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Teaching Physics in Rural Education: decolonizing, instrumentalizing and participatory

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SUMMARY. This work presents a theoretical-practical discussion of a critical epistemological character of Physics - its history, nature and practice - under the bias of colonialism from which the possible contributions of the teaching of this discipline in the context of Rural Education are presented. The article is divided into three parts: in the first part, a critique of Physics, its history, epistemology and teaching is made, in which the traces of a Counter-History of Science and also the differentiation between formal logic and dialectical logic are exposed. based on the Brazilian philosopher Álvaro Vieira Pinto. Then, the linguistic and reproductive character of Physics teaching is highlighted. in the s Physics in Rural Education is discussed, as well as its possible contributions to a teaching centered on the development of attitudinal practices, as well as the need to integrate Physics with other disciplines. Finally, a methodological approach is presented in a synthetic way, applied to two groups of undergraduates from the Rural Education course – Nature Sciences at the Federal University of Paraná, Setor Litoral.

Keywords: Physics Teaching, Field Education, Instrumentalization, Decolonization, Participation.

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ABSTRACT. This paper presents a theoretical and practical discussion of the critical epistemological nature of physics - its history, nature and practice - under the bias of colonialism, from which the possible contributions of the teaching of this discipline in the context of the Rural Education are presented.
The paper is divided into three parts: in the first is did the critique of the physics, its history, epistemology and teaching, which exposes traces of a counter-history of science and also the differentiation between formal logic and dialectical logic grounded on the Brazilian philosopher Álvaro Vieira Pinto, then the linguistic and reproductive nature of the teaching of Physics is highlighted. In the second part, it is thought that physics in the Rural Education its possible contributions in a teaching centered on the development of attitudinal practices, as well as in the need to integrate physics with other disciplines. Finally, a methodological approach applied to two under graduating classes of the Rural Education course - Natural Sciences is presented in a summarizing way.

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Introduction

This article presents a critical reading of Physics and its teaching in the context of Rural Education, especially with a discursive bias focused in colonialism and/or imperialism European, who was responsible for subjugation of the peoples of the continents Asian, American and African. The term decolonization is borrowed from the doctor psychiatrist from Martinique, Franz Fanon, who theorized and denounced the effects psychological aspects of colonialism on the blacks and also looked into the processes for liberation and revolution from African peoples. ideas that influenced also the Brazilian educator Paulo Freire especially in his work “Pedagogy of Oppressed”, from which we extract the idea of participation.

In Freire's conception (1967), the The word participation is related to a conscious, critical and creative human action and which can lead to the transformation of the situation concrete oppression. oppression that was and is also caused by Science modern, which was formed from the appropriation of people's knowledge invaded. Today, Science is at the service of capital under the most different expressions do development technology, especially agribusiness, which relies on biotechnology, engineering genetics, mechatronics and robotics for maintain a necrophilic logic. So it's It is in this context that we discuss Physics, its history, epistemology and language a work which is divided into three parts.

First, there is a counter history of science as it relates to nature and the origin of “modern science”, highlighting aspects and characters before omitted by traditional literature under the perspective of European colonialism in South Asian countries, Africa and the Americas. Then, a epistemological discussion of Science/Physics in particular, differentiating the logic of dialectical logic from the Brazilian philosopher Álvaro Vieira Pintoi . AND

In the end, these are some of the characteristics of physics that interfere in the teaching and learning process: the cultural/representational nature, its language and its goals.

The second part discusses the Physics in Rural Education and its possible contributions to a teaching centered on the development of attitudinal practices. Here, too, the need interdisciplinary that Physics must maintain with other disciplines for training more holistic view of rural subjects.

Finally, we present the results of an approach dialogic methodology carried out with

undergraduate students in
Field Education - Sciences of
Nature of the Federal University of
Paraná – Coastal Sector, this approach
inspired by the phrase “dialogue begins in
search for program content”, from the
Brazilian educator Paulo Freire.

Critique of Physics, its history, epistemology and its Teaching

Counter-history of Science/Physics

Physics is a scientific discipline
prominently inside and outside the
academy, is a Science that brings together
technical and/or technological instruments,
processes and knowledge related to
different forms of energy, to
movement of things and interactions
between objects. Physics seeks explanations
respect of the world watching
regularities and patterns that occur in the
natural environment such as the phases of the moon, the
Sun's movement and changes
climate. Lots of physics knowledge
came from millenary civilizations such as
Babylonians, Chinese, Indians,
Arabs, South Africans and North Africans
like the Egyptians without considering the
knowledge from tribal peoples
and/or indigenous people.

The knowledge that usually
are credited to the Greeks had their origin in South
Asia and also in Egypt.

According to Goonatilake (1982), almost all
theories, religions, philosophies and the
mathematics taught by the Pythagoreans were
known in India in the 6th century
BC — that is, before Pythagoras, including the
The famous Pythagorean theorem was already
known in South Asia, as was the
concept of irrational numbers.
knowledge what They arrived
later to Europe thanks to
Arab participation.

> ... In general, while medieval Europe was in scientific darkness, knowledge continued to grow rapidly and was acumulated in South Asia. The horse stirrup, the Chinese-shaped Javanese violin bow, the pointed bow and dome (dome) of Buddhist architecture, the magnetic needle and paper, and possibly gunpowder that was known in China for at least two centuries before be known in Europe are some technological inventions that were taken from Asia to Europe in the medieval period. At the beginning of the renaissance, the belief that took hold of Europe that technological progress was desirable and possible, associated with the great maritime journeys, Europeans had at their command a wide set of skills devices...
>
> and
>
> (Goonatilake, 1982, p. 423).

For Brazilian physicist Mario
Schenberg (2001, p. 52),

> It seems that the great impulse of cultural development in Europe came with the crusades that did not have a strictly religious objective, but also

> economic to conquer and plunder, as those regions of the Middle East were much more advanced. The Crusaders came into contact with advanced civilizations and from there they brought knowledge to Christian Europe with unknown technologies. It seems that even Gothic architecture itself was not a European creation, the principle of this architecture was certainly imported from the East. As well as the use of rain energy (water mill).

In the 15th and 16th centuries, with the help of of cartography and geography already quite developed, Europeans headed towards towards the Americas retracing routes already traveled by people natives americans. In the Americas and also in the African continent, they invaded, enslaved and looted objects, plants and knowledge of the original peoples. Knowledge that in Europe was reorganized into disciplines such as Botany, Physics, Chemistry, Biology, Astronomy, Medicine, Archeology, among others. knowledge that was re-elaborated and re-edited in the context European Union, above all by erasing its origins, which transformed knowledge universal scientific and plural in something private and the domain of a single society – the European one. Second Feyerabend (1977),

> the rise of modern Science coincides with the suppression of non-Western tribes by western invaders. Tribes are not just physically suppressed, but they lose their intellectual independence and are forced to adopt the bloodthirsty religion of brotherly love —Christianity. The more intelligent members gain an advantage and they are initiated into the mysteries of Western Rationalism and what is its culmination—Western Science (Feyerabend, 1977, p. 453).

This period was also called Enlightenment, for Smith (1999) the Enlightenment provided the spirit, the impetus, the confidence and the economic and political structure that facilitated the search for new knowledge. In other terms,

> Indigenous peoples were classified in the same way as flora and fauna; hierarchical typologies of humans and systems of representation were elaborated and objectified by new discoveries; cultural maps were drawn and territories claimed contested by the main European powers. At the same time, indigenous peoples were ranked and compared to others in terms of things like the beliefs in which they were considered 'close to humans', 'almost human' or 'subhuman' (Smith, 1999, p. 59).

In addition to this, the idea of superiority (Fanon, 2004; Said, 1979) that populated the imagination of Europeans in this period it legitimized the dominion and the violence against men, women and indigenous children, called savage, barbaric and uncivilized. For American historian Howard Zinn

(1997), the dehumanization of the "enemy" has itself a necessary resource for wars of conquest. Too easy explain atrocities if they are committed against infidels (non-Christians) or against people of inferior race. A context in that 'modern' Science (and that includes the Physics) is rewritten in Europe and later spread in the colonies, just like Brazil and all of Latin America in which schools and universities. In these institutions the scientific knowledge produced in different parts of the world are spread with names of white and European men, Galileo Galilei, Isaac Newton, Descartes and Francis Bacon, for example, hiding the sources of such ideas and omitting the previous contribution from people like the Chinese, Indian, Arab, North and South Africans as well as indigenous peoples.

Such practices took a harmful consequences for peoples not Europeans, as this legitimized speeches negative and racist linked to humanity and the intellectual capacity to such peoples, who endure until the days of today. In this sense, to counter such speeches are presented below some examples of physical knowledge that are still studied and whose ethnic origin was omitted.

Table 1. Physical knowledge and their ethnic origins.

type of knowledge	**Origin story – observational and/or explanatory**
Law of gravitation, laws of motion of bodies, tidal motion and differential calculus.	Babylonians, Maori prehistoric indigenous peoples (4 thousand years BC), Indians (Varahamihira - 505 and 587 AD, Brahma Gupta - 628 AD and Bhaskara II - 1114 AD) and Brazilian indigenous peoples – the Tupinambás – 1614 (Prasad, 1999; Afonso, 2009; Conner, 2005). Arabs – Iraqi
Refraction and reflection of light at atmospheric pressure.	physicist (Al Hazen or Ibn Al-Haitham) – 1039 AD (Sarton, 1927).
Supernova explosion, crab nebula and the compass.	Chinese and Egyptians (AD 1054) (Reeves, 1986).
Star Sirius, solar system, rings of saturn, spiral structure of the milky way, the aridity of the Moon.	South African peoples 'The Dogons' millenary knowledge (Adams, 2007).
Non-uniform character of acceleration consideration and that the speed of light is much faster than the speed of sound.	Persian and/or Muslim (Al-Biruni - 1021) (Pappademos, 2007).

Source: Author's research.

As can be noticed, you knowledge and the subjects mentioned expose a geographical plurality, cultural and temporal of Science still studied, which does not come from Europeans. Diversity that was omitted in the name of European domination and exploitation over the other peoples of the world, a practice that occurred through cleaning or ethnic-cultural erasure that generated labels and legitimized violent actions on Indians, Indians, Chinese and Africans.

According to Fanon (2004), opulence Europe was founded on slavery. O Europe's well-being and progress were built with the sweat and corpses of blacks, Arabs, Indians and yellow races.

Critical Epistemology of Science/Physics

The epistemological discussion that here presents itself basically refers to treating of the dialectical relationship between subject and object, man/woman and the natural world and it is in this relationship that Physics/Science is produced. Based on your conditions of existence, humanity in contact with the world interprets and represents it, for this reason it can be said that science is part of the human culture that involves, among other things, activities the study of plants: their medicinal, physical, chemical properties and biological; the study of the Sun: as a source of light, heat and life; the study of the sea: your nature, movement and energy; the study of the sky: its beauty, its stars, the rain and the winds; the study of fire: its power and heat; the study of animals: their nature, speed and physiology; etc.

Knowledge that is linked directly with the creation and improvement of technical instruments or technologically originated historically in its beginnings of experience everyday life of ordinary people such as, midwives, cooks, fishermen, hunters, sailors, miners, healers, artisans, farmers and traders (Conner, 2005) and who were recorded and accumulated during the centuries by different peoples, at the same time when society was modifying and adopting more and more products of Science in the fabrication of life, their ways of acting and thinking.

Under regimes imperialists, colonialists and capitalists you scientific knowledge has become instruments for economic and dominance of certain groups over others, whereas the dominant groups appropriated scientific knowledge and other peoples' modes of production to then produce goods for purchase and sale. They are, for example, sponsor the great laboratories of genetic-food research, informatics, warfare, communications, and chemistry medicinal, aesthetic and industrial. are these organizations which scientists are submitted and that influence their theoretical-methodological elaborations of research and which, therefore, are not forms neither neutral nor 'pure' ways of doing Science. In Pinto's view (1979, p. 152),

> The Naive Equation of Science “pure” to the work of theoretical formulation, in any branch of knowledge is nothing more than a sophistry forged by the authors of “Pure” Science for the Purpose of

> appear pure themselves.
> It is a rationalization intended to make us believe that such men of Science do not serve subaltern interests. It is a concealment of the existential reality of the scientist, which he welcomes and propagates with the purpose of pacifying his own conscience and discharging responsibility for the services he renders for purposes that he would otherwise have scruples in serving.

Researchers who do not have awareness of your role as an agent subject to a system of interests economic and political, it can be said that they have their conscience alienated. "THE alienated consciousness is fundamentally consumer of ideas... The man alienated cannot be a producer, he is limited to be a predator and repeater of ideas others, is incapable of having an original thought" (Pinto, 1979, p. 52)ii. In this panorama, to help us understand better to do Science and its representation Next, a distinction is made between formal logic and dialectical logic.

Formal logic or positivist epistemology and dialectical logic or critical epistemology

The aforementioned sale is must often emphasize the consideration of Science from the perspective of formal logic, because as the name itself says such logic focuses on the norms and formalized thought patterns to from clippings of objective reality. THE great ingenuity of this current of thought is that she seeks, from specific premises, explain the world through postulates or laws supposedly general, a perspective whose focus is on language, that is to say on the discourse, in the world of ideas. Such condition often leads to a confusion that is to identify Science with its language, that is, with its expression formal. According to Pinto (1979, p. 79-80),

> Language does not represent a fundamental ingredient for the constitution of Science, as the analytical and semantic schools want, which confuse the transmission of scientific knowledge with its formulation in the existential relationship between man and reality.... Language, as a social mode of communication, is only a subject of study related to the problem of Science, because the methods of discovering reality are so complex and refined that it imposes the requirement that their results be expressed in manifestations. as rigorous as possible, since it is a question of 'transmitting' to another individual what the creator of knowledge, the scientist, has elaborated or discovered.

Therefore Science is not languageiii and to consider this, is to deny the sensible world, is to allow speech to build the world real objective and this becomes true and unquestionable, regardless of whether the senses say otherwise. In addition, such

vision disregards the complexity of the to do Science, its imagery wealth, logical, methodological, practical and philosophical. For this reason positivist epistemology is considered naive or uncritical, because it does not question your statements or your methods. An example of this was the misguided explanation given by Galilei to the tidal movement, which was based on the Aristotelian, Ptolemaic and copernicanas and not in data observational and empirical studies available at era. According to Afonso (2009, p. 63),

> Galileo showed that the composition of these two uniform circular motions, diurnal and annual, results in a deformed motion, accelerated and retarded, for parts of the earth's surface. For him, this variation in the resulting velocity would cause the flow and backflow of the tides, that is, the rise and fall of the average level of the oceans' waters, without the need for the Moon to participate.

Brazilian indigenous people, you tupinambás who obviously don't mastered all these nomenclatures much less Latin, according to the account of a French Capuchin priest, knew of your experience near the coast Brazilian economy, that the raising and lowering of sea level were due to the attraction gravity of the moon, an explanation known to them for at least 18 years before Galileo and 73 years before Newton (D'Abbeville, 2008).

In view of this, this fact exposes the limitation of formal logic to know the world, because it does not adopt the social practice as a criterion of truth, that is, the practice as confirmation of content of the imagined idea (Pinto, 1979). THE scientific experience serves as an example of this type of confirmation, but your validity is not in this practice itself, but in a body of evidence that belong to the sociocultural context in which instruments and subjects are insert. In this sense, consistency and reliability of this evidence must consider at least two aspects – the social purpose of the research (for what? and for whom?) and the possibility of observing regularities and patterns by other subjects under similar conditions. We can say that these two aspects are the basis of the critical epistemology, because unlike of positivist epistemology, which focuses now in ideas (idealism, metaphysics) sometimes in experience (empiricism), dialectical logic considers the inseparable relationship of the subject world or the world-subject, because

> it is not legitimate to conceive any scientific theory, nor to examine the logical value of those that make up current Science, in any domain, not to mention the presence of men (or women). ... The need to treat Science data in its

> immediate content can make us forget that such data, if on the one hand they are data from reality, from the outside world or from the universe of intelligible abstractions, as in mathematics, on the other hand they are data from man... not to the isolated individual, but to the social being that constitutes the creator of Science (Pinto, 1979, p. 115).

For this reason critical epistemology contradictory in nature is more advanced in terms of analysis, as it faces the world dialectically and organizes and makes available their ideas formally, that is, it encompasses the formal logic. Above all, consider the social practice as a criterion of truth, well, it is not bound by speeches to observe reality, but observe the world and confront what you see and feel with what is said. For example, one cannot believe that Science began in Greece, or that Descartes, Galileo and Newton are the great forerunners of the thinking about objects scientific and technological that would lead to the kind of society we live in today. This is a great naivete that for centuries has been diffused and reinforced in our minds mainly in schools and universities. According to Pinto (1979, p. 56),

> The world of formal, metaphysical thinking presents itself as self-sufficient, without revealing its own imperfections. It is necessary to be the object of examination by a thought that involves it and the particularizes so that it comes to recognize its lesser validity. Such an attitude will hardly be expected from men of Science, educated in the formal style of thinking, generally distant and disinterested in what they call 'philosophical speculations', which almost never find resonance in their spirit, seeming to them a waste of precious time that should be devoted to effective work. We do not believe that there is a remedy for this position other than the adequate training of new generations of researchers.

In view of these considerations, it is It can be said that the adoption of a Critical epistemology is a necessity urgent, as it allows for a more total understanding of reality whose subject is a part. In this frame a indispensable element is the sociology of Science, the study of material conditions and social networks in which this product is made cultural, in the absence of these elements, facts and conditions of production of scientific knowledge is omitted, the which makes it impossible to understand holistic approach to the knowledge taught. from the point from the point of view of dialectical logic the impersonality, timelessness and supposed rigidity of scientific ideas serve to hide your true political and ideological nature. that's what defenders of so-called science modern day have done, have hidden the sources of know Indian, Chinese, African and indigenous of its supposed 'discoveries'.

Teaching Physics - reproduction, alienation and expulsion

Physics is generally treated as a language, symbols, terminologies, mathematical expressions, that must be taught. In this sense, learn the concepts and ideas of this Discipline refers to mastering words and mathematical processes. The problem of this consideration is that this conception is reductionistiv, as it despises a large group of objects, practices and motivations that led to this or that concept or idea.

Tal condition probably contributes to the fact that the vast majority of students do not understand it, because as it was said earlier the language is just the formal aspect of the activity scientific. Table that can be observed in the evaluative practices that demonstrate the how breeding, in the vygotskyanov sense term, this process has been, as it is during assessments that students are asked to repeat idea words and/or concept words and to solve problems, which rarely do so. strictly.

A frame that is possibly linked to the academic focus that underlies the objectives and processes of teaching and Physics learning. These so general are thought and planned for a school or university context, without take into account the social, political purpose and economic of the formation of the subjects.

Furthermore, although institutions educational institutions have a bond and a role with the social whole, many of its practices are geared towards the formation of a repeater or imitator of ideas, the which can lead you to be an incapable subject of an original thought and that produces or return something useful or beneficial to the society, and not only serve to individual rise in a career professional, when this occurs (Schiff, 1993; Tragtenberg, 2004; Alencar, 2004).

In this context, considering that We live in a society where there are class differences and divisions, one can say that Physics, as a knowledge spread from the Euro-American thought-language and that in Brazil and other countries it is taught in public schools or in the area urban or rural, when it comes to children of the working class, it is possible to notice at least three rolesvi that it fulfills:

a) assist in the expulsion of those students from educational institutions and possible social benefits that they could, perhaps one day have. Among others reasons, this is due to the difficulty of apprehension of this knowledge.

b) contribute to the formation of a individualistic subject, alienated, without criticality and reproducer of other people's ideas, generally conservativevii (Freire, 1987).

c) form subjects incapable of creating something authentic or original and that they can go beyond what they learned (Schiff, 1993; Alencar, 2004).

These consequences are due to insistence on teaching focused on memorization of abstract concepts disconnected from the concrete reality of students, as well as the disregard the technical nature of its language and the unaware of its scope. In this direction, the following are other dimensions of this same process, which can contribute to bad or bad understanding of this discipline.

Physics is not the expression of the truth about the world

It is very common for teachers and students consider that learning Physics is about learning the truth about the world. However, this view is wrong, because physics only translates a form specific way of seeing and representing reality, which is not the most correct, nor the most true or real than the ideas that students bring from home. it can be said that this confusion occurs for at least two reasons: first, to the Physical explanations that sometimes come close to reality of students (friction force, heat, temperature, speed) and sometimes away (electrical charge, electric field and atomic interactions), and second, to the idea of that learning Physics implies replacing students' spontaneous knowledge through their notions and concepts. Such conceptions can confuse students about the nature of scientific knowledge. Per example,

> Schoolgirls....seem to feel that “exotic” topics like relativity and astrophysics are closer to their everyday lives than mechanics and electricity, etc. (Angell *et* al., 2004, p. 701).

> In one of my engineering physics classes, I asked a question about Newton's third law on the final exam. One of my best students after the exam came to my room very upset. She expressed her confusion as to which of the two cars after colliding would feel the greater force, a small car, or a large truck, and she reported that she had altered her answer numerous times during the test. 'I know,' she said, 'that Newton's Third Law says it must be equal, but it can't be right, or it can'. The classroom context led her to create a 'Classroom Physics' model of Newton's third law, but the common discourse wording of the question led her to bring her answer to common sense, larger objects exert a force larger. Successfully learning Newton's third law was not enough for her to feel comfortable with the situations in which it should be used (Redish & Steinberg, 1999, p. 13).

These examples show that there is a lack of clarification on the part of the students about Physics and its relationship with the reality that under the dialectical perspective, it is, among other things, stuff, of a representation, interpretation, nominalization of parts of the sensible reality, aspect considered also by Lemke (1990), when stating that what should be taught to students is that science is simply a way, among others, of talking about the world, which is important and useful, but not the best, the truest, or even the more complete and sufficient (Lemke, 1990, P. 176). In addition, physical knowledge is often counterintuitive, that is, does not reveal itself immediately, because its existence is conditioned to pre conditions that need to be known. According to Robilotta (1988, p. 12),

> Access to this world is made through sensations, words, images and intuition, and the mind seeks the intimacy of the object to be known. In this kind of knowledge there is no cold clarity of reason. However, as Schenberg states, 'there are things that by their very nature cannot be seen very clearly. corpuscular things, and they, when disappear. And they have to be seen anyway.' Knowledge is associated with enriching the content of the reality of symbols used in the formal treatment of problems.

theoretical.

These aspects lead us to the second reason why teachers and students consider physics as an expression of truth about the world. How it is famously known, research on conceptual change have already proven that learning physics involves adding to the subject's knowledge base new ways of thinking that coexist with the old ways of thinking, so don't there is a substitution of a knowledge for the other. This idea is close to what Mortimer (1996) called it profile conceptual. In your words,

> The notion of conceptual profile provides us with elements to understand the permanence of previous ideas among students who have gone through a process of teaching scientific notions. At the same time, expectations regarding the fate of these ideas change, as it is recognized that they can remain with scientific ideas, each one being used in appropriate contexts (Mortimer, 1996, p. 34).

In this perspective, it is prudent to teachers who during their assessments ask students to interpret a certain aspect of reality from the point of from the point of view of physics, that is, that they adopt their references and representations, on the contrary to ask them to give their opinion on a certain

subject, which would allow students to use of a non-scientific framework.

Grammatical and semantic features of scientific language

As mentioned earlier, the Physics represents a specific form of see and think the material world, which has a particular language that differs the language used in conversations informal. Roth and Lawless (2002) emphasize that Science is, in fact, "a form of culture that has its own creeds, language, practices materials, perceptions, theories and beliefs" (Roth and Lowless, 2002, p. 369). In this perspective, Fang (2004, p. 337) points out what,

> Unlike everyday spontaneous language, which is functional to construct common sense knowledge of everyday life, scientific language is functional to construct a domain of beliefs and scientific knowledge. The specialized grammar of scientific language makes it possible for the scientist to construct an alternative interpretation of the physical world to that provided by the spontaneous speech of common sense language (Halliday & Martin, 1993; Martin & Veel, 1998).

In this way and understanding that the scientific language has characteristics specifics that influence learning and Physical, we highlight some grammatical and semantic features that belong to this discipline that make it difficult to apprehend them at the level linguistic. Fang (2004) points out 4 characteristics of scientific language writing: density informational, abstraction, technicality and authority.

Information density refers to the amount of concepts and ideas present in a sentence, usually represented by nouns. Per example: White *light* is a *wave* polychromatic *electromagnetic* detected by the *retina* of our eyes.

If a teacher presents this definition for students who do not they hardly know these terms will understand it. Therefore, it is important that teachers are aware of the complexity than the definition of a concept can have for students.

The second feature of writing science related to the previous one is the abstraction. unlike language spontaneously acquired and used to represent everyday experience, language scientific theorizes as concrete life experiences in abstract entities, which can then be examined and criticized. According to Christie (2001, p. 66), the nominalization of phrases "departs from the immediate context of the subjects' life experience and builds

truths, abstractions, generalizations and arguments". Nominalization allows the author create technical terms or new entities, to establish relationships of cause and effect between different phenomena, and to synthesize and systematize information previously stated (Veel, 1997, p. 184). As an example, look at the difference between the following two sentences:

The first, in lesser language technique, can be expressed as follows: way: The Sun is a bright sphere that stays over our heads that warms us that gives life to plants and animals. At scientific language I could say: The Sun is a fifth magnitude *star* that emits *infrared radiation* that raises the *temperature* of *planet earth* and causes for plants to carry out *photosynthesis.*

As can be seen, the terms star, infrared radiation, energy, temperature, planet earth and photosynthesis are expressions that translate ideas and meanings about concrete reality, they are considered abstract because they do not can be designed immediately, I mean, by the senses, they are creations of the human mind conditioned to a cultural historical context.

These terminologies lead to third grammatical aspect of language scientific, which is its technical character, because As can be seen earlier, if of specialized terms, that is, that only those who dominate are people who had a specific training. Second Possenti (1997, p. 20), "the domain of technical language is an important part of scientist learning. A student medicine no longer talks about 'stroke', but in 'stroke' or, simply in stroke". then learn Physics also refers to mastering the jargon of this area of knowledge. However, the that cannot occur is to focus almost exclusively the teaching of Physics in its terminology, its language and jargon, as if you were teaching physics in all its complexity.

This technical character allied to other social practices of science and technology lead to the last aspect highlighted here of the scientific language, which is your authority. Obviously it's not just by the expression of the technical language that the Science has an authoritative *status ,* the its effective results such as predicting the rain, produce a pill, make a plane to fly, all this gives Science and technology an authority almost unquestionable in our society. Feyerabend expresses how Science builds its authority in terms linguistic.

> It is not said, some people believe that the Earth moves in

> around the Sun, while others
> they consider the Earth to be a hollow
> sphere, containing the Sun, the
> planets, the fixed stars. It is said: the
> Earth revolves around the Sun—and
> everything else is sheer idiocy
> (Feyerabend, 1977, p. 456).

This authority, which is often
authoritarianism, submits scientists and all
society to its imperative statements
'partial truths' about other forms of
consider the world, inhibiting diversity
of ideas, thought and practices.

Physical knowledge as a means and not as an end – the objective content duality

Teaching Physics in general
takes place with a focus on knowledge
contained in textbooks - concepts,
terms, units and symbols, calculations that
must be learned during classes and
although it seems normal this way of
carry out the teaching, she is a reproducer of
ideas and practices. In Paul's conception
Freeze the contents or knowledge of
teaching should be used as a means
to understand reality and not how
a goal in itself, especially
because apprehending concepts and ideas in a
specific field of knowledge without
bond with the social, does not allow
transcend it or question it. Well, if the
teachers wish to teach critically is
need to think about educational goals
beyond the contents, that is, with a focus
in the unveiling of reality and its
relations with humanity, to escape
of what I call content duality
objective, in which teaching and learning Physics
refers to memorizing concepts,
terminology and symbology.

In this sense, we must not have
purpose of a physics class to learn the
laws of motion or the different forms
to transfer heat between bodies, but rather
propose or encourage the search for
unveiling a certain aspect
from reality what demand Those
knowledge. But learn this or
that concept without being a requirement of the
topic under study makes learning a
empty and meaningless practice.

Thus, conceptual knowledge,
informational is important, but when
detached from a social context or
concrete loses value and is limited to
understand a very dimension
particular of the reality that is not linked to the
totality or the reality of the learners.

Physics and Rural Education: the Physics as an instrument of struggle for rural people

Paradoxically, to think about the
Physics teaching in the context of Education
do Campo it is necessary, at first, not to think
about Physics. IT IS

necessary to think about the subject of learning, under the conditions material and social, thinking about the subjects in the world and the world of subjects, their position within the social structure and its conditions of existence – of injustice, inequality and oppression. According to Caldart (2004, p. 152),

> The subjects of the countryside are those people who feel the effects of this perverse reality in their own skin, but who do not conform to it. They are subjects of resistance in and of the countryside: subjects who struggle to remain farmers despite an increasingly excluding model of agriculture; subjects in the struggle for land and agrarian reform; subjects in the struggle for better working conditions in the countryside; subjects of resistance in the land of the quilombos and for the identity of this heritage; subjects of the struggle for the right to remain indigenous and Brazilian, in demarcated lands and respected rights; and subjects of so many pedagogical resistances. social, cultural, political and

In this sense, if the subject you teaches is the exploited and mistreated by the capitalist system it is necessary to think how help you to overcome this state, because "there is no how to truly educate the subjects from the field without transforming as dehumanizing social circumstances and without preparing them to be the subjects of these transformations" (Caldart, 2004, p. 155). Can learning physics help? in this appointment? As? Questions difficult to answer, but I will try to expose my point of view. First, for know how Physics can help us to help students, we do the following Question: What is Physics about?

a) *It arises from the dialectical relationship between humanity world* – of human action during its experiential and/or observational experience and/or experimental. experience that was changing with the creation of laboratories and research centers, with instruments increasingly sophisticated technologies. THE Physical gather a set of knowledge related to how some parts of the world "works" generally belonging to the natural world, the sun, the winds, the moon.

b) *Elaborate explanations about the things of the world* – The atmosphere exists, has weight and puts pressure on our bodies. At tides fall and rise due to the gravitational interaction with the Moon. The land revolves around the Sun due to the action of a gravitational force and/or the curvature of the space-time, a curved lens deflects the path of a beam of light.

c) *Describes processes* - The rains result from the condensation of water vapor accumulated in the clouds that formed due to the evaporation of sea water and rivers heated by solar radiation. O movement of a magnet towards the

center of a copper coil produces a induced electric current.

d) *Uses mathematics* in representation and problem solving - geometry and algebra.

F = m.a, W = F. d. cos , Ep = m.g.h , P.V = nRT, d = m / v

e) *Adopts graphic representations and symbolic.*

f) *Builds and uses instruments* that measure and amplify their action – telescopes, thermometers, clocks, compasses, spectrometers and rulers.

g) *Imagine and create* universes, particles, photons, black holes, electrons.

Finally, Physics linked to an area broader scope of science and technology is a human construction about certain aspects that belong to the world non-artificial, created by reason of needs (survival, spiritual and materials), economic reasons (trade, war) and also curiosity (to know in what a living world). It can be presented by an individual subject, but always results from historical context and society that will find foundation when confronted with other subjects from other nations. Perhaps therein lies the beauty of Science/Physics, no date the consciences of the world (Freire, 1987).

In this way, for the teaching of Physics contribute beyond the consolidation of a critical discourse about reality makes if necessary,

> to gestate in the midst of the concrete contexts new practices, together with the subjects of the community, new relationships, whether with the subjects, or with the knowledge, with the method. Committed reflection action on the changing reality, generating at the same time human emancipation, perhaps it is the great harbinger of the Licentiate courses in the area knowledge, providing for this with some components of the class struggle, still scarce in the impoverished working class school from the countryside (Ghedini; Von Oncay; Debortoli, 2014, p. 108).

For this reason it is believed that thinking a Field Education that responds to the aspirations highlighted above makes necessary to develop in our practical undergraduate students who enable them to act on the world to turn it. In this perspective the contents and/or knowledge of Physics should be used as a means and not as an end (Freire, 1987). Soon than teaching content, concepts and ideas of Physics, one must strive for the development of attitudinal practices, which will be instruments of action. You knowledge must undergo

need to understand this or that aspect of reality. Such knowledge become subject to the requirement of the development of practices that are listed below.

Table 2 – Attitudinal practices and formalization.

Attitudinal Practices - action-reflection	**Formal attitudinal practices - Action-reflection**
I. Curiosear - observe, touch, experiment.	I. Annotate and/or write.
II. think (world - we, we – world) – think dialectically.	II. Draw and schematize.
III. Imagine and Create (ideas and objects).	III. Graph.
IV. Read and search.	IV. Symbolically represent.
V. Explain and describe processes.	IV. Represent mathematically and calculate.
SAW. Design, build, use instruments and experiments.	V. Record Explanations.
VII. Carry out tests.	SAW. Describe processes.
VIII. Confront, question ideas, practices and claims.	

Source: Author's research.

practices what must to be developed simultaneously and from of significant themes for the subjects of the field, their relationships in life, work and conditions of existence. Relative practices to the actions of the subjects both in doing and to represent the world through formalization.

In this direction, the thematic approach Freiriana has two purposes: to bring the students of scientific knowledge to from objects and practices that they know and at the same time allow get to know the world in a better way totalizing. Thus, knowledge and scientific practices become a means for the unveiling of reality and the at the same time an object of instrumentalization of subjects who must Contribute to:

a) To help the subjects of the field to know the world – its relations to objects and natural phenomena, intangibles and inanimate, terrestrial or extraterrestrial, without disregard its historical nature and social.

b) Combat the situation of oppression – present scientific evidence of actions harmful to agribusiness to survival of the subjects of the field, to build means alternatives to lessen their economic exploitation (heaters of water and alternative energy generators electric).

c) Produce new knowledge – new relationships with the environment, new economic relations and new ways of seeing the world.

Physics and the interdisciplinary need – Whole of the world

As was highlighted earlier, the Physics deals with certain aspects of reality and therefore it is limited and limiting, so like any other scientific discipline, since such disciplines are constituted in the specialization although they have dialogue and influence of the social whole. And fatally one teaching and learning process centered on one discipline tends to take the student to alienation and consequently the a very restricted worldview, which can get them to join messages spread by those who have the greatest power to disclosure or propaganda of ideas/ideologies such as television media, radio and journalism that are generally sponsored by large economic groups such as Agribusiness.

Therefore, thinking about Education Field in the field of Natural Sciences and Physics in particular, refers to a more comprehensive reading of the world, more complex and less reductionist. Per For example, talk about the construction of a hydroelectric power plant for the production of energy is not just about knowing the processes and energy transformations that occur in the production of electricity. It implies, above all, getting to know the place, the people who live there, their families, their ways of life, their roots and heritages material and immaterial beyond the interests political and economic hidden behind its deployment.

In this context, it is necessary to study and understand the social dimensions, historical, political and economic permeate such objectives and themes, as the Generalized physics is presented in a way that simplifies and reduces reality. Therefore, the books textbooks cannot be used as guidelines of teaching practices, as these only provide clippings of conceptual knowledge and for this reason prevent a more totalizing vision or critique of reality.

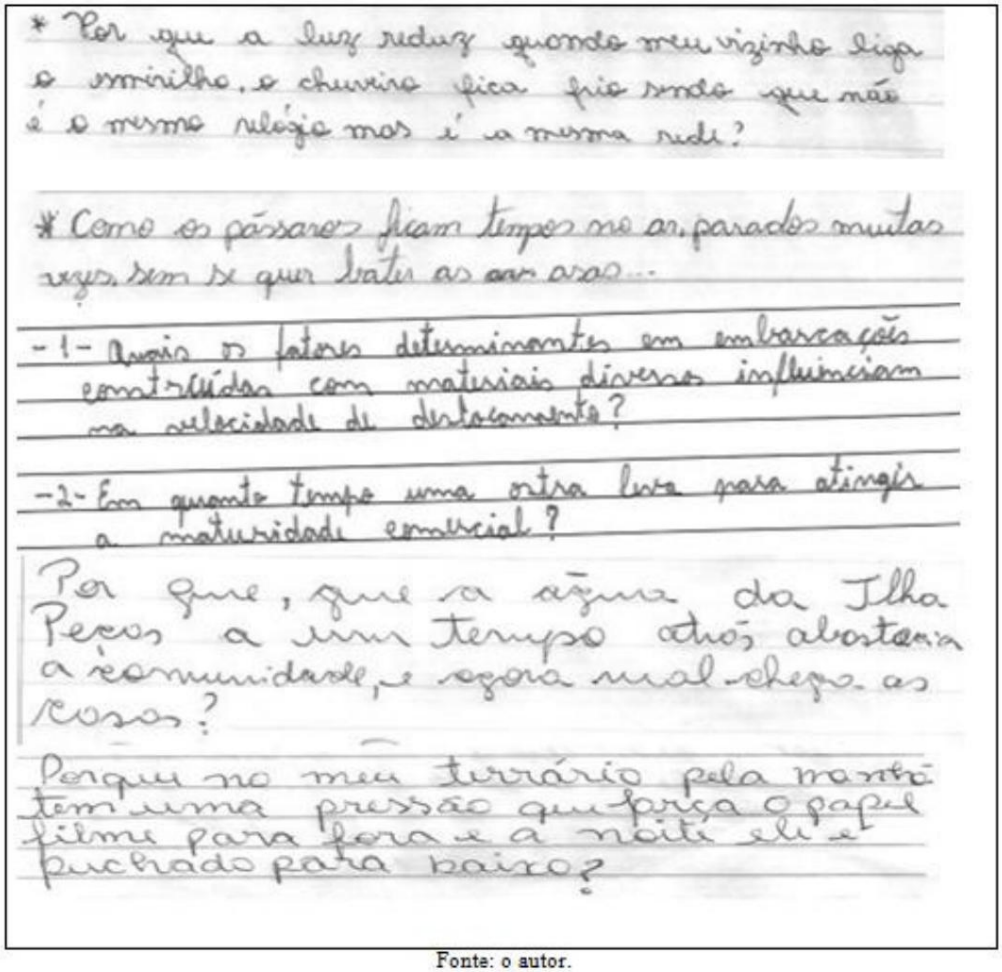
The dialogue begins in the search for the syllabus – a methodological approach

Inspired by the educator's phrase Brazilian Paulo Freire “the dialogue begins in the search for program content”, was developed a methodological approach applied to two classes, one of the first semester and another for the fifth, of the Field Education - Sciences of Nature of the Federal University of Paraná, coastal sector, with the aim of extract from students problems that affect and which could be linked to the Physical. Beyond the dialogic dimension consideration was also given to the need to escape the ready-made exercises that textbooks bring, which in general

do not reflect the reality of the subjects of the field.

In view of this, we proceeded with the following question: *What are the our physical problems? What are your physical problems? For example; Which velocity...? How long...?, What force..., pressure..., energy..., position..., space..., temperature..., heat..., displacement.* From of this problematization the students did the following questions that are presented in the Table 3:

Table 3 – Questions made by the students.



Fonte: o autor.

Discussion and Analysis

To analyze the questions created by students will be considered the Freirean thought. However, in First, an analysis will be carried out of the methodological approach used.

The method

This methodological approach deals with from a dialogical, thematic and problematizing not strict sense Freireano, this is because it makes room for that the students pronounce themselves point out themes or issues on which they have some interest or curiosity, at the same time as the dialogue between educator and students. In this In particular, the educator co-responsible for the teaching process and learning brings the elements that provoke action, the voice of the students, which, in turn, take the first step in towards participation in their own training process, which problematize their own reality. This approach can be considered also a way of teaching the future teachers to escape conditioning of textbooks that do not present class interest problems worker, in addition to allowing delimit the topics of Physics to be studied according to each context.

The students' questions

Description: In the sample above are Six questions are presented, which can be classified according to their nature curious or of social necessity. the ones that refer to terrarium and bird flight we call curious. The others, although they reflect a personal curiosity, linked to an everyday situation, the a social necessity, that is, the lack of water on the island, the lack of electricity, to the movement of boats on the ocean, and the time for an oyster to develop. In this last example, although the problem of the maturity of an oyster is not exactly a problem that the Physics usually pores over, in a course such as the degree in Education from the Field, which adopts the knowledge area as a teaching focus, answering this issue shouldn't be a problem.

Inference: As you can see, the questions produced by the students are authentic, linked to their curiosities, as well as their daily lives. Questions that were developed from physical terms/concepts for which they already had a pre-conception coincident or not with the meanings given by physics. unlike the abstract character of the conceptual teaching of Physics, this methodological approach allows you to study various topics related to to a context. Finally, it is not Physics for the Physics, but Physics aimed at understanding of reality and perhaps for practical resolution the problem of lack of water or energy electricity that reaches a certain group social.

Final considerations

Why a Physics Teaching? decolonizing? First, it is considered as well as Smith (1999) that the system current capitalist that also falls on the Brazil and other countries in the world is a extension of economic and social policy colonialist and imperialist implanted by the countries Europeans on the continents American, Asian and African around the XV century. As a result of this historical period, the Physics restructures itself according to the logic of the European thought-language, your culture, values and symbols.

Such a discipline inserted in other cultural scenarios, such as Brazil, becomes a strange knowledge. which requires a great effort to be apprehended, However, behind this difficulty there is a cheating, that is, its presentation that takes place in a fragmented and disconnected way from the its production context. soon, few students will understand it and those who If they do, they run a great risk of alienate themselves from the objective world, for they enter in a closed conceptual world. You working-class students, instead they are excluded from the system education and prestigious posts that he supposedly guarantees. Anyway, this dynamics is part of a process of domain that intentionally tries show the colonized that they are incapable of learning.

Therefore, to reverse this situation, it is I need to escape from this vicious circle of content as an end, for content as means of understanding, acting and transform reality. Not only that; it is necessary to help students to have mastery of intellectual instruments, such as how to classify, analyze, describe and recreate reality; and also from technical instruments, that is, design, build objects that improve your living conditions and their communities. These practices, linked to other discussions such as agrarian issues and agroecological foundations, allow think of another approach to teaching Physics for and with the subjects of the field that be critical and decolonizing and therefore participatory.

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[i] Brazilian thinker born in Rio de Janeiro in 1909. He was head of the Philosophy Department at the Instituto Superior de Estudos Brasileiros ISEB – founded in 1955 and extinguished in 1964 with the military coup. Exiled in Yugoslavia, he accepted the invitation of educator Paulo Freire to work in Chile. Álvaro Vieira Pinto is considered by many to be the first and universally important Brazilian philosopher (Cortês, 2003).

[ii] The dominant elites, in societies like ours, normally alienated, behave like irrational animals: they prey on nature to subsist; the alienated man preys on culture. It takes from it the goods, the ideas, which it stores in the spirit, but it is incapable of producing anything original with them, that is, of creating the authentic emerging culture, with the help of which it has absorbed (Pinto, 1979, p. 52). .

[iii] If Science now tends towards the formalization of its statements, this inclination must be considered neither general nor necessary. It is a historical fact, it represents the current stage of the development of scientific creation. The communication of the technique of production of fire by the individuals of the pre-sapiens species could have happened only through gestures or simple imitation, which corresponded, to the degree of development of the productive forces of the time and of the being in the process of humanization that dominated them. , to the "formalization" possible at that time (Pinto, 1979, p. 82).

[iv] (Michel) Serres condemns writing itself, refusing that history has to be defined by its appearance. Graphocentrism, for him, is another form of racism against non-literate cultures. But the criticism is a little broader and

it actually encompasses the whole verb, the word, the speech: nothing numbs the flesh more than the word, he says in The Five Senses. In other words, its focus globally implies both written and spoken language, that is, the very notion of linguistic representation that reduces the thing to its supports. And such reductionism has reached, in the present time, thanks to consumption, the peak of its unfolding, constituting an entirely ascetic culture. The administration uses language to dominate (empty verbiage of politicians), the media seduce by communicating, Science imposes its component of truth through the word. A dominant class intoxicated with codes, producer of worlds, derives from this.

Social chemistry, stronger than narcotics, therefore worse, belongs to the *mass media,* to fashions. And amid this general noise of communication, nobody pays attention, nobody delves into anything. Theodor W. Adorno said that working in a team is disastrous, because everything that is attributed to the thinking individual evaporates in the abstraction that reduces several people to the formula of a "common conscience".
Serres, like Adorno, thinks that when several scientists come together to carry out research, the research escapes them, as only the verb dominates.
The scientific group, constituted as an ivory tower, is enclosed in a linguistic wall, paying attention only to words (Marcondes Filho, 2005, p. 10).

[in] Reproductive Explanation (non-creative) or imitation - expresses the language and/or constant thought(s) in Physics teaching materials.
It is specifically one of the functions of imitation, which, according to Pino (1993, p.19), implies a double semiotic operation, in which the reproduction of the model constitutes a signifier of this model, which, in turn, refers to the imitated person. In this case, there is a type of alienation of himself by the subject himself, a process in which the voice of the "I" expresses the thought of the "other" (Wertsch, 1991); (Barbosa, 2014, p. 92).

[we] These statements are taken from the doctoral thesis entitled "Scientific and Technological Education for Participation: Paulo Freire and creativity" (Barbosa, 2014).

[vii] Ideas adopted by the bourgeois class that aim to maintain (conserve) the *status quo* (Carvalho, 2005, np).

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