes more important. It becomes more important to investigate and act coherently. Coherence can be seen as the point at which even uncoordinated actors act because they feel interdependent - that it is not possible to achieve goals, needs or dreams in isolation. It is all the more important when coherence can be at the origin of commensurable work capable of satisfying personal and professional needs and support individual and common and synchronized actions important to a healthier scholarship and research ecosystem (Huse, 2020). And cannot be given, but constructed; therefore, cannot be

determined prior to interactions between agents, but emerge from the conditions under which agents interact.

The notion seems promising to me since it has the potential to ensure the elements that are present in the complex nature of education (the specific power of each agent, the modularity of agents' knowledge, the diversity of agents). In this context, it is a matter of ascertaining the conditions for putting into interaction what each agent carries with him, depending on what is important to respond to the moment (therefore, and to clarify, without defining an obligation).

Is it internecessity? It is also an interesting construct, as it points to what the context offers to knowledge interactions, in particular, what the agents are critically sensitive to and, therefore, which is capable of mobilizing energies and wills (Cilliers, 1998). It will be, to that extent, what the context causes and what can lead agents to seek coherence.

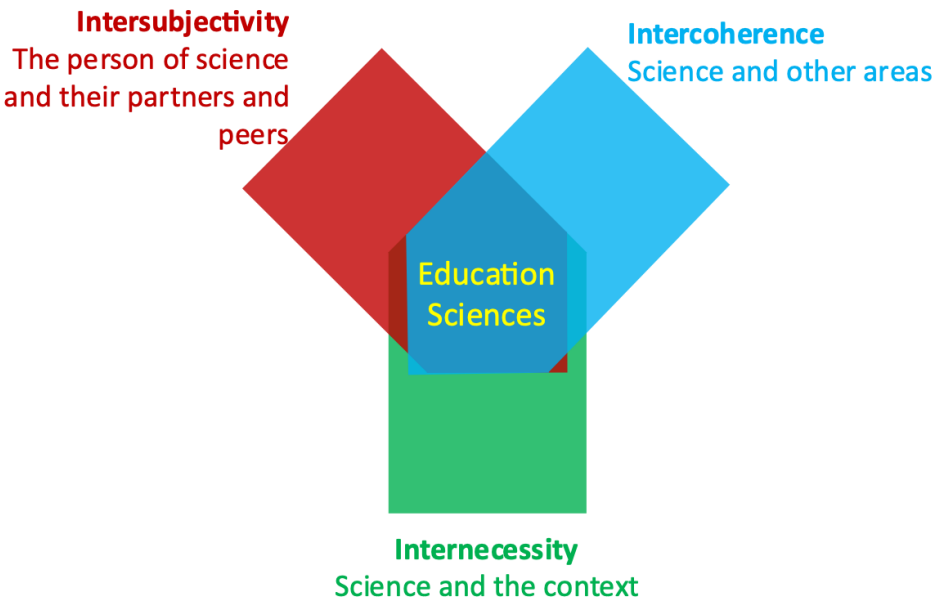

Figure 1. Virtuous epistemic arguments of Educational Sciences

Very interestingly, it seems that part of the practices that can support these eventual epistemic virtues (intersubjectivity, intercoherence and internecessity) are already being experimented with in Educational Sciences! Its expression is the concern in returning the results to the participants in the studies and in their debate, in expanding the number of research participants, to accommodate more agents who are interested (even that is not a particular interest, but an interest in the possible consequences of the investigation) or in the emergence of popular doctoral juries.

What seems to run through these examples and the complexity of educational interactions, what remains important for the epistemological status of Educational Sciences is that education seems to transform itself based on practices that make sense in the contexts and that the theories that are proposed are continuously challenged. Thus, in the words I borrow from Georges Canguilhem (2009) (who was talking about medicine), education still seems to us to be an art situated at the confluence of several sciences.

Footnotes

[1] They were also subject to other lines of influence from the humanities (such as Max Webber or Hans-Georg Gadamer), but here I focus on the line rooted in the natural sciences, because it has had an undeniable influence on the way science is done and knowledge is developed.

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