# The teaching of robotics in computer recycling centers: discursive constructions of technological disobedience*

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## Abstract

This article presents the main theoretical and methodological intakes for the execution of a research that has the overall objective of investigating the use and legitimization of digital technologies in the construction and execution of political-pedagogical robotics projects in eleven computer recycling centers supported by the Ministry of Science, Technology, Innovations and Communications. The work intends to enlighten the adopted theoretical perspectives, the construction of research strategies, and its practical tools. The results of the descriptive-analytical studies, with a qualitative approach, puts in evidence discursive counter-hegemonic constructions regarding patterns of production, goods consumption, and the appropriation of knowledge that results or reproduces the digital/social exclusion. Thus meaning that the investigated speeches formulates and demarcates a posture of technological disobedience on which to build its formation identity of teachers and learners, as well as models and educational robotics standards in those centers. Hopefully the thoughts presented in this article contribute on the deep immersion of the discussions regarding the qualitative methodologies in educational research, about the emergence of new areas and educational models, also putting in evidence the importance of a historical-sociological perspective, and non-technologist/deterministic approaches for the digital technology studies, its representations and on how to use them in an educational environment, and the teaching-learning process.

## Keywords

Educational robotics – Free robotics  – Discourse analysis – Qualitative research.

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## Introduction

In the 1990s, theoreticians such as Pierre Lévy (1998) and Manuel Castells (2010) were already dedicated to explaining the impact of digital technologies on the economy, on political and cultural activities, and to expose their direct implications on the daily lives of people and societies. A new technological or socio-technical paradigm, whose core of its transformation is digital technologies, information, processing and communication, was already announced in that decade with several developments.

It is noteworthy that, with the increasing automation of manufacturing processes and the emergence of machines capable of learning more and more and relatively autonomously, that is, with the diffusion of artificial intelligence, there are rumors of a fourth industrial revolution that is already underway, at a rapid pace.

Thus, through the increasing presence of digital technologies in the daily lives of organizations and people, educational institutions and education, in general, have also been compelled to adhere to the changes of that time, at the risk of being considered obsolete in the face of this new socio-technical paradigm.

In this sense, it should be noted that educational institutions have received demands for updating their didactic models and resources, which can be observed by the proliferation of the use of new educational technologies, software, applications and also by the large number of educational courses and platforms available online, to mention just a few examples.

It is also worth noting that, in this scenario of socio-technical transformations, educational models, broadly, have also been provoked by the emergence of new spaces for teaching-learning and socio-pedagogical interaction-based increasingly on the use of digital technologies.

It is important to emphasize that, given the high use and diffusion of digital technologies in the daily lives of most people and in spaces focused on education, the way in which the theme of technology and technological development is addressed should become a reason for constant surveillance. Naturalizing or treating the presence of digital technologies in a deterministic manner becomes a risk, including in educational research.

When a researcher treats technological development and its developments as a kind of technical-scientific determinism, it prevents discourses of problematization concerning the use of digital technologies from being revealed in the investigation.

In the case of the research presented in this article, this understanding and vigilance were fundamental, allowing not only that fields of conflict regarding technologies emerge from the discourses analyzed, but also that a new perception of their use and their legitimation evidences their impacts.

## Initial challenges for the construction of this proposal

Initially, it should be clarified that the research was a descriptive-analytical study on the model and practices of robotics teaching in 11 Computer Recycling Centers (CRCs) supported by the Ministry of Science, Technology, Innovation and Communications

(MCTIC). The CRCs briefly carry out two major processes, namely, the recycling of electronics and the training of young people in vulnerable situations, with a focus on digital information and communication technologies.

It is noteworthy that despite the public policy of support from the federal government to the CRCs exists for more than a decade, the approach received by these centers in the literature, in general, is restricted to the treatment that these spaces give to electronic waste, without focusing on their training processes.

Thus, due to the scarcity of bibliographic references on the CRCs and, in particular, on the training processes carried out in these centers, describing and analyzing their models and educational practices assumes even greater relevance and urgency. The CRCs develop a great variety of courses, workshops and training events, such as maintenance and computer assembly workshops, courses in electronics, robotics, digital entrepreneurship, environmental management and even the production of crafts from scrap electronics, among others.

Given this variety, it was decided to delimit the research theme specifically to the teaching of robotics in the CRCs. From the delimitation and approximation of the theme, a question arose that constituted the research problem and that can be expressed as follows: To what extent does the way in which the CRCs use and legitimize digital technologies influence the construction of their political-pedagogical projects and the socio-educational practices of robotics developed in these centers?

It is worth noting that both the process of recycling electronics and the training of young people carried out by the CRCs are directly related to digital technologies, non-analog technologies, information and communication. Such technologies are part of the routine activities of recycling and training in the CRCs, especially in robotics courses. As for the concept of robotics, in general, it is a science dedicated to the study of robots, automatons. However, this study deals with educational robotics, or pedagogical robotics, as defined by Albuquerque et al. (2007), focusing on pedagogical projects that propose reconciliation between the use of mechanical and electronic devices and the teaching-learning process. As for the political-pedagogical projects of the CRCs, this research identified the documents that bring together and organize the educational intentionalities and the proposals for concrete action, with the means and strategies envisaged within the scope of these Centers.

Thus meaning, although it may seem too obvious to justify the presence of digital technologies in the activities of the CRCs due to the nature and the express purpose of these centers, it was sought to investigate this presence, analyzing the speeches of the main social actors involved in the construction of guidelines and in the preparation of political-pedagogical projects.

In this sense, the importance of research on educational discourses and practices is emphasized following what Merton (1979) advocates about organized skepticism. It is essential to always submit the discursive ideas and constructions to a critical and systematic analysis. When thinking about the imperatives that underlie the ethos of science, that is, when thinking of scientific activity as a set of values and institutionalized norms that guide and legitimize the practices performed by scientists, Merton (1979)

prescribes a critical attitude that must be maintained throughout any research, even in the face of the temptation of explanations apparently evident and faster. The presence and use of digital technologies should also be systematically wondered and questioned, without evading this rule.

As for how the theme of technology and technological and scientific development is approached, it should be emphasized that it is crucial to avoid a deterministic perspective, especially concerning the investigation of educational processes involving digital technologies. Thus, when seeking to understand the use of digital technologies and their consequences for teaching-learning practices, it is necessary to be constantly vigilant regarding the false idea of technology neutrality.

It should be noted that the mistaken idea of neutrality of technological development can lead researchers to treat the technological choices made as something free of social constraints and to perceive the questions about technological development itself and its consequences as a kind of technological or technical-scientific determinism provided with a rationality of its own or with a rationalization that would be inherent to it.

Regarding the theme of technical-scientific development, Habermas (2014, p. 75-149) warns not only about the economic interests that invest so that the technological advance takes a particular direction, but also and above all, for the technicalist ideology that seeks to give this development a character of neutral rationality and a-historical rationalization, which depoliticizes social conflicts and legitimizes the relations of domination.

Thus, it is fundamental for scientific research to avoid the trap of seeing technological advances as something self-sustaining, as if it had an intrinsic rationality. In this same understanding, we sought to investigate the perceptions and analyze the discourses of those who developed and defend political-pedagogical projects that deal with the appropriation of digital technologies in the CRCs, seeking to perceive the connections with the multiple socio-historical conditioning factors and the political and economic positions chosen.

Caution concerning a technicist vision allows the fields of conflict also to manifest themselves freely in discourses, enunciate explanations about their conditioning, rhythms and directions, but avoid deterministic or wilfull perspectives, in line with what is pointed out by Figueiredo (1989, p. 7):

> Multiply conditioned by economic, cultural, social and political needs, the technology advances with rhythms and directions varied according to change time and place where it is practiced. This does not mean, however, that the development is random to such an extent that it does not involve explanations. What does not fit are deterministic perspectives, or on the contrary, wilfull. (FIGUEIREDO, 1989, p. 7).

Still regarding the problematization of the technological issue, Porto (1992, p. 82-83) highlights a very relevant aspect regarding the risk of using the technology in an a-political way. According to this author, if technological production is assumed as something natural and neutral, as a necessary result of progress, it becomes linked to a perspective that denies the material-economic and ideal-symbolic nature of the technology.

In this sense, Porto (1992, p. 93) also presents the a-historical approach of technology as a form of ideology, symbolic violence and exclusion. Technology needs to be treated in a perspective that allows for discussion about its choices and its constraints, in order to allow the democratization of the forms of production, management and consumption of technological innovations and avoid new processes of exclusion.

It is also worth highlighting the importance of a broader look at education itself to seek to understand the discourses produced about its intentionality and about the choices from which its practices result. Broadly speaking, educational theories and practices are built on perceptions of the world, of identity formations and of objective and subjective social relations, which include complex relations and power networks. Foucault (1996, p. 44) states that "The entire education system is a political way to maintain or modify the appropriation of discourses, with the knowledge and powers they bring with them".

In this sense, reflecting on the teaching-learning practices also requires a broader perspective and an approach that takes into account the discourses, their producing and propagating subjects, as well as the socio-historical context in which such discourses are inscribed in order to finally understand the "enunciations and relations, which the discourse itself puts into operation" (FISCHER, 2001, p. 198). Thus, aiming to understand how the CRCs refer to digital technologies and how they legitimize their use in teaching, discourse analysis was chosen as the most appropriate method of analysis in research with these centers.

It is noteworthy that the discourses, in the Foucauldian perspective, are not only a set of signs or significant elements used to express or represent a specific content. They are social constructions permeated by values, knowledge and relationships that result and simultaneously re-signify the social contexts in which they are inscribed. Moreover, when discussing the importance of Foucault's contributions to the research in Education, Fischer (2001, p. 201) highlights some methodological attitudes present in the work of that philosopher. Among them, two stand out: i) the importance of the researcher to be aware of the discursive and non-discursive practices; and ii) the need to maintain, throughout the research, a constant attitude of doubt and openness to the unexpected.

The first highlight refers to the relevance of what is said, as well as of what is quiet in the speeches. The identification and analysis of what is silenced can also be indicative of relationships and a context of social rules that can also be perceived in this non-discourse. According to Fischer (2003, p. 379):

> For Foucault, describing discursive and non-discursive practices around a specific object or theme has to do with a dedicated and detailed work of investigating and exposing those non-obvious spaces, those voids (that is, that which is beyond the obvious, the already said, the already well-known and named) that are located around our objects, that which, in a particular historical period, is virtually in place for such and such objectives to occur. (FISCHER, 2003, p. 379).

The second highlight corroborates that attitude of mistrust that is necessary in the Mertonians' organized skepticism: that of being surprised by what is already known. Many times, we take for granted what was still a mere initial impression about the discursive

constructions and about the statements that appear in the research. To research, however, is to be ready to have one's own perceptions and discourses deconstructed throughout the process. It is not to legitimize what is already thought to be known. It is to be open to new knowledge, and this requires positioning and vigilance.

As for another essential theoretical-methodological contribution to be highlighted in the research conducted with the CRCs, it is proposed to resume, albeit briefly, the reflection on the profound changes in the organization of societies and the economy, at a global level, driven mainly from the second half of the twentieth century. To understand the public policy of support to the CRCs, their discourses of creation and implementation and their educational practices, it is essential to perceive the context in which they are enrolled. It is necessary to verify the economic, cultural and social conditions in which such policies and the CRCs themselves arise and from which their discourses are enunciated.

In this sense, it is noteworthy that the discursive constructions analyzed took into account the context, being the constructed context understood in research especially from the power relations, from the Foucauldian perspective (FOUCAULT, 1986) and the discursive constructions also treated as forms of social practice (FAIRCLOUGH, 1992, p. 65).

Thus, from the contributions made available by the theoretical framework, it was possible to realize that the governmental discourses and the CRCs were built in connection with a certain socio-technical paradigm and in dialogue with a specific cultural context, either to validate it as hegemonic discourse or to face it, with counterhegemonic discursive constructions.

It is noteworthy that the speeches and theories on the information society (CASTELLS, 2010) and on programmed obsolescence (BAUMAN, 2008, p. 31), among other critical theoretical contributions, provided concepts and essential elements for the expanded understanding of the context where digital exclusion is enrolled. Consequently, they allowed a better understanding of the characteristics and conflicts of this time, the public policies for digital inclusion of which the CRCs are part and their discourses on the use of technologies in their training processes of robotics.

Complementing this same understanding, it is also noted that the analyses in this research were carried out, from the faircloughian perspective, assuming that the discourses are also a mode of action and representation, which have a dialectical relationship of creation and limitation by the social structure.

In this sense, the discourses are constructed and marked, but can also challenge the dimensions of the social structure. In line with what states Fairclough (1992, p. 65), the discursive practices are constitutive, conventionally and creatively, because they contribute to maintain and reproduce, but also to challenge the identities and social relations, the systems of knowledge and values. In this understanding, the discourses have the potential to contribute both to the maintenance of social conditions and conditioning, and to the transformation of society, as clearly advocated by Fairclough (1992), in his book Discourse and Social Change.

## Proposal materialization

As a development of the research problem, which sought to investigate to what extent the way in which CRCs use and legitimize digital technologies influences the construction of political-pedagogical projects and socio-pedagogical practices of robotics, the following specific objectives were defined: i) Identify and categorize the government guidelines for the training processes in the CRCs; ii) Verify which categories of guidelines more directly affect the educational projects of Robotics in these Centers; iii) Map and describe the training of Robotics offered by the CRCs; iv) Survey the materials chosen and used by the CRCs in Robotics teaching and analyze how their choices are justified; v) Verify if there is a shared education model among the CRCs; and vi) Analyze how the discourses of the CRCs on the uses of digital technologies unfold into socio-pedagogical implications in Robotics teaching.

It is noteworthy that the research, regarding its nature, was constituted as basic research, with a qualitative approach, since it seeks to explain meanings, values, motivations and beliefs, therefore, non-quantitative data, which can not be reduced to the operationalization of quantifiable variables, having exploratory-descriptive and analytical objectives. Its operationalization had as main technical procedures: i) the bibliographic research; ii) the documentary research; and iii) the preparation and application of a questionnaire, also counting on a stage of data triangulation and analysis of results.

As for the literature search, its deepening allowed the identification of the main concepts related to the research, enabling a more systematized approach to issues related to the theme. Thus, in addition to circumventing the scarcity of bibliographic references on the CRCs, the literature search allowed identifying the fundamental issues and concepts and determining which dimensions and information should be sought and prioritized in the other stages.

During the documentary research, the exploration and analysis of official documents were carried out, especially considering the speeches recorded in the project's Propositional Documents for inclusion - the project integrated by the CRCs - made available by the MCTIC, as well as in the proposals, institutional portfolios and terms of reference, which had been forwarded by the CRCs when the partnerships with that Ministry were agreed upon.

It is also essential to clarify that, in the stage of bibliographic research, as well as in documentary research, to delimit the corpus of the research and carry out the choice of documents that would be analyzed, the criteria proposed by Barthes (2006) regarding relevance, homogeneity and temporality served as guiding principles. Thus, based on the criterion of pertinence, understood here as thematic pertinence, the selection prioritized the search for documents, data and information that would allow the verification of pedagogical guidelines towards the operationalization of public policy, also contributing to identify the model of education and technological appropriation that guides the educational practices developed in the CRCs.

On the other hand, the criterion of homogeneity guided the research in the sense of analyzing materials constituted of the same nature and intentionality. In practice,

the operationalization of this criterion implied the choice of the last two propositional Documents of the project *computers for inclusion*, and the eleven terms of reference prepared by the centers. In these documents, the governmental guidelines and the political-pedagogical proposals of the CRCs were identified.

Finally, regarding the temporality criterion, the clipping proposed to analyze only the active CRCs, which corresponded to those centers whose partnerships had been agreed with the MCTIC due to the calls launched in 2013 and 2015. The primary motivation for this temporal cut was the possibility of ensuring access to the managers and pedagogical coordinators of the CRCs since they are still active partnerships.

It is noteworthy that the findings, from the literature search and documentary research, enabled the identification of the guidelines for training, as well as their typology or categorization into four major dimensions, namely: i) cognitive; ii) work; iii) environmental; and iv) sociopolitical. In the same way, such readings also indicated the possible teaching materials used by the CRCs in the teaching of robotics. However, to verify if these findings did not represent a mistaken perception or even a distortion built from the clippings made, it was decided to expose these findings again to the speeches of managers and pedagogical coordinators in the CRCs, through the application of a questionnaire.

The stage related to the questionnaire consisted of preparing the data collection instrument and making it available online for application to the CRCs. The instrument had open and closed questions, multiple-choice, classification and simple alphanumeric text and was applied through a platform of solutions for the questionnaire, obtaining complete answers from all eleven centers active in the period of execution of the research.

From the answers to the questionnaire, it was possible to perform the triangulation of the data collected through the stages of bibliographic research, documentary research and the application of the questionnaire itself. Taking the findings of these first three steps as inputs, the research used, above all, elements of Discursive Textual Analysis (DTA) and Discursive Critical Analysis (DCA) to arrive at the results of the investigation.

As for the DTA, it was performed as guided by Pedruzzi et al. (2015). In this sense, from the disassembly of the texts, a detailed examination was performed with the establishment of relationships between each unit, seeking the identity between them. We sought to understand what emerges from the totality of the texts, as a new discursive construction and a new understanding of the phenomena investigated.

The DTA was performed in three stages, as suggested by these authors. First, the process of unitarization, in which the text is deconstructed. Then, the categorization, in which occurred the simplifications, reductions and summaries of information that resulted in the formation of a set with elements in common. Finally, it was carried out the production of metatexts with descriptions and interpretations that presented new ways of understanding how the CRCs use and legitimize digital technologies, their formative process in robotics and the way they perceive consumption and technological appropriation.

As for the Discourse Critical Analysis, it can be said that its contribution to the operationalization of the research was, above all, in the perspective adopted for the

analyses. In this sense, the texts and the discursive analyses, seen as social practices (FAIRCLOUGH, 1992, p. 65), allowed the identification of the identity construction, the social relations established and the knowledge system and values defended and fought by the discourse emitters. The analysis of content anchored in the faircloughian perspective allowed that the production of discourses, their producers, consumers and propagators of discursive constructions are also thought in their relationship with social and cultural changes, from a socio-historical and culturally situated context.

## Results and analysis: disruptive technologies, discourses and practices of social change

Based on the results of the stages of bibliographic and documentary research, structural elements of the socio-historical, economic and cultural context in which the public policy of digital inclusion emerged, its main theorists and themes, as well as the main social actors involved with this theme in the Brazilian scenario, especially regarding government policies, at the federal level, were identified.

In the documentary research, the pedagogical guidelines and the guiding principles for the formative processes in the CRCs were mapped out. Regarding the pedagogical guidelines, the following stand out: the orientation for the offer of courses, workshops and training that allow young people to appropriate knowledge that will qualify them professionally and enable their insertion in the world of work and the stimulus for the inclusion of transversal themes focused on citizenship, guided by ethics, social and community participation and the defense of human rights.

The analysis of these findings resulted in the definition of four major categories or dimensions for training in the CRCs: i) the cognitive dimension, whose objectives could be translated as promoting the integration of knowledge, technical training and improvement of school performance of adolescents and young people in the CRCs; ii) the environmental dimension, whose main objective could be translated as the offer of citizen training oriented to environmental management; iii) the work dimension, with goals to grant young people the occupational certification required by the world of work, as well as promote digital entrepreneurship; and iv) the socio-political dimension, seeking technological appropriation by previously excluded segments, as a means for the social inclusion of these young people and communities.

Although the dimensions were defined, the order of importance that each one of them represented for the CRCs was not yet clarified. Thus, it was decided to apply the questionnaire to check these findings and verify their relevance, from the perspective of the respondents. When asked, through the questionnaire, about the relevance of the dimensions identified for the objectives of the course or its Robotics workshops, the CRCs pointed out the following classification, in descending order of importance: 1) Sociopolitical Dimension; 2) Environmental Dimension; 3) Work Dimension; and 4) Cognitive Dimension. The socio-political dimension was the one that received the highest score, is considered the most relevant.

Besides, the questionnaire also served another essential purpose, which was to check the use of the materials used in robotics teaching and learning and how the CRCs justify their importance. It is worth clarifying that two questions of that data collection instrument sought to subsidize the understanding of the use and legitimization of technological choices in the CRCs. For this, one of the questions, of matrix type, was adapted from the comparison criteria proposed by Silva and Barreto (2011) for the choice of educational robotics kits.

Regarding these materials, it is noteworthy that the answers of the CRCs pointed out as essential criteria for the choice of their robotics kits: i) allow the use of scrap and waste electrical and eletronic equipments (WEEE); ii) have low cost; and iii) have open source. It is also important to highlight that the CRCs refer to their robotics courses as "Free Robotics" courses. Those centers that offer regular robotics courses use Arduino, which despite being a commercial solution, is basically an open, low-cost electronic prototyping platform that allows integration with virtually any software and hardware.

In analyzing this result, it is important to remember the two major processes that occur in CRCs: the recycling of electronics and the formations. It is equally important to be clear that the recycling process in the CRCs is subdivided into processes of reception, sorting, recycling, inventory, environmentally correct disposal of waste and donation of equipment. All this takes place in conjunction with teaching-learning processes.

The reuse of electronics and the offer of vocational training take place simultaneously, combining training with a focus on technologies, environmental management and citizen participation. Young people learn by doing, hands-on, in a proposal to build knowledge that is closer to the constructionism of Seymour Papert (1980).

It is worth clarifying that constructionism is a learning theory that started from Piagetian constructivism and, therefore, also treats the student as an active constructor of the cognitive structures themselves. Constructionism focuses on the form of learning. According to this proposal, it is in the process of interaction with the world, in environments that stimulate learning, through experimentation and creation of tangible objects, that the student tests his ideas, theories and hypotheses, favoring the construction of knowledge. To test his ideas about learning Papert (1980) developed a programming language called LOGO, through which children demonstrated integrating concrete and abstract knowledge to solve challenges. The constructionist approach allows the integration of knowledge from different areas through experimentation, making use of digital technologies, and considering that learning is significant when it results from a discovery centered on the student himself.

Thus, based on the information and their own references, the student seeks to acquire new knowledge. Through projects that present a problematization, connections between different ideas and areas of knowledge are established by the student. Similarly, in the robotics courses of the CRCs, the approach requires active

learning through experimentation and the creation of tangible objects. Cognitive development, in this type of pedagogical proposal, does not result from the simple transfer of information. The student does not receive knowledge passively. The teacher mediates the process, but it is through the action of problematizing or confronting the environment and the scrap material, abundant in the CRCs, that young people develop their understanding of reality, as active subjects and builders of their own knowledge. It should be noted that this constructionist approach adapted and used in the CRCs is a teaching-learning strategy from which young people experience, explore, manipulate and learn as they build.

To better understand the developments of this proposal of learning and technological appropriation of CRCs, we find in Castells (2010) a fundamental contribution. When thinking about the specific conditions of each society, concerning the greater or lesser degree of lag for its entry into the new paradigm of the information society, the author provides us with a component related to the way in which the learning takes place within this new development model. According to the author:

> Elites learn by doing, thereby modifyng the applications of technology, while most people learn by using, and thus remain within the constraints of the packaging of technology. (CASTELLS, 2010, p. 73.).

In this sense, it is possible to realize that the type of choice for the teaching-learning model already brings with it some fields of conflict. It is noticed, from the statement of Castells (2010, p. 73), that even in the choice of the technological appropriation model it is possible to define who will be able to modify the applications of technology and who will be a mere consumer of the technological packages created and/or chosen by others. This is also evident in the speeches of the CRCs about their own choices. The social role they want is that of producers of new technologies, new uses, new processes and new knowledge.

It is also important to highlight another result and the new perceptions arising from it. The CRCs are places where materials discarded by other people and institutions become inputs for robotics classes and workshops. It was evident in the environmental dimension of the study that something characteristic of the CRCs is precisely their nature as a space for teaching conscious consumption, where, on the one hand, occurs the extension of the useful life of equipment discarded through recycling and, on the other hand, also happens the reuse of equipment and its parts for the construction of new artifacts. As examples of findings that subsidize this analysis, we highlight, in Chart 1, some answers of the CRCs, when asked through the questionnaire if there would be advantage or differential in the teaching of robotics offered by these centers:

**Quadro 1 –** Examples of answers on the CRCs differential in robotics education

| CRC answers (reproduced with preservation of respondents' identities) | Identified dimensions, categories and highlights of the pre-analysis |
|---|---|
| "The most significant differential of teaching in the CRC is the freedom of creation that the student has in function of the materials we use during the course, which in this case are the scrap metal and electronic components that may have adapted for other functionality. | **Cognitive, socio-political and environmental dimensions**: Freedom of creation; Materials, scrap material; Adaptation of materials and electronic components with other functionalities. |
| "Yes, because there is a stimulus for the appropriation of technology, re-use of equipment and components and awareness of the environment." | **Cognitive dimension**: The stimulus for technology appropriation; **Environmental dimension**: Reuse of equipment; Awareness regarding the environment. |
| "Yes, in addition to all the technological and practical knowledge that robotics teaching can provide, it can also promote collective work and the exchange of ideas, since all construction can be done in teams. Solving problems and developing a critical sense and logical reasoning are capabilities that need to be developed in children and adolescents and that, unfortunately, are not always stimulated in conventional education. However, it is perfectly possible in a collaborative, creative and innovative environment as the CRC should be". | **Cognitive dimension**: Practical technological knowledge; Critical sense, logical reasoning; and Solve problems; **Cognitive and socio-political dimensions**: Collective work, exchange of ideas; Team building; Solve problems; and The collaborative, creative and innovative environment in opposition to conventional teaching. |

Source: own elaboration.

In this way, a discarded computer can be recycled and revitalized in its original function or it can be disassembled to become a three-dimensional printer (3D), a drone, a robot, or any other technological apparatus. In this same understanding, by knowing the logic of the equipment functioning, teachers and students of robotics make possible the technological disobedience, as used by Ernesto Oroza (2012). In a simplified way, the concept of technological disobedience consists of giving different uses and/or aesthetics to objects, equipment and their parts concerning those imagined initially and developed by the industry. The practice is related to the knowledge of the logic of equipment operation and the freedom of use of equipment and materials, often in insubordination to the model defined by large industry.

In dealing with the history of technological disobedience in Cuba, Oroza (2012) highlights the historical-sociological reasons and the endless crises that led Cubans to this attitude and expression of disobedience in their relationship with objects. Faced with the need to produce in deplorable conditions, Cubans have assumed a growing disrespect for the identity of products, as well as for the truth and authority that this identity seeks to impose. Thus, in the author's view, after opening, repairing, fragmenting and using the objects at their convenience, the signs that make the objects a closed unit or identity no longer mattered to Cubans.

For Oroza (2012), the processes of repair, refunctionalization and reinvention can be considered imaginative leaps, as opposed to the concepts of innovation developed by current commercial logic. Such logics, according to the author, proposes scarce solutions to the current problems of the individual. Imaginative leaps, on the contrary, represent a recovery of the capacity and creative attitudes of users and centers of the generation of material goods.

It is noteworthy that technological disobedience does not only occur in new uses for scrap material, but also presents new ethics. In the case of CRCs, it is a socio-environmental ethic, with discourses on environmental management and circular economy that stand out in their work proposals. It is noted, in addition, that there is also a new aesthetic in technological disobedience, which focuses on the functionality of the equipment.

It is also noteworthy, from the socio-political dimension, that technological disobedience is clearly revealed in the discursive constructions of the CRCs, indicating the positions and social and cultural changes that are part of their desires. This analysis is further corroborated by the idea defended by Fairclough (1992, p. 96) that change involves forms of transgression and the crossing of limits or boundaries.

Thus, when analyzing the discourses and non-discourses of the CRCs, one realizes that there is an evident and permanent clash between two very distinct logics: that of consumerism and that of constructionism. One is enslaved and, even in the process of construction and diffusion of knowledge, seeks domination. The other, in turn, stands out for the autonomy of the subjects, seeks to decode and share knowledge, in the process of technological disobedience (OROZA, 2012) and of rupture with the hegemonic discourses of consumerist logic, the market, fighting its processes of economic, social and digital exclusion.

Regarding the logic of consumerism and the social relations resulting from it, we find in the sociologist Zygmunt Bauman (2008, p. 31) some theoretical elements to understand that the many tons of scrap that arrive at the CRCs each year are a consequence, above all, of a programmed obsolescence. About this logic, the author states in his book Life for Consumption:

> The short life expectancy of a product in practice and in its proclaimed usefulness is included in the marketing strategy and profit calculation: it tends to be preconceived, prescribed and instilled in consumer practices through the apotheosis of new offers (of today) and the defamation of old ones (of yesterday).
> Among the ways in which the consumer faces dissatisfaction, the main one is to discard the objects that cause it. The consumer society devalues durability, equating 'old' to 'outdated', inappropriate to continue being used and disposed of in the garbage can. (BAUMAN, 2008, p. 31).

On the other hand, the constructionist logic, which prevails in the discourses and socio-educational practices of the CRCs, sees in the discarded equipment an almost inexhaustible source of resources for recycling for learning and for creation. In this other perspective, the dismantling and (re)making constitute a challenging form of appropriation and dissemination of knowledge, existing technologies and other innovations.

It is noteworthy that the discourse analyses were corroborating these understandings and showing that digital technologies are represented and legitimized, in the CRCs, in a disruptive perspective, which is not aligned with the consumption logic established by industry and the market. Such positioning becomes a conceptual and relational framework. In the CRCs, digital technologies are disruptive both in their discursive constructions about their formation processes, in general, and in their practical choices.

Thus, based on the theoretical contributions and the development of research already presented, it was evidenced that the positions assumed in relation to the models of production and consumption of technologies have a significant impact on the identity formation of teachers and students. From the positions and their identity, their teaching-learning practices are more clearly demarcated, towards constructionism and new forms of technological appropriation.

## Conclusion

The study presented in this article was descriptive-analytical and aimed to investigate to what extent the way in which CRCs use and legitimize digital technologies influences the construction of their political-pedagogical projects and the socio-pedagogical practices of robotics developed by them.

The approach developed was qualitative and was based mainly on the Foucauldian perspective (FOUCAULT, 1986, p. 56), treating the discursive constructions from power relations and also on the faircloughian perspective (FAIRCLOUGH, 1992), seeking to understand the discourses, as forms of social practice, established from a social structure and situated in a context of change, concerning a socio-technical paradigm defined historically and culturally.

As for the research strategies developed, the importance of triangulation performed from the techniques of bibliographic research, documentary research and the application of a questionnaire is emphasized. The execution of these techniques and the discursive analyses resulting from them showed that the use and legitimization of technologies, in the CRCs, have a character of technological disobedience. The technologies are used and legitimized in a disruptive perspective, which is not subjected to the usage model defined by the industry, nor to the consumption logic established by the market.

In this perspective, it is noteworthy that the discourses of the CRCs on digital technologies assume a counter-hegemonic posture and define a model of appropriation and technological consumption that seeks to be inclusive. This model and its discourses promote an identity formation of teachers and students, reinforcing the autonomy of the subject, in a constructionist approach. Furthermore, the perspective assumed in the discursive constructions of the CRCs contributes to producing a whole system of knowledge and values in which digital technologies, for being assumedly disruptive, allow and drive social change.

It should be noted that, in seeking to understand the use of digital technologies in teaching-learning practices, it is necessary to be alert to the way in which technologies and technological development are treated. A technical and deterministic reading of

technological development, especially by educational researchers, can bias research, preventing the fields of conflict and the relationships of power, domination and digital exclusion from being freely manifested by social actors.

To conclude this article, it is worth retaking the perspective of Porto (1992, p. 93) regarding the importance of not denying the material-economic and symbolic nature of technology. If, on the one hand, the a-historical approach to technology produces symbolic violence and exclusion, on the other hand, the discussion and investigation of its constraints, interests and choices in its production, management and consumption processes can be a way not to produce new exclusions in the current socio-technical paradigm.

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