Paakat
Revista de tecnología y sociedad

The role of the state in the technological development of capitalist society[1]

La función del Estado en el desarrollo tecnológico de la sociedad capitalista

http://dx.doi.org/10.32870/Pk.a11n20.592

Received: December 14, 2020
Accepted: February 16, 2021

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ABSTRACT

Based on the contributions of critical theory, the present text aims to expose in which ways the state intervenes in technological advancement within the capitalist system and the conditions in which it grants tools, both to ruling classes and to the dominated classes, to access, develop and implement technology. The argument that is upheld is that the state apparatus has to cover the necessary conditions so that knowledge in technological matters continues to be generated, but it is also essential that it provide the pertinent conditions so that the working class has the appropriate tools to be able to operate it.

Keywords
Science and technology; state policy; technological change; capitalist system; critical theory; ruling classes, dominated classes

RESUMEN

Con base en las aportaciones de la teoría crítica, el presente texto tiene por objetivo exponer las formas en las que el Estado interviene en el avance tecnológico dentro del sistema capitalista y las condiciones en las que este otorga herramientas, tanto a las clases dominantes como a las clases dominadas, para acceder, desarrollar e implementar la tecnología. El argumento que se sostiene es que el aparato estatal ha de cubrir las condiciones necesarias para que se siga generando conocimiento en materia tecnológica, pero también es fundamental que provea las condiciones pertinentes para que la clase trabajadora cuente con las herramientas oportunas para poder operarla.

Palabras clave
Ciencia y tecnología; política estatal; cambio tecnológico; sistema capitalista; teoría crítica; clase dominante; clase dominada

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Introduction

Throughout history, the participation of the State has been fundamental to maintain the conditions of permanence and development of the capitalist system. Much of the Marxist literature affirms that the state structure invariably tends to satisfy the needs of the capitalist class to the detriment of the non-capitalist classes (Marx and Engels in García Vela, 2017; Lenin, 2006). However, some authors suggest that, at times, the State may sacrifice the interests of the ruling class in favor of the dominated classes, in order to maintain a certain balance of the prevailing system (Poulantzas, 1973).

Although there is some truth in both positions, both perspectives consider it unquestionable that the participation of the State is fundamental in sustaining the conditions that allow the development of capitalist society. One of the elements in which the intervention of the State stands out is related to the development and promotion of science and technology. The purpose of this text is to explain the ways in which the State intervenes in technological progress within the prevailing capitalist system and the conditions under which it provides tools to the dominant and dominated classes to access, develop and implement technology.

It is argued that the state apparatus has to cover the necessary conditions for the continued generation of technological knowledge, but it is also essential that it provides the relevant conditions for the working class, who will use these technologies in the production system, to have the appropriate tools to operate them.

The above exemplifies one of the many contradictions of the conflict between classes: while technological knowledge is usually developed within the dominant elites and for the benefit of production, it is essential to train specialized labor that knows how to use this technology in order to generate economic gains; the sharing of this knowledge represents a certain loss of control over it in favor of the working class. In order to carry out the process described above, the State has at its disposal multiple tools that usually benefit the ruling class, but also represent the granting of some concessions to the dominated classes.

For the presentation of the subject, this paper is divided into four parts. In the first part, the role of the State as mediator between the interests of the dominant classes and the non-dominant classes, a notorious function with regard to technological progress, is presented. Next, the strategies of the state apparatus to inculcate the vision of technology as an inherent element of development are analyzed. Thirdly, some of the social consequences and repercussions of state action linked to technological progress are reviewed. And, in closing, some final considerations are made.

Due to time and space limitations, the article does not go in depth into syntagms such as technological transfer, division of labor, social classes, among others; only certain

theoretical concepts concerning the participation of the State in some aspects of scientific progress are exemplified.

Development

The State as Mediator and Regulator

Of the multiple elements involved in the management of the capitalist production regime, one of the most important is scientific and technological development. Like most of the aspects involved in the world economic system, science is subscribed to the interests and objectives of certain groups; that is, scientific knowledge is not neutral, its development is accompanied by various state structures and tools that promote and generate it. In order to review this point of concreteness, it is necessary, first of all, to analyze the role of the State.

In most critical studies, the predominant idea has been that, despite its regulatory function, the State is not neutral –just like science– and defends the interests of the ruling class (Lenin, 2006; Marx and Engels in García Vela, 2017). Likewise, the State is based on the protection of private property and the means of production (Lenin, 2006; Miliband, 1971). For these reasons, it is currently possible to affirm that technological and scientific development has become a kind of private property. It is enough to remember that when there is a technological innovation or a scientific creation, a patent is processed that limits its use and even generates surplus value, and that for the generation of this scientific development it is necessary to pay labor with a salary not equal to the profit it produces.

Some positions maintain the relative autonomy of the State with respect to the economic base. On this point, the contributions of Poulantzas (1973) and Miliband (1971) stand out; however, the reason for this autonomy differs in both authors. Poulantzas affirms that the state is a structure in itself, and is therefore independent of the economic base. From this perspective, it could be said that the State would generate its own technological progress for the satisfaction of its own needs; an example of this would be investment in military development.

Miliband (1971), for his part, argues that the fact that the State is exercised by a specific elite (the bureaucracy) allows it autonomy, but State power will always tend to defend the economic interests of the capitalist class. This position would suppose that State sponsorship of science and technological innovation would generate a kind of scientific bureaucracy which, although it belongs to the State, its work will necessarily be aimed at satisfying the interests of the ruling class.

While power is responsive to class interests, Miliband reveals a distribution and fragmentation of power in the state, arguing that no government can fail to meet the demands

of competing interests. To ensure the balance of the system, the state guarantees competition between different interest blocs and is subject to pressures from various actors, since reconciling conflicts between them is part of its functions.

In the case of technological development, this is reflected in government programs and public policies that encourage the incorporation of members of the non-dominant classes into scientific knowledge. This is mainly focused on improving productivity; however, the fact of promoting elements linked to the training and formation of cadres, releases a little the power of the capitalist classes through the technical knowledge that producers are usually unaware of.

It is important to consider the emancipatory power of science and technology, especially if we take into account the current relative democratization of technological means. Automation is part of the process of the old political economy that exercises control through machinery, but computers and the high connectivity in which we are immersed at present go beyond that limit and offer a high potential for the rupture of the system (Negri, 2009). This development of technology from the need to increase production also reflects a level of appropriation within the non-dominant classes.

Along the same lines, Poulantzas (1973) argues that the function of the state cannot be the same for each of the classes. State functions work to keep the dominant classes organized in order to preserve the productive process. On the contrary, the State usually prevents the dominated classes from organizing in order to preserve the social order. This necessarily implies certain concessions on the part of the State and the ruling classes in favor of the dominated classes so that the latter do not reveal themselves; some examples are education, access to information and the infrastructure provided to obtain the necessary qualifications in industry.

This is linked to the author's idea that there is an unstable balance of commitments: The State is obliged to the dominant class to maintain its predominance and the stability of the productive process, while at the same time imposing certain economic sacrifices on it so as not to threaten its political stability. The capitalist State marks a double peculiarity: its autonomy with respect to the economic implies the possibility of a social policy (obtaining economic benefits in favor of non-dominant classes), at the same time that its institutionalization grants it the possibility of undermining economic power without threatening political power (Poulantzas, 1973).

With this it can be inferred that knowledge has a certain tendency to democratize, but only partially. Although the State has created public policies to promote access to education and training, as well as strategies for the generation of scientific knowledge, it has been seen that these are regularly directed towards the improvement of productive –or military– processes and rarely have the objective of improving living conditions, despite the fact that the public policies promoted in order to generate knowledge and specialization

are conceived and implemented under the assumption of being in favor of a reduction of social inequalities.

The participation of the State aims at reducing social differences, which brings with it an attenuation of conflict and, therefore, social peace, basic conditions for the market to develop in an expansive and intensive manner. In addition to the above, it is important to consider that capitalism spreads within the Nation-States, and these, in turn, have to compete in the global market with capital from other States (Osorio, 2017). This situation provokes the need for investment and linkage of the State to educate and keep its fleet of workers updated, in order to remain competitive in the global market.

Once the international division of labor emerges and, with it, unequal exchange, class differences within States are reproduced at the international level (Osorio, 2017). This leads to differences in the specialization needs of the participating States in the world-system, and when specialization produces competitive advantages in the global market, national States would have incentives to promote it.

This goes hand in hand with the idea that there is no single type of state, and that states do not act in isolation (Holloway, 1993). The theory of dependency posits a subjection of peripheral countries to the exploitation of the countries of the center; these differentiated units present an interrelationship that implies a joint dynamic (Holloway, 1993), visible in the function that each State has within the international productive process. This necessarily implies a form of specialization of the Nation-States themselves with respect to scientific development, which brings with it the generation of a particular agenda in technological innovation. Thus, while some States generate their own technology, others depend on technology transfer and act, to a greater extent, as technology consumers.

On the other hand, the working class is the one that operates the means of production; this knowledge gives it a certain advantage over the producer, since it is possible that the latter does not even know how his own machinery works. However, that the worker knows how to use the equipment is indispensable for mercantile production, but it is not necessary for the owner of the means of production to have this knowledge, since he only needs to hire someone who knows how to do it. Thus, the dominant classes possess, to a certain extent, a dependence on the working class, which is why educational and knowledge generation policies exemplify the sacrifice promoted by the State of the interests of the dominant class in favor of the dominated classes.

As the State favors a certain mediation of scientific knowledge between some classes and others, it is necessary to recognize which are the State forms to regulate these relations; although in certain circumstances the tools are produced to generate a certain degree of socialization of knowledge, the State also interferes to limit and distribute them under some meanings.

Since the years of greatest capitalist expansion, the consensus was reached that an unrestricted market is not convenient, and it is the State who must interfere in order to generate adequate economic, political and social planning, in addition to promoting employment (Hobsbawm, 2014). In these considerations, the role of science and technological innovation is essential, especially with regard to the generation of employment, which is inescapably linked to the processes of specialization and training. Employment itself and the development of productive forces derive from the division of labor.

In this sense, social policy assumes universal access to education and training of the labor force, requirements of the dominated classes that are met with certain governmental actions. For example, in Mexico, technological schools such as the Training Centers for Industrial Work (Cecati) arise to produce specialized labor, by providing technical skills to potential personnel; this meets the educational needs of the dominated classes, while increasing the supply of trained workers to meet the demands of industry.

For these policies to have an adequate planning and structuring, which achieves social stability and an increase in productive activities, a sufficiently strong State is necessary to efficiently regulate the market; the stronger one is, the more the other will be (Bresser, 2019; García Linera, 2017). Strengthening the State is indispensable for market rules to decrease uncertainty for producers, workers and consumers.

With regard to technological development, it translates into the capacity of the State to propitiate the necessary conditions in the generation of technological innovations, in accordance with its position in the global production system, and to provide adequate infrastructure to use and take advantage of technology. To achieve this task, the State has various tools at its disposal, such as competition legislation, copyright protection and legal mechanisms related to industrial property and patents.

Both Bresser (2019) and White and Wade (1996), make important points regarding the strategic role of the state in controlling and harnessing market forces in the national economic interest. It should be noted that this benefit is not feasible without adequate knowledge and specialization to manage capital goods and means of production; ignorance of technology and lack of competitiveness always contravene national interests.

White and Wade (1996) also point to the idea of development based on the concept of the State as a mobilizer of socioeconomic progress, which implies the drive towards technological innovation, but also the importance of balancing government regulation and the free market, without neglecting the participation of civil society. The latter registers two senses: on the one hand, that public policies necessarily have a social outlet –in science and technology the creation of instances that promote specialization and training has been mentioned– and, on the other hand, that the participation of organized civil society itself generates a link with the processes of economic development.

An example of this, with regard to science and technology, is the STEM (Science, Technology, Engineering and Mathematics) movement in Mexico, whose objective is to promote education in these subjects, with a gender focus (STEM Movement, 2020). Similar cases are present at the international level, such as the OPAL Project (Open Algorithms) and the Oxfam toolkit for humanitarian organizations, whose objective is digital literacy for the use of digital tools and data (World Economic Forum, 2019).

Ideology as an element of assimilation

In the previous section we reviewed the participation of the State in maintaining a certain degree of equilibrium between the interests of the dominated and dominant classes, as well as some of the different incentives and tools that the State has to open up and socialize scientific knowledge. However, the generation of technological development implies an increase in productivity, hence an increase in surplus value, which leads to greater exploitation of workers. In this sense, it is necessary that the dominated classes have an optimistic perspective towards technological development, in order to subordinate themselves to it and be interested in it; it is here where one of the main functions of the State intervenes to maintain a certain stability of the capitalist system of production: the participation of ideology as a form of assimilation of the prevailing thought.

Gramsci (in Portelli, 1977) makes important points about the development of the dominant classes in the formation of hegemonies. Unlike Lenin –who understood hegemony as political leadership–, Gramsci defines it as the cultural and ideological leadership of society; the essential aspect of the hegemony of the ruling class is the intellectual monopoly it exercises (Gramsci in Portelli, 1977). Arguably, the perspective of science as an inherent driver of development is an idea imposed by the ruling class in order to ideologically legitimize scientific innovation as an engine of development. In this sense, Gramsci's concept of historical bloc, understood as the combination of structure (economic or material forces) and superstructure (ideology), stands out.

In the case of technological development, this is observed with the creation of educational policies and programs (for example, the promotion of technical careers to the detriment of social careers), along with the designation of infrastructure to benefit scientific progress (such as the donation of land to technical schools and industrial parks). To this same end, what the author defines as dictatorship is put into practice: the execution of the functions of management, education and domination (when the political class takes civil society as a resource) by a social class, the business class.

Along the same lines, Poulantzas (1973) argues that the function of ideology in the state apparatus is a form of legitimization of political action; it functions to validate it and as an element that cohesively binds the structure and superstructure. Science, in scientific

advancement, would appear as a mechanism of ideology that seeks to be assimilated by the dominant classes and accepted as a technique by the dominated classes. Again, it is evident that science and technology are not neutral.

From the above it can be concluded that the interest in scientific and technological development is closely linked to the mobilization of ideology, projected by the dominant classes, and the state apparatus to legitimize it, as inherent to development. Although the ideology comes from the dominant classes, it is through the State that it is disseminated.

On this point, it is worth noting the contributions of Conversi (2008) which, although they were linked to the generation of a nationalist ideology, they forcefully expose how the state apparatus disseminates the ideology. Furthermore, this author highlights the role of state elites in cultural homogenization; he argues that the idea of citizen equality is fundamental to the legitimacy of nationalist projects. He also asserts that the relationship between the mass army and the school through the state is reciprocal, and egalitarian patriotism is its operative framework: the ideology of nationalism cohesionized all aspects.

Although Conversi's argument is focused on the nationalist upsurge, the idea of the State, the school and the militia as engines of cultural homogenization subscribes to the role of the State as the main disseminator of ideology.

Impact on segmentation and emergence of new classes

It is known that the division of labor causes segmentation and the emergence of new social classes. In this sense, technological progress leads to social segmentation inherent to labor specialization, which modifies the social structure linked to technological changes. Since the period of greatest economic expansion, important social transformations arising from technological and scientific progress linked to professionalization have been observed. Some examples are:

1) The peasantry ends due to the migration from the countryside to the city, because of the technification of the former and the great demand for labor for the industries.

2) Students emerge as a social sector; with this the professional class and the middle classes are born, many of these new professionals are requested by the State itself, to sustain the large and growing market (Hobsbawm, 2014). That is, the relatively autonomous bureaucratic class mentioned by Miliband (1971) is also favored by scientific advancement.

3) The working class continues to expand and collective thinking is lost. However, there are contradictory episodes, as happens in the eighties, when a decrease of the working class is experienced as a result of the extinction of some industries that gave way to the emergence of others, also as a result of technological advances.

4) A new feminist wave emerges, with greater social organization, which fights for the *de facto* follow-up of what had been won de jure. A large number of women entered the labor market, among other things, due to the preference of businessmen for female labor, as it was considered cheaper and supposed to be more malleable. However, despite this incorporation of women into wage labor, the social responsibility of care and reproductive work in the home was never taken away from them (Hobsbawm, 2014).

The above cases are illustration of the new specialization of labor arising, to a large extent, from the development of science and technology, where the intervention of the State is necessary, at least in terms of a new legal harmonization and public policies that facilitate the mobility of workers and regulate changes in the social structure. In this sense, Beltrán (2001) attempts to establish a concept of social structure that refers to the basic dimensions of society, whose relationships determine the social places that correspond to each member.

Furthermore, this same author argues that, although what is understood as structure is the most permanent thing in the social system, it is not immutable, and, in fact, it is in constant modification depending on the historical context in which it develops. The social structure changes and its transformations are the result of the internal contradictions of social action and conflict. This is clearly shown with regard to technological changes and advances, which alter the social structure seen from a class perspective: as fast as technology changes, new forms of employment and professionalization appear; that is, new divisions of labor are created and, therefore, new social classes, that is, aggregates of individuals in a society that oppose each other by the role they occupy in a productive process historically defined from the perspective of mutual relations in the capital-labor organization (Dos Santos, 1973).

Linked to the previous point, Antunes (2001) points out that from this new differentiation and specialization of labor arise changes in multiple processes: deproletarianization (the decrease of the traditional industrial working class) and precarization (linked to the expansion of salaried and service work), at the same time as the incorporation of women into the working world expands. Deproletarianization is closely related to the development of science and technology: the greater the technification, the less living labor is required; this supports the argument of the author, who maintains that science is always at the service of the capitalist class.

Precarization refers, among other things, to partial, temporary or subcontracted work, different forms of contracting in which there seems to be a setback in social policies and labor protection, which reflects a certain subordination of the State to class interests: The State reduces the commitments of the contracting parties towards the employees (Antunes, 2001).

Antunes (2001) suggests that the qualitative alteration in the way of being of work is linked, at the same time, to the impulse to a greater qualification of work and to a greater disqualification of work. The former implies the substitution of living labor for dead labor, which poses a tendency that makes the logic of capitalism impossible: machines do not consume. On the other hand, disqualification in various sectors leads to the emergence of multifunctional workers (Antunes, 2001); the emergence of multifunctionality brings with it a greater need for education, so that the State finds it necessary to generate more educational and training offerings, reinforced by the emergence of a large number of private institutions that contribute to these purposes.

The above has shown an evident segmentation of labor generated by the technification of the means of production. This forces the State to intervene, directing technological development towards certain ends and granting policy instruments that facilitate the training of the productive sectors to generate the technical skills required in industry, accompanied by social and educational policies aimed at improving technological processes.

At this point, it is also relevant to consider alternative development processes, in addition to those linked to the proposals of advisory democracies derived from workers' movements (Azzellini, 2018). These imply an appropriation of the means of production that can only be executed by those trained workers. Training is necessary to exercise an advisory democracy as an alternative form of regulation. The technical knowledge that workers require to participate in the capitalist production system inevitably endows them with a competitive advantage over the capitalist class, and it is often the state that provides this knowledge to the dominated classes, being in charge of establishing the guidelines of educational policy.

Final considerations

It is crucial for the State to establish policies to ensure the training and professionalization of production workers, since this favors the interests of the ruling class, which needs specialized and qualified labor to operate technology and produce value. However, this professionalization means a sacrifice of class interests, by providing technical knowledge to the dominated classes.

It is evident that workers require sufficient knowledge to generate production, but this leads to an important contradiction in the capitalist system: the owners of the means of production often do not know how their own machinery works, and the worker is the one who is trained and has the technical expertise. Even realizing that this knowledge endows the worker with advantages over the means of production could mean increasing his potential ability to take them.

It is relevant to ask whether this position, started with the appropriation of this already acquired knowledge, encloses the possibility of a class consciousness; this in view of the fact that the State itself, many times facilitator of this knowledge, has historically assumed the function of educating the population as part of its duties towards the capitalist system.

Technological progress increases productivity, which leads to the substitution of productive labor and a tendency to crisis derived from the loss of jobs. The profound drawback of the substitution of man by machine becomes visible: if only human labor creates value, one of the reasons why the current crisis has not been overcome by technological irruption may lie in the fact that most production contains a higher percentage of transferred value than of created value.

The tendency towards a crisis of capitalism is notorious, because although productive levels had not reached higher numbers in other times, considering that machines do not consume, it remains to be clarified who will buy such a quantity of mercantile surplus. Although in recent times it has been seen that technology has increased resilience to face certain crises, this does not mean that it is exempt from provoking others. In the end, one might ask how desirable is the advance of technology in the development of productive forces. However, the reality is that human beings are already immersed in this unstoppable technological development and cannot conceive of social relations outside of it.

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[1] This work was developed as part of the project CONACYT: Ciencia de Frontera 2019 No. 304320.