



Professional Education and STS: a View on the Federal Institutes

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ABSTRACT

This text takes an approach to the principles of professional training of the Federal Institutes (FIs) and their correlation with an approach in the field of Science Technology and Society (STS). Its objective was to show how the policies that underpin the institutionality of FIs contribute to think about professional training in the STS perspective, that is, in a socially engaged way. At first, a delineation is constructed based on a critical presentation of the STS field and the type of professional training associated with it, in order to, in a second moment, indicate the ethical-political bases of education in the FIs, resuming the document on its conceptions and guidelines and the law of its creation, Law n° 11.892. It is shown that the FIs present themselves as a privileged space for the STS formation, and may be the occasion for the association of this with a conception of professional training of workers, researchers and citizens capable of intervening in the public decision processes involving science technology.

KEYWORDS

Science technology and society. Federal Institutes. Professional Education.

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Formação Profissional e CTS: uma Abordagem dos Institutos Federais

RESUMO

Este texto faz uma abordagem dos princípios da formação profissional dos Institutos Federais (IFs) e sua relação com o campo de Ciência Tecnologia e Sociedade (CTS). Seu objetivo foi analisar até que ponto as políticas que embasam a institucionalidade dos IFs alinham-se com a formação profissional na perspectiva CTS, isto é, de forma socialmente contextualizada e engajada. Em um primeiro momento delineou-se um quadro teórico apresentando uma abordagem crítica do campo CTS e do tipo de formação profissional a ele associado, para, posteriormente, indicar as bases ético-políticas da educação nos IFs, retomando para isso a lei de sua criação, a Lei nº 11.892 e o documento sobre sua concepção e diretrizes. Mostra-se que os IFs são um espaço privilegiado para a formação com enfoque CTS, podendo assim ser ocasião para o desenvolvimento de uma educação profissional de trabalhadores, pesquisadores e cidadãos capazes de intervir nos processos de decisão pública envolvendo ciência tecnologia.

PALAVRAS CHAVE

Ciência, tecnologia e sociedade. Institutos federais. Formação profissional.

Formación Profesional y CTS: un Enfoque de los Institutos Federales

RESUMEN

Este texto hace un enfoque de los principios de la formación profesional de los Institutos federales (IFs) y su correlación con un enfoque en el campo de Ciencia, tecnología y Sociedad (CTS). Su objetivo fue mostrar cómo las políticas que fundamentan la institucionalidad de los IFs contribuyen a pensar la formación profesional en la perspectiva CTS, es decir, de forma socialmente comprometida. En un primer momento se construye un delineamiento a partir de una presentación crítica del campo CTS y del tipo de formación profesional a él asociado, para, en un segundo momento, indicar las bases ético-políticas de la educación en los IFs retomando el documento relativo a sus concepciones y directrices y la ley de su creación, la Ley nº 11.892. Se muestra que los IFs se presentan como un espacio privilegiado para la formación CTS, pudiendo ser ocasión para la asociación de ésta con una concepción de formación profesional de trabajadores, investigadores y ciudadanos capaces de intervenir en los procesos de decisión pública involucrando ciencia y tecnología.

PALABRAS-CLAVE

Ciencia, tecnología y sociedad. Institutos federales. Formación profesional.

Introduction

The formation of workers in a society has as a parameter the standard given by the working conditions of their time, according to the level of the forces of production and the civilizational advance of the relations of production achieved. The worker has his formation well successful or unsuccessful depending to what extent he is prepared or not to orient himself and adapt to the "development" of science, technology and social relations of his time. Understanding the relationship between science, technology and society becomes a key to identifying the formation requirements of a "good" worker (good in the sense of what is current standard), which is not always done in a critical way, when the contradictions of this training are not taken into account. Apparently, a training that suits the worker to be successful in an iniquitous society would be efficient, but this is at a cost of mutilations and limits in terms of the development of human potentialities, which is up to a critical investigation to uncover.

The Federal Institutes, founded in 2008, are characterized as professional, technical and technological training space aimed at students from a territorially dispersed population, attending, therefore, areas previously neglected by this modality of education. This is a clearly committed proposal with a comprehensive education with local and regional orientation (BRASIL, 2010). But in what sense can an instruction be offered that goes beyond the qualification of professionals to deal with purely technical solutions? More precisely, to what extent can these educational institutions meet the demands of an education that takes into account the emancipation of workers and critically incorporates the STS debate in professional education?

This text is based on the following concerns: in the face of the emergence of the field of Science, Technology and Society (STS)¹ in the form of interdisciplinary approaches to correlation between these three areas, how, from it, think of a proposal of emancipatory professional education? And, taking a concrete case, in what sense does the professional

¹ About this, see what is said on the University of Harvard's Science and Technology Study Program website, specifying the origin and nature of that field: "Science and Technology Studies (STS) is a relatively new academic field. Its roots lie in the interwar period and continue into the beginning of the Cold War, when historians and sociologists of science, and scientists themselves, became interested in the relationship between scientific knowledge, technological systems, and society. practiced in academia today, merges two broad streams of scholarship. The first consists of research on the nature and practices of science and technology (S & T). Studies in this genre approach S & T as social institutions possessing distinctive structures, commitments, practices, and discourses that vary across cultures and change over time. This line of work addresses questions like the following: is there a scientific method; what makes scientific facts credible; how the new disciplines emerges; How does science relate to religion? The second stream concerns itself more with the impacts and control of science and technology, with particular focus on the risks that S & T may pose to peace, security, community, democracy, environmental sustainability, and human values. Driving this body of research are questions like the following: how should states set priorities for research funding; who should participate, and how, in technological decision-making; should life forms be patented; how should societies measure risks and set safety standards; and how should experts communicate the reasons for their judgments to the public?" (HARVARD UNIVERSITY, 2018, p.2)

education proposed by the Federal Institutes², anchored in the commitment to articulate science, technology and culture / society, have affinities with the said STS field?

These issues lead to the discussion of the relationship between science, technology and education, more specifically public policies for vocational education and training of workers. In a special way, the relation of this formation with the vision of science and its foundations and the understanding of the scientific base of the productive processes, not only to train efficient workers and adapted to the demands of the labor reality, but also in the sense of preparing them to critically appraise and participate, in some way, in making decisions about science, technology and social development. It is expected that a professional formation with a CTS scope will be able to foster the flourishing of a culture of participation in decisions in Science and Technology (S & T) oriented to the demand of social mechanisms of control of these instances. For the discussion of these questions, it is sought to construct a theoretical-methodological framework from the field of Social Studies of Science and Technology or Science, Technology and Society, to discuss perspectives for professional education in its field and then approach the policies that institutionalize the Federal Institutes like the Law n°. 11.892 (BRASIL, 2008) and its “Concepts and Guidelines” document (BRASIL, 2010).

The STS field (Science, Technology and Society)

The STS field, in a critical approach³, is characterized by a diverse range of interdisciplinary studies of the mutual links and conditioning of scientific, technological, economic and cultural production with the reproduction of society itself. In this field we seek to understand not only the social background, but also the clash of forces (economic and moral) within the practices of production of rigorous knowledge and its application. In this sense, it is not conceived as neutral and pacific the development of a wide range of technical devices, procedures, methods and processes, whether for productive efficiency, for the adequacy of work management and for expediting the circulation of goods and information, or for the regulation of communication and social interaction. STS correlation can therefore be thought of as the fulcrum of *cognitive policy* as the basis of an education capable of preparing workers to participate in decisions in this field. In this way, it is possible to instrumentalize the "bottom-up", those "who were never invited (and did not feel qualified) to participate in the decision-making process of cognitive politics” (DAGNINO, 2016), to not be merely manipulated by the elite working in the area, but for this, a "qualification in science

² "On December 29, 2008, 31 federal centers of technological education (CEFETs), 75 decentralized units of education (Uneds), 39 agrotechnical schools, 7 federal technical schools and 8 schools linked to universities ceased to exist to form the Federal Institutes of Education, Science and Technology. "(BRASIL, 2016).

³ Moreno (2008) presents the following relationship between science, technology and critical reflection: "the first one focused on the formulation of theories about objects, the second focused on the formulation of immediate solutions to practical difficulties and the third, of presuppositions present in the most diverse reasonings used to justify what we do, we think and realize even when we formulate object theories and solutions to practical difficulties” (MORENO, 2008, p. 83). Such assumptions may be epistemological, methodological, ontological, ethical, aesthetic and political in nature.

and technology for social development" is needed, not only for researchers, but also for participants in social movements and public officials (DAGNINO, 2014, p.159).

The STS proposal presented by Dagnino takes this approach towards a democratic radicalization. However, the STS approach harbors a wide variety of models of research and understanding of the phenomenon studied. In it prevails a diverse range of ideological tendencies and ways of prioritizing one dimension or another of the field. The STS approach is, therefore, a space of hegemonic clash, which delineates in a special way within the academy.

Feenberg (1992) shows that within the academy a mechanistic and unilinear perspective of scientific progress prevailed. In the horizon circumscribed by this prism it is understood that the technical devices are exempt of values and the choices in S & T are fruits of strictly technical decisions. There is, therefore, a forgetting that artifacts are historical and cultural (FEENBERG, 2002). It is therefore necessary to emphasize the deterministic understanding that technology has its own logic and that its development is always towards a progress taken as a separate entity, without reference to society and its specific dynamics (FEENBERG, 1991).

The assertion of technical-scientific progress as a process led by experts, considered the only ones capable of objectively defining what is acceptable in terms of the increase of technological apparatuses and devices, presupposes refusing to accept that adaptive innovations can emerge in different socio- based on initiatives and orientations of the users themselves. In this sense, the understanding prevails that objects are neutral because of the necessary mode of their engenderment, that is, because of the internal logic of their development. Thus, it is argued that, in the context of technological determinism, socially relevant questions concern merely how to employ technical devices for good rather than evil, in order to legally restrict their uses.

However, from the ethical-political point of view, it has become necessary, in the face of the authoritarian advance of the power of the masters of technology, to make a holistic critique of technology and its democratic potential, since the antidemocratic tendency of the production of technology can be transformed (FEENBERG, 1991, 2002). Feenberg (2002) and Lacey (1999) understand that the appropriation and redesign of S & T are necessary conditions for the development of democratic technologies, although they are not enough to generate new trajectories and alternatives. This also requires a redesign of technology that incorporates, in addition to democratic participation, environmental variables, workers 'and consumers' health issues, and skills development of professionals who are sensitive to these points. Without this, progress of scientific knowledge and technical skill would continue to lead to "barbarism," orchestrated by insatiable markets.

Faced with this, STS field studies can remain harmless, even when critical. However, even recognizing the catastrophic potentials identified by the Frankfurt school, authors such

as Feenberg (1992, 2003) propose a different departure from paralyzing pessimism, often associated with Frankfurtian thinkers. In this sense, technology is conceived from a proposal based on historical freedom, while rejecting to the same time the naive liberal triumphalism of scientific and technological progress harmonized with democracy and social justice and the dystopian prophetism of a technically molded totalitarian society.

It is understood in a critical approach that, being social, technology is redefined from the interests, many times antagonistic, of various actors, whether by the corporate engineer elites, whether on the "factory floor" or within the scope of scientific and technological policies. The STS debate is based on the technique and its un/determinism (NOBLE, 1989; FEENBERG, 2002), on the trans-historical and historical characteristics of technology (MÉSZÁROS, 2002) and on the un/possibility of proclaiming the self-management even with the taking of power or the possessing the means of production by the proletariat (BETTELHEIM, 1979). In any case, public policies in the context of social conflicts are affected and affect the production of science and technology, with outcomes marked by how the forces at play are confronted in their production.

In this sense, an anti-hegemonic project of science and technology becomes possible when associated with alternative policies and forms of production, such as the practice of solidarity economy and social technology. In this case, it is necessary to approach the technology by the studies in economics marked by the cooperative interest of self-managed enterprises aiming at the knowledge of possibilities and barriers existing for the adaptation of hetero-managed technologies (NOVAES; DAGNINO, 2004).

About these possibilities for (re) configuration and (re) S&T design and, more specifically, technological artifacts, from the point of view of the various social actors, Winner (1986) points to the greater or lesser latitude of decision possibilities in Science and Technology depending on the relations between the actors and of these with the artifacts, as well as of political, economic and social issues, among others. For the author, artifacts, arrangements, and sociotechnical devices possess political qualities, and can provide convenient means of establishing patterns of power and authority in specific contexts, having ranges of flexibility in their material forms: "precisely because they are flexible, their consequences for society must be understood with reference to social actors capable of influencing the choice of the project and of the arrangements." (1986, p.16). They may present properties linked to institutional patterns of specific power and authority, the initial choice being "decisive in view of its consequences" (1986, p. 16). The variety of interpretations on decisions applicable to each case is the subject of disputes, not being able to ignore both the objects themselves, but also the contexts in which they are situated, as well as which contexts are desirable in the construction of S & T.

These considerations lead to an understanding of the STS approach as a study of specific systems, its history and the controversies over its effects not only economic, social, cultural and political, but also academic, i.e. epistemic and educational (ACEVEDO-DÍAZ;

GARCÍA-CARMONA, 2017). The aim is also to understand in their approach the reasons why people are willing to radically change their ways of living to incorporate technological change, and at the same time, others resist similar changes justified either in everyday life, or in the political arena. In this sense, in the STS perspective, it is sought to clarify the directions to which the orientations, designs and configurations of the policies and strategies to be adopted in terms of science and technology are subject to, implying in this also the orientations for the formation of those who act directly with the production of them and those that will be affected directly or indirectly by them.

Professional Education and STS

The technological artifacts and the knowledge that make them possible are systemically mediated, that is, they are social relations and their objects contain ideas and values, being permeated by relations of power. In this sense, it would be up to the education committed to the critical formation to place the student "in contact, at the same time, with human history and the history of "things", under the teacher's control" (GRAMSCI 1982, p. 142). Professional education in the STS critical perspective, that is, demystified, does not dissociate, therefore, from the principles of the unitary school proposed by Gramsci. According to this author, an emancipatory education is one that forms the student "as a person capable of thinking, studying, directing or controlling who directs" (GRAMSCI, 1982, p.136). It also highlights the refusal to prepare socially and academically isolated individuals to merely adapt to the established order, posing as a challenge the creation of "a type of school that educates the instrumental and subordinate classes for a leading role in society as a whole and not as singular individuals "(GRAMSCI, 1982, p.149). Faced with this challenge, work⁴ becomes the central category for human formation.

Professional education, understood from the perspective of omni lateral and polytechnic education, constituted as integral education⁵, requires work as an educational

⁴ According to Gramsci, the concept of labor is not effective "in all its power of expansion and productivity without an exact and realistic knowledge of natural laws and without a legal order that organically regulates the reciprocal life of men, an order that must be respected by convention spontaneous and not only by external imposition, by necessity recognized and proposed by men themselves as freedom and not by simple coercion. The concept of the balance between social order and natural order on the basis of work, of the theoretical and practical activity of man, creates the first elements of an intuition of the world freed from all magic or witchcraft, and provides the point of departure for the subsequent development of a historical-dialectical conception of the world, for the understanding of movement and becoming, for the valorization of the sum of efforts and sacrifices that the present cost the past and that the future costs the present, for the conception of actuality as a synthesis of the past, of all past generations, projected into the future. "(GRAMSCI, 1982, p. 130-1)

⁵ Omni lateral education, polytechnics and integral education constitute a set of terms associated with work as an educational principle; refer to a educational process that takes into account all aspects of hominization, specifically referring to a way of acting in the correlation between high school and professional education. Thus, integral education is not only about "integrating one another in the form, but rather of forming secondary education as a formative process that integrates the structuring dimensions of life, work, science and culture, opens new perspectives of life for the young and compete for overcoming inequalities among social classes "(CIAVATTA, 2014, p 198).

principle and demands the approach of socially oriented studies of science and technology, since these factors directly concern the conditions of production and reproduction of social life. In this sense, it analyzes the requirements of the STS for professional education and the conceptions and guidelines of the Federal Institutes.

Historically, human formation in capitalist societies, especially in relation to the relationship between labor and education, has occurred in contexts of the sale of labor forces, precarious work and unemployment, and under conditions of exploitation, repetition and restricted choices, and limited, typical of new forms of alienation. At school this also reverberates, exposing the social division given by the clash between capital and labor (SAVIANI, 1994). This contradiction runs through professional training. The educational duality manifested in training for the workers and the segments that direct and guide society is linked to the characteristics of modern education in Western societies in the capitalist mode of production. Hence the relation between work and professional education is not neutral and taking work as an educational principle means going beyond methodological choices, is to understand it as an ontological basis and ethical and political principle. However, as a key to personal and social development, especially when taken as the right or duty of all, work is marked by relations of exploitation and alienation, conditions that impede the free flowering of man. This is a central point to understand the approach of science and technology in the direction given by secondary education integrated with omni lateral formation guidelines, which was the basis of the IFs proposal.

Secondary education in Brazil, as well as professional education, is a tributary of a class society and an inheritance of the slave-owning matrix, which presents a certain discredit of manual activities, historically guided by dualism, which has only recently been discussed with a certain radicalness and would be beginning to be overcome (CIAVATTA, 2014; FRIGOTTO; CIAVATTA; RAMOS, 2006; FRIGOTTO; DICKMANN; PERTUZATTI, 2017). More specifically, professional education has presented in Brazil characteristics of social assistance and essentially utilitarian orientation for the productive universe of the market. Hence, the integrated paths are configured as alternatives to this dualistic model, when understanding that knowledge, actions and behaviors are indissociable elements, requiring a formation for autonomy related to the integral development of the subjects, taking as inseparable their productive, political, ethical dimensions and aesthetic.

Both the assumptions of the field of STS studies and those of Work and Education, whether in the conceptions of polytechnic education, integrated or omni lateral, have been oriented towards understanding the inseparability between theoretical and practical knowledge (ARAUJO; SILVA, 2012). The proposal of scientific education in the STS field passes through a broad vision of science and its ethical and social foundations, and on the other hand, the reference of work and education evidences the necessity of forming subjects capable of comprehending globally the scientific basis of the productive processes.

In this sense, it is understood that the integral formation of workers passes through the understanding of how knowledge and science relate to work processes, transform themselves into productive forces through technology. And, rather than techniques and knowledge applied in specific contexts, it is the understanding of the historical process of the production of knowledge and its appropriation in the intentional intervention in reality. Science and technology, in this way, are understood as developed and socially appropriate skills capable of transforming natural-historical conditions of life and expanding and blossoming human potentialities. This implies, in the correlation education and STS, to approach socially constructed knowledge in its historicity as a formative base that integrates humanities, science and technology. In this context, the meaning of "full development of the learner" cannot be understood without connecting it to the joint formation of capacities to produce, act, judge and decide, to the articulation between intellectual, manual and mediating artefacts, as well as to how the economic and political interests guide the techno-scientific endeavours.

Decisions about science and technology are often in the hands of technocrats who have specific knowledge and are not accessible to most citizens (LORENZETO & MOREIRA, 2014). Faced with the authoritarian reality of many countries with limited forms of participation, there will be little control over the non-hegemonic fractions of civil society, that is, the majority of the population, over appropriations and technoscience uses, since technocrats as well as specialists make up, or at least are attuned to, the most powerful sectors of society. The creation of mechanisms of social participation in the decisions on research in Science and Technology means the emergence of ways of orienting them to meet the needs of the population and not only the needs of the market, for the pursuit of profit in spite of their social costs. This refers to the limits of the development of social technology or solidarity within the framework of capitalism and what can be done alternatively in them.

The STS formation in basic education makes it possible to promote the scientific and technological education of the citizens, that is, to prepare the people in good measures to understand the intricacies and to take part of the decisions on technoscience. From reflections and activities on scientific and technological development and its consequences in the short, medium and long term, as well as on how people and social organizations affect and are affected thereby, students can take theoretical and practical knowledge of the ways human and non-human actors interact in this context. At stake are not only knowledge of a specific field, but the confluence of areas of knowledge, taking into account not only economic, but also cultural, moral and ethical aspects involved in the STS dynamics. From the dialogue/confrontation of knowledge, an integrative approach can be constituted in order to avoid fragmentation, because without a more comprehensive report there is no horizon for formulating criticism and understanding the meaning of social practices⁶, which can occur when one tells a history of technology or a specific technique as another narrative among others that do not communicate.

⁶ "There is a difference between a theory from which all else is supposed to be deduced, as it occurs in the more megalomaniacal forms of high rationalism, and a narrative that is "grand" in the sense of providing the matrix by which many, but not all, of our other practices can be shaped "(EAGLETON 1996, p. 87.)

This would lead to curricular modifications that make it possible to discuss citizenship, social projects, and technological development, based on social responsibility criteria, as proposed by scholars in the area (SANTOS; MORTIMER, 2001). However, a critical approach to STS requires that we not only go beyond content-oriented curricula, addressing, for example, large generating themes, but also to question the limits of social responsibility itself within capitalism.

Likewise, STS approach in professional and technological education is not limited to changes in curricular components, but also demands methodological changes, ways of making education a privileged moment of social practice, allowing greater student autonomy, creative and critical postures, (NASCIMENTO; RODRIGUES; NUNES, 2016), without, however, minimizing the importance of the intervention and the direction of the teacher. Lorenzeto and Moreira (2014) point out the possibility of pedagogical practices based on discursive interactions, seminars, debates, expositions, dramatizations, group work, among others, that allow dialogue between the participants in order to enable their representations to be confronted and with school knowledge. It is important to focus on social practices in school, STS issues, especially the impacts of the development of Science and Technology, their relationship and conflicts with work and production in their various stages. The focus is on democratic participation or authoritarianism in decisions concerning the promotion of scientific research and public support for certain technologies (pre-production) and the positive enhancement or minimization of damage and impact of the effects of scientific and technological development (post production).

Technical-scientific education in the service of liberation and humanization breaks with the mystification of technicality of technicians, and scientism of scientists (LORENZETO; MOREIRA, 2014). By broadening the notion of professional education as not restricted to technicality and the formation of specialized skills, it seeks to overcome the dualism by shifting the focus from the market objectives to that of a comprehensive human formation, understanding this in its contradictory historical-social context, which limits and potentiates it. In this sense, the proposals of unitary, omni lateral and polytechnic education emerge (CIAVATTA, 2014). It is not an overlapping of humanistic and technical contents, but of amalgamating constitutive knowledges of technoscience as a social practice, which requires not only interdisciplinary pedagogical approaches, but also an epistemology capable of imparting apparently fragmented knowledge, enabling passages between them without reductionism, as a way of situating them as moments of production and maintenance of human life. The importance of a STS approach in professional education lies in its contributions to go beyond the technician's technical instruction, contextualizing the way technical solutions and problems have a background and an "*a priori*" non-technical. The technique is no longer considered in itself and as an end activity, to be looked at as a medium activity (LINSINGEN, 2006). Thus, it can be focused as a moment of a whole that makes it possible, whose mode of being interpreted (ideology) justifies and legitimates it in its most diverse and questionable purposes.

Taking STS as an axis of the formation of workers requires understanding of conceptions of human being, work, society, science, technique, education, among others (ARAÚJO; SILVA, 2012). However, this perspective only makes sense when it contributes to overcome the reductionist views of science and technology and leads the debate to the possibilities and limits of participation in decisions in the fields of science and technology (PINHEIRO; SILVEIRA; BAZZO, 2009). In terms of education, it is about breaking with the perspective of the neutrality of science and technology and assuming a perspective of social commitment on these from a critical and questioning view of society itself. Although they point to the limitations of models, especially those based on other realities, the aforementioned authors present some possible readings of STS: (1) their discussion in science disciplines, questioning the role of science and technology; (2) the science and technology debate through a STS approach, either through specific discipline or interdisciplinary work; and (3) a 'pure STS' perspective, where science, technology, and society are discussed, and scientific content is subordinated to debates. It is also essential to think about the responsibility of the human sciences in the discussions and debates about science and technology (MORENO, 2008).

As Lorenzeto and Moreira (2014) point out, scholars of professional and technological education, as well as those who relate science, technology and society to professional education, emphasize the need for a critical and reflexive education:

The STS approach allows us to conceive science and technology as cultural constructions, situated historically and socially. [...] the use of a STS approach, in technical/technological courses, has the potential to comply with the legislation and policies of professional education, in the sense of integral human formation, giving students not only the technical capacity that will allow a professional education, but also developing the capacity to understand reality and broaden its critical awareness (LORENZETO; MOREIRA, 2014, p.14).

The curricula of science education, which also applies to technological education itineraries, oriented towards citizenship, need to take into account the development of decision-making capacity (SANTOS; MORTIMER, 2011). In other words, rather than providing up-to-date information on science and technology, which alone is not sufficient for engaging in social issues, active participation in the decisions of society is based on an education geared towards critical social action and that considers and confronts attitudes and values. The approach to social issues involving science and technology, especially those that are directly linked to students, refers to this dimension of the formation of attitudes and values, the basis for teleological, that is, ethics-political, positioning. In this way, although the scientific and technological education is fundamental, it remains very weak if it does not give relevance "for a change of personal attitude and for a questioning about the directions of our scientific and technological development" (SANTOS; MORTIMER, 2011, p.107). The perspective of the neutrality of science, in this sense, tends to reinforce values contrary to those of democracy and citizenship, always surrounded by conflicting and often tragic choices and decisions.

Work as an educational principle and integral or omni lateral training oriented towards human emancipation are the basis for understanding the relationship of sciences and knowledge socially constructed and the way they are linked to the production and reproduction of life. To understand historically and contextually the actions, possibilities and limits of these sciences and knowledge, as well as its application, enables an integral formation oriented to the decision and autonomy, considering that in this integration the non-dissociability between theory and practice, between work intellectual and manual, between the paths of science and technology and economic interests.

The STS approach in basic education forms the basis for making critical decisions both in the context of individual consumption, as well as in the professional career and citizen participation. This is the basis for the creation of practices of participation in decisions in Science and Technology prioritizing the real needs of the population, that is, of their social well-being and fair access to the benefits of the "advances" already made by humanity. A citizenship-oriented approach to science and technology confronts values and ideologies that justify development options that are opposed to the interests of those who live or work for and crave for work, forging ethical-political strategies to change undesirable trends. This is what can be required of an education that shapes professionals according to their own interests and needs and not merely as a stock of labor for the unstable demands of the market.

The perspective of the neutrality of science, in this sense, tends to reinforce values contrary to those of radical democracy and citizenship, whose horizon is that of a society of freely associated producers. The approach of social issues involving science and technology, especially those that are directly linked to the daily life and the professional horizon of the students, refers to the formation of engaged attitudes and the creation of values that are accordance with the requirements of the human dignity and the ecosystem that makes possible our existence, against which the capitalist technical-scientific development catastrophically has detached itself as if it were the only bearer of an intrinsic value to which everything must be sacrificed.

The technique, as opposed to work as an educational principle, presents itself as a moment of a historical-social totality. In the face of this, it makes no sense to speak of the neutrality of science by separating it from social contradictions. Engagement around values relating to forms of life production, environmental and social justice issues present compelling challenges, whether in the short or long term, by those who promote science and technology.

In the light of what has been said, it can be affirmed that, in a sense, the STS approach, or its spirit, although critically slowed down, whether initially explicitly or openly acknowledged in the guidelines and legislation, is basic to the achievement of the proposed objectives by the recent public policies of professional education, at least those that will prevail until 2016, in Brazil.

Federal Institutes and education with STS approach

If in any way a new governmental tendency imposes itself in a country, it alters the civilizational pattern of the people, or it cannot be considered new, either from a progressive or conservative point of view. The so-called “Lula age” has been the subject of intense debate in this respect. In this sense, the proposal of the Federal Institutes is one of the highlights of the educational reforms of the period with regard to professional education.

Regarding the Federal Technological Education Network (Federal Technological Education Centers) (CEFETs) and other institutions isolated from or linked to Federal Universities, the Lula government repealed from Law n° 9.649 / 98 the content according to which the expansion of supply of professional education, through the creation of new educational units by the Union, could only occur in partnership with States, Municipalities, Federal District, productive sector or organizations, which would be responsible for the maintenance and management of new educational establishments. Since then, an "aggressive policy of expansion of the federal network of technological and professional education" has been adopted (DANTAS, 2009, p.12), whose "innovation" occurred with the FIs, in charge of offering high school integrated to the professional, well such as higher technology courses, bachelors in engineering and bachelor's degrees.

Thus, a broad investment has been made in the sector. The funding of costing and staffing in the Federal Network of Professional and Technological Education from 856 million in 1998 went to 1.2 billion in 2005. From 2003 to 2006, 3,433 education servants were hired, as opposed to 1995 and 1998. Between 1909 and 2002, 140 federal units of Vocational and Technological Education were authorized in the country and, between 2003 and 2010, 214 new units, added to the previous units (BRASIL, 2007).

In the PDE, the links between Professional and Technological Education, territory and development are proposed with more emphasis, especially in the FIs, models of professional education institutions of integrated action and referenced socially and territorially; the actions of the plan would contemplate the reorganization of the Federal Network, integrating it to the FIs, the articulation between the High School and the Professional Education, the hiring of new servers and the focus of action from the 'pole cities'. However, of the 30 actions that focus on the aspects foreseen in the National Plan of Education (PNE), 17 are referred to Basic Education; 7 to teaching modalities; and 1 refers simultaneously to Basic, Professional and Higher Education (SAVIANI, 2007, p.1239).

In opposition to Decree 2,208 of April 14, 1997, which dismantled experiences of integration of regular education with professional education, Decree 5,154, of July 23, 2004, sought to retake the perspective of integration. The latter regulates paragraph 2 of art. 36 and arts. 39-41 of Law n° 9.394, dated December 20, 1996. It guaranteed the verticalization of professional education, the possibilities of educational routes, its articulation with secondary education, especially in an integrated or concomitant way, the qualification for work, the

academic qualification, among others. Special mention should be made of Decree 8.268/2014, which also foresaw the centrality of work as an educational principle and the inseparability between theory and practice.

Through the creation of the Federal Institutes of Education, Science and Technology under Law n° 11.892/2008, a human and civic formation was affirmed as a process inherent to the qualification for the exercise of labor, capable of articulating science, technology, culture and specific knowledge (SILVA; FERNANDES, 2016; BRASIL, 2008; BRASIL, 2010).

This articulation is correlated with a conception of science produced in a certain social context that gives it priorities in terms of directing it according to local technological demands and in consonance with a national political education project. The teaching, research and extension triad adjusts itself to favor the social incorporation of science, understanding it as a way of producing territorially oriented knowledge, technology and innovation. In this sense, the national political orientation is decisive, as it will promote projects accordingly, favoring certain aspirations of the school community, internal and external, segmented according to the own division of Brazilian civil society.

The territoriality aspect of education is related to the expansion of the professional and technological network in remote localities previously lacking educational opportunities for the technical formation of workers, which is consistent with a proposal to reduce local and regional asymmetries. The main aim is to establish an institution which, as a matter of principle, was not directed at clientelistic political interests, but at the need of technical and technological development in its territorial distribution. It would be in line with local social and cultural arrangements (that is, local and regional development), preferentially considering "peripheries of metropolises and in rural municipalities far from urban centers, where the courses were articulated with the local potentialities of generation of work "(BRASIL, 2010, p.14). As public policies, the Federal Institutes are proposing an integrated action and institutionality of a social character that emphasizes professional and technological education and occupation of the territory, understood as a place of life (BRASIL, 2010, p. 15).

The Federal Education Network and professional and technological education are taken as strategic not only for national development, but also for the "citizen insertion of millions of Brazilians" (BRASIL, 2010, p.18). The qualitative leap in the centennial trajectory of the vocational, technical and technological education network, especially in the social perspective, based on public inclusion policies (JESUS; COSTA, 2013) stands out. It is assumed, according to the document on conceptions and objectives of the FIs (BRASIL, 2010), education and public institutions as fundamental for the construction of sovereignty and democracy and the fight against structural inequalities. Federal Institutes were thought of as public goods that articulated social transformation, responding to the need to institutionalize professional and technological education, the search for equality in diversity (social, geographic and cultural) and the articulation between other labor and income policies, development sectoral, environmental, social and educational (BRASIL, 2010). In this sense,

collaboration in structuring policies for the region in which they operate allows FIs to maintain a dialogue between public authorities and local communities.

The determination by the regional and the local also refers to the overcoming of the local versus global antinomy. The Federal Institutes, according to their founding narrative, would be committed to a proposal of overcoming the notion of subordination to economic power, assuming the commitment to the humanistic and aesthetic formation of professionals in the most diverse levels of education, without compromising with the "Intervention in reality, from the perspective of a sovereign and inclusive country" (BRASIL, 2010, p.21). The notion of public policy of the Federal Institutes is based on the possibility of educating people capable of mastering technologies for the construction of a different world. This refers to a new way of seeing the relationship between science and technology in the professional education of actors in an intentional process of transformation of reality, aimed at a technological redesign based on the construction of more humane and solidary logics. Hence the idea of guaranteeing actions aimed at incorporating, above all, social sectors that have historically been neglected in Brazil's development and modernization processes, which legitimizes and justifies the importance of its public nature and affirms a professional and technological education as an instrument really vigorous in the construction and rescue of citizenship and social transformation (BRASIL, 2010).

The conceptions of Science, Technology and Society, in this founding sense, are not attached to the triumphalist view of science and technology that guides management policies committed to mere economic growth without taking into account social inequality. The purpose of this study was to lead the Federal Institutes, not to be merely subservient educational establishments and reproducers of industrial models based on market logic, but also to professional educational centers geared to research and extension, open to ethical-political reflection on science and technology and its correlation with regional producers and local productive arrangements.

In such a founding discourse (BRASIL, 2010) there was no blind reception of the models of science, technology, and triumphalist and linear society. It is not assumed uncritically that the development of science would be conducive to the enhancement of technology, which in turn would lead to increased wealth and social welfare. In a sense, it has been recognized that not all science and technology is capable of producing social welfare, especially when these are dissociated from democratic projects of production and knowledge-sharing.

In this way, an opening was made for non-technical or non-epistemic factors that play a significant role in the production and consolidation of technology (LACEY, 2005). The FIs were initially presented in their conception and their guidelines, as agencies instances of sciences and technology, able to democratize the access, not only to the professional / productive domain of its results, but also to the processes of its construction.

The FIs have, as stated in their foundational narrative (BRASIL, 2010), express potentialities for transforming forms of life alienated from the market, going beyond an education committed to the mere training of technicians subordinated to the reproduction of capital. The institution of FIs, in proposing dialogue with local reality as one of its pillars, has committed itself to the production of technological solutions that guarantee access and the rights to social goods, especially to education. Its local insertion is, in principle, understood as propitiating the changes in larger spheres, considering that the universal is in the regional. Regional and local action is thought to be the construction of a culture that "surpasses a global identity based on an identity based on the sense of territorial belonging" (BRASIL, 2010, 22).

Predominates a notion of territory which is not driven by competitiveness or maximization of productivity, in relation to which hegemonic social actors benefit greatly, but driven by the dialogue with the communities where the FIs are located, "this dialogue that includes natural and sociocultural things, the social heritage and the society in its movement" (BRASIL, 2010, p. 22). The proposed technical and technological professional education is not limited to the instrumentalization of people for specific jobs, pointing to the generation of knowledge from an interactive practice with reality, thus leveraging development with social inclusion and income generation.

Challenging local aspects are in the negotiations between the local and the global, the "construction of an intercultural solidarity network" (BRASIL, 2010, p. 23), woven from existing social relations. It proposes the formation of a culture of democratic participation that associates the domain, the development and the adequacy of techniques with respect to the traditions and customs of the populations. It is a question of finding ways of sharing knowledge from its capacity to increase "local productive arrangements". This is without losing sight of the commitment assumed as being based on the ethics of responsibility and care, with "social, economic and cultural demands permeating the issues of cultural diversity and environmental preservation" (BRASIL, 2010, p. 26).

The emancipatory formation is understood as the educational basis in the articulation between work, science, technique and culture. More than purely academic work, emphasis is given to formation with a mastery of work techniques and learning methodologies articulated with concrete reality, bringing together "knowledge, appropriation of technologies, national, local and regional sustainable development" to think about the subjects of education professional as a "subject of reflection and research, open to collective work and critical cooperative action, which translates as a reflexive deal that actually works the technoscience" (BRASIL, 2010, p. 30). The aim was to overcome dichotomies such as theory and practice, or science and technology through research as an educational factor, as well as scientific, and human intervention in the social world through action on technological and institutional "arrangements", taking into account view the break with a dualistic perspective.

It is also aimed at overcoming a merely economic view of technology. The universe of work in Brazil is heterogeneous, prevailing models of Taylorism/Fordist production and flexible accumulation, as well as the greater centrality of the technical bases assumed by microelectronics, which has provoked new demands in the professional and technical education of workers. This results in a disconnect between educational systems and the world of work and the need to qualify workers. If, on the one hand, this demand for labor in the productive scenario was a key element of technical and technological vocational education and "definition of the policy for expanding vacancies for this type of education", the conceptions and guidelines of the Federal Institutes, without ruling out the articulation between professional education and the world of production and work, are "beyond the economic factor", seeking to relate education and work with a view to social inclusion and the "intellectual domain of technology from culture" (BRASIL, 2010, p.33). The proposed education aims, together with the technical-professional preparation, to institute citizens with the perspective of "enabling the political, economic, cultural and social transformations necessary for the construction of another possible world" (BRASIL, 2010, p.33).

It is recognized that this requires an education as integrality from the interactive practice with reality and in the perspective of emancipation. In this way, it starts from a critique of the reductionism of the mere training for the job posts and proposes a formative activity focused on "the construction of a more democratic, inclusive and socially and environmentally balanced society" (BRASIL, 2010, p. 34). More than just competent users, the aim is to capacitate producers able of adapting science and technology in a context sensitive way.

The Federal Institutes were thought of as public goods, responding to the need for institutionalization of professional and technological education, the search for equality in diversity, and articulation among other policies (work and income, sectoral, environmental, social development and educational). The democratization of access to benefits arising from the advancement of science, is presented in the proposal as a mediator of professional education. The relationship between the development of solutions that meet the community and the world of work is the basis of educational processes that generate work and income from a principle of emancipation of citizens, taking into account local and regional socioeconomic development. This formation is combined with the development of technical and technological solutions that extend their benefits to the community and, together with extension activities, are articulated with the world of work and social segments for the production, development and diffusion of technological knowledge. These policies give the subjects of the educational process centrality in a praxis oriented to ensure the conditions of interpretation of society and the exercise of citizenship. And this is put, in terms of the proposal, through an articulation of the humanistic-technical-scientific educational base capable of articulating with differences and social needs in the territories where it is inserted.

Final Considerations

In terms of the proposal, the conceptions and directives of the FIs talk with both assumptions that guide the field of STS studies, as well as those that study the relation between Work and Education, or in the conceptions of polytechnic, integrated or omni lateral education. There is an understanding of the inseparability between theoretical and practical knowledge and the determinations and socially conditioned tendencies of the activities and directions of scientific research and technical and technological development.

As a public policy, the Federal Institutes, from their founding proposal given in their conceptions and guidelines, are constituted as actors that bring the possibility of a deeper articulation in the relation between Science, Technology and Society. The proposed relationship in this public policy between Science and Technology and local and regional development taking into account a criterion of social nature, understanding science technology and society as inseparable elements. From the point of view of preparation for professional life, the relationship between science and technology and society presented, opens space for omni lateral education, in its version of integral formation, in order to enhance work as an educational principle, allowing the appropriation of the humanities in the technical and scientific education, avoiding reduction to technicality.

According to the founding law of the FIs (BRASIL, 2008), the interrelation between the development of solutions that serve the community and the world of work is put in the base of educational processes that generate work and income and the emancipation of the citizen, which apparently differs from the principles of accumulation, profit maximization, expanded capital expansion, among others (DAGNINO, 2012), taking into account local and regional socioeconomic development (BRASIL, 2008). The initial and continuous formation of workers, their qualification, improvement, specialization and updating in the areas of professional and technological education are combined with the development of technical and technological solutions that extend their benefits to the community and appear, along with extension activities, articulated with the world of work and social segments for the production, development and diffusion of technological knowledge. This conception is guided by the "sustainable territorial development" and "integral formation of emancipated citizen-workers", in a perspective that affirms a "project of society that corroborates emancipatory social inclusion" (BRASIL, 2010, p.14), more which in a paternalist policies perspective or social control, as seen in the initial proposal of the Federal Network (BRASIL, 1909).

The Federal Institutes took as their basis the "consolidation and strengthening of local social and cultural productive arrangements" (BRASIL, 2008), in order to take into account the mapping of potential socioeconomic and cultural development, and to guide ways of inserting technologies in communities, which implies thinking about the rupture with dominant logics of science (VELHO, 2011) and even with a division of international S & T work based on logics of exploitation and domination (HERRERA, 1995). In its initial

conceptions and guidelines, there is a concern of FIs with the "development and transfer of social technologies, especially those aimed at the preservation of the environment" (BRASIL, 2008). This corresponds to a valorization of a socially engaged and contextualized technology, in the way it is understood as democratization of access and participation in production and the benefits arising from the advance of science (DAGNINO; BRANDÃO, NOVAES, 2004). It is also a proposal for the democratization of access to scientific knowledge mediated by professional training, articulating the dimension of knowledge and doing.

While proposed, these conceptual and normative frameworks tend to be effective when the actors who operate on the floor of the institution incorporate and defend them, which, in turn, depends on the kind of academic formation they have had and still have. As a suggestion for future studies, it would be pertinent to analyze the Institutional Development Plans (PDIs) and Course Pedagogical Project (PPCs) of units of the FIs, in order to verify how the founding proposals are effective in the materiality of the institutional documents that guide the course design and the institutional development in the local and regional spheres, from which we can also study what has been done in the didactic-pedagogical scope, as well as research and extension.

References

ACEVEDO-DÍAZ, José Antonio; GARCÍA-CARMONA, Antonio. **Controversias en la historia de la ciencia y cultura científica**. Madrid: Catarata, 2017, 108 p. ISBN: 978-84-9097-323-3. Disponível em: <https://www.oei.es/historico/salactsi/Controversias.pdf>. Acesso em: 15 maio 2018.

ARAÚJO, A. B.; SILVA, M. A. Ciência, tecnologia e sociedade; trabalho e educação: possibilidades de integração no currículo da educação profissional tecnológica. **Rev. Ensaio**, Belo Horizonte, v. 14, n. 01, p.99-112, jan.-abr., 2012. ISSN 1983-2117. Disponível em: <http://www.scielo.br/pdf/epec/v14n1/1983-2117-epec-14-01-00099.pdf>. Acesso em: 15 set. 2017.

BETTELHEIM, C. **A luta de classes na União Soviética**. Rio de Janeiro: Paz e Terra, 1979, 320 p. ISBN: 9721013278.

BRASIL. **Decreto nº 7.566, De 23 De Setembro De 1909**. Crêa nas capitães dos Estados da Republica Escolas de Aprendizes Artífices, para o ensino profissional primario e gratuito. Disponível em: <http://www2.camara.leg.br/legin/fed/decret/1900-1909/decreto-7566-23-setembro-1909-525411-publicacaooriginal-1-pe.html>. Acesso em: 20 ago. 2017.

BRASIL. **O plano de desenvolvimento da educação: razões, princípios e programas**. Brasília, DF: MEC, 2007, 43 p. Disponível em: <http://portal.mec.gov.br/arquivos/livro/livro.pdf>. Acesso em: 15 maio 2018.

BRASIL, Histórico. **Portal da rede Federal de Educação Profissional, Científica e Tecnológica** (atualizado em 2016). Disponível em: <http://redefederal.mec.gov.br/historico>. Acesso em: 11 fev. 2018.

BRASIL. Lei nº 11.892, de 29 de dezembro de 2008. Institui a Rede Federal de Educação Profissional, Científica e Tecnológica, cria os Institutos Federais de Educação, Ciência e Tecnologia, e dá outras providências. **Diário Oficial da União** - Seção 1 - 30/12/2008. Disponível em: http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2008/lei/111892.htm. Acesso em: 20 ago. 2017.

BRASIL. **Instituto Federal de Educação, Ciência e Tecnologia**: um novo modelo em educação profissional e tecnológica – concepção e diretrizes. Brasília: SETEC – MEC, 2010. Disponível em: http://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=6691-if-concepcaoediretrizes&Itemid=30192. Acesso em: 12 jul. 2017.

CIAVATTA, M. O ensino integrado, a politecnia e a educação omnilateral. Por que lutamos? **Trabalho & Educação**, Belo Horizonte, v.23, n.1, p. 187-205, jan.-abr. 2014. ISSN 1516-9537. Disponível em: <https://seer.ufmg.br/index.php/trabedu/article/view/7693/5935>. Acesso em: 21 jul. 2017.

DAGNINO, R; BRANDÃO, F. C.; NOVAES, H. T. Sobre o marco analítico conceitual da tecnologia social. In: DE PAULO, A.; MELLO, C. (Ed.). **Tecnologia social**: uma estratégia para o desenvolvimento. Rio de Janeiro: Fundação Banco do Brasil, 2004. p. 15-64. ISBN 85-86392-13-8. Disponível em: <https://www.oei.es/historico/salactsi/Teconologiasocial.pdf>. Acesso em: 15 set. 2017.

DAGNINO, R. (Org.) **Tecnologia social e economia solidária**: construindo pontes. [Documento de trabalho do curso Gestão Estratégica em Tecnologia Social]. Campinas: Gapi/Unicamp, 2012. mimeo.

DAGNINO, R. A tecnologia social e seus desafios. In: DAGNINO, R. (Org.). **Tecnologia social**: ferramenta para construir outra sociedade. 2.ed. rev. ampl. Campinas: Komedi, 2010, p. 53-70. ISBN 978-85-85369-08-8.

DAGNINO, R. Para que Ensinar CTS? **Revista Brasileira de gestão e Desenvolvimento regional**, v. 10, n. 3, p. 156-183, set/2014. ISSN 1809-239x. Disponível em: <http://www.rbgdr.net/revista/index.php/rbgdr/article/view/1476>. Acesso em: 11 abr. 2018.

DAGNINO, R. Ajudando a pensar a universidade pública. **Jornalgnn**, 14/08/2016. Disponível em: <https://jornalgnn.com.br/noticia/ajudando-a-repensar-nossa-universidade-publica-por-renato-dagnino>. Acesso em: 19 set. 2017.

DANTAS, Éder. SOUZA JUNIOR, Luiz. Na contracorrente: a política do governo lula para a educação superior. In: REUNIÃO ANUAL DA ANPED, Caxambu, 32., 2009. **Anais eletrônicos**. Caxambu: ANPED, 2009, p. 1-17. Disponível em: <http://32reuniao.anped.org.br/arquivos/trabalhos/GT11-5581--Int.pdf>. Acesso em: 23 ago. 2017. (“Sociedade, cultura e educação: novas regulações?”).

EAGLETON, Terry. **As ilusões do pós-modernismo**. Rio de Janeiro: Zahar, 1996. p. 144. ISBN- 8571104631.

FEENBERG, A. **Critical theory of technology**. New York: Oxford University Press, 1991, 256 p. ISBN: 7301082207.

FEENBERG, A. **Racionalización semocrática: tecnología, poder y libertad**. 1992. Disponível em <http://www-rohan.sdsu.edu>. Acesso: 12 mar. 2017.

FEENBERG, A. **Transforming technology**. New York: Oxford University Press, 2003, 218 p. ISBN 0-19-514615-8.

FRIGOTTO, G., CIAVATTA, M.; RAMOS, M. A gênese do Decreto n. 5154/2004: um debate no contexto controverso da democracia restrita. In: FRIGOTTO, G., CIAVATTA, M.; RAMOS, M. (Org.). **Ensino médio integrado: concepções e contradições**. São Paulo: Cortez, 2005. p. 21-56. ISBN: 9788524919855

FRIGOTTO, G. DICKMANN, I. PERTUZATTI, I. Currículo integrado, ensino médio técnico base nacional comum curricular: entrevista com Gaudêncio Frigotto. **Revista e-Curriculum**, São Paulo, v.15, n3, p. 871-884, jul./set. 2017. Disponível em: <https://revistas.pucsp.br/index.php/curriculum/article/download/30272/23739>. Acesso em: 19 mar. 2018.

GRAMSCI, A. **Os intelectuais e a organização da cultura**. Tradução de. Carlos Nelson Coutinho. 4. a edição. Rio de Janeiro: Civilização Brasileira, 1982, 244 p. ISBN 85-200-0097-5.

HERRERA, A. Los determinantes sociales de la política científica en América Latina. Política científica explícita y política científica implícita, **Redes**, v. 2, n. 5, diciembre, p. 117-131, 1995. ISSN: 1851-7072. Disponível em: <http://docs.politicasci.net/documents/Teoricos/Herrera.pdf>. Acesso em: 12 maio 2017.

JESUS, V. M. B. de; COSTA, A. B. Tecnologia social: breve referencial teórico e experiências ilustrativas. In: COSTA, A. B. **Tecnologia social e políticas públicas**. Brasília: Fundação Banco do Brasil, 2013. p. 17-33. ISBN: 978-85-7561-063-3

LACEY, H. Como devem os valores influenciar a ciência? **Filosofia Unisinos**, v.6, n.1, p. 41-54, jan/abr 2005. ISSN: 1984-8234. Disponível em: revistas.unisinos.br/index.php/filosofia/article/view/6333/3482. Acesso em: 20 jul 2017.

LACEY, H. **Is science value free?** London: Routledge, 1999, 304 p. ISBN: 0415349036.

LINSINGEN, I. CTS na educação tecnológica: tensões e desafios. In: Congreso Iberoamericano de Ciencia, Tecnología, Sociedad y Innovación CTS+I, 1º, 2006. **Memórias del Congreso Ibero CTS+I**. México D.F: UNAM, 2006. v.1, p. 1-14. Disponível em: <https://www.oei.es/historico/memoriasctsi/mesa4/m04p18.pdf>. Acesso em: 15 out. 2017.

LORENZETO, V. C.; MOREIRA, A. F. Uma reflexão sobre abordagem cts e sua relação com a Educação profissional e tecnológica em contexto brasileiro. In: SEMINÁRIO NACIONAL DE EDUCAÇÃO PROFISSIONAL E TECNOLÓGICA, 4., **Anais ...** Belo

Horizonte: CEFET-MG, 2014, p. 1-15. ISSN 1983-1315. Disponível em: <http://www.senept.cefetmg.br/site/AnaisSENEPT/anaisIVsenept.html>. Acesso em: 20 set. 2017. (Tema: Perspectivas para a Ciência, Tecnologia e Educação Profissional e Tecnológica no cenário brasileiro atual).

MÉSZÁROS, I. **Para além do capital**. Campinas: Editora da Unicamp, 2002. 1104 p. ISBN: 9788575590010.

MORENO, Arley. Área de humanidades na universidade tecnológica. In: BITTENCOURT, A.; FERREIRA, N. **Formação humana e gestão da educação: a arte de pensar ameaçada**. São Paulo: Cortez, 2008. p.83-101. ISBN: 9788524914485

NASCIMENTO, A.; RODRIGUES, M.; NUNES, A. O. A pertinência do enfoque ciência, tecnologia e sociedade (cts) na educação profissional e tecnológica. **RBEPT**, v. 2, n. 11, p. 117-129, 2016. ISSN: 2447-1801. Disponível em: <http://www2.ifrn.edu.br/ojs/index.php/RBEPT/article/view/5457>. Acesso em: 25 ago 2017.

NOBLE, D. Social Choice in Machine Design. In: ZIMBALIST, A. (Org.). **Case 112 Studies on the labor process**. New York: Monthly Review Press, 1989. p. 103- 135. ISBN:1412818281.

NOVAES, H. DAGNINO, R. O fetiche da tecnologia. **ORG & DEMO**, v.5, n.2, p.189-210, 2004. ISSN: 1519-0110.

PINHEIRO, N. A. M.; SILVEIRA, R. M. C. F.; BAZZO, W. A. O contexto científicotecnológico e social acerca de uma abordagem crítico-reflexiva: perspectiva e enfoque. **Revista Iberoamericana de Educación**, v.49, n.1, p. 1-14, 2009. ISSN: 1681-5653. Disponível em: <https://rieoei.org/RIE/article/view/2116>. Acesso em: 18 jul. 2017.

SANTOS, W. L. P; MORTIMER, E. F. Tomada de decisão para ação social responsável no ensino de ciências. **Ciência & Educação**, v.7, n.1, p.95-111, 2001. ISSN 1980-850X. Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1516-73132001000100007. Acesso em: 27 set. 2017.

SAVIANI, Dermeval. O trabalho como princípio educativo frente às novas tecnologias. In: FERRETTI, C.J. *et al.* (Org.) **Novas tecnologias, trabalho e educação**. Petrópolis /RJ: Vozes, 1994. p. 151-166. ISBN: 9788532611758

SAVIANI, Dermeval. O Plano de Desenvolvimento da Educação: Análise do Projeto do MEC. **Educ. Soc.**, Campinas, v. 28, n. 100 - Especial, p. 1231-1255, out. 2007. ISSN 1678-4626. Disponível em: <http://www.scielo.br/pdf/es/v28n100/a2728100.pdf>. Acesso em: 19 out. 2017.

SILVA, S. R.; FERNANDES, R.R. Institutos Federais: uma articulação entre Ciência, Tecnologia e Sociedade?. In: JORNADAS LATINO-AMERICANAS DE ESTUDOS SOCIAIS DA CIÊNCIA E DA TECNOLOGIA, 11., 2016. Curitiba. **Anais eletrônicos...**, Curitiba: ESOCITE, 2016. Disponível em: <http://www.esocite2016.esocite.net/resources/anais/>. Acesso em: 20 maio 2018. (Tema: ESOCITE 21 Anos: Trajetórias plurais entre passados e futuros).

UNIVERSIDADE DE HAVARD. **Program on science, technology and society**. (2018). Disponível em: <http://sts.hks.harvard.edu/about/whatissts.html>. Acesso em: 11 fev. 2018.

VELHO, L. Conceitos de Ciência e a Política Científica, Tecnológica e de Inovação. **Sociologias**, Porto Alegre, ano 13, no 26, p. 128-153, jan./abr. 2011. ISSN:1807-0337. Disponível em: <http://www.scielo.br/pdf/soc/v13n26/06.pdf>. Acesso em: 14 mai. 2018.

WINNER. L. Artefatos têm política? Trad. Fernando Manso. *In*: _____. **The Whale and the Reactor** – a search for limits in an age of high technology. Chicago: The University of Chicago Press, 1986. p. 19-39. ISBN: 0226902110. Disponível em: <http://www.necso.ufrj.br/Trads/Artefatos%20tem%20Politica.htm>. Acesso em: 18 nov. 2017.