

Tikhomirov's Reorganization Theory and Its Application in Basic Education: Computers as Instruments of Thought Mediation¹

A Teoria da Reorganização de Tikhomirov e sua Aplicação na Educação Básica:
Computadores como Instrumentos de Mediação do Pensamento

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ABSTRACT

In this article, we discuss the reorganization of the teacher's didactic work in the context of the use of digital technologies, with an emphasis on computers, in light of the assumptions of Tikhomirov's Reorganization Theory and Historical-Cultural Theory. This theoretical, bibliographical research, with a historical-dialectical materialist approach, aims to problematize the discussion regarding teaching and learning in schools, particularly concerning the use of computers, based on the Didactic Reorganization Theory, specifically the human-computer relationship. To this end, we seek to understand how the computer, as an instrument of cultural mediation, reorganizes cognitive activity and acts as a resource that fosters the development of theoretical thought, contributing to the

RESUMO

Neste artigo, nos propomos a discutir a reorganização do trabalho didático docente no contexto do uso de tecnologias digitais, com ênfase no computador, à luz dos pressupostos da Teoria da Reorganização de Tikhomirov e da Teoria Histórico-Cultural. A pesquisa teórica bibliográfica, com enfoque materialista histórico-dialético, tem como objetivo problematizar a discussão a respeito do ensino e das aprendizagens escolares, no que diz respeito ao uso de computadores, com base na Teoria da Reorganização Didática, especificamente na relação humano-computador. Para isto, buscamos compreender como o computador, enquanto instrumento de mediação cultural, reorganiza a atividade cognitiva e atua como um recurso que favorece a formação do pensamento teórico, contribuindo para o desenvolvimento das

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advancement of higher psychic functions—memory, attention, and conceptual thinking—essential for the appropriation of scientific concepts. Finally, we conclude that its use, when integrated into an organization of didactic work grounded in historical-cultural assumptions, in which the role of the teacher is that of an organizing agent of knowledge in the teaching and learning processes, strengthens teaching practice and contributes to the development of students' theoretical thinking.

Keywords: Reorganization Theory. Mediation. Computer.

funções psíquicas superiores – memória, atenção e pensamento conceitual – essenciais para a apropriação dos conceitos científicos. Por fim, concluímos que seu uso, quando integrado a uma organização do trabalho didático fundamentada nos pressupostos histórico-culturais, em que o papel do professor é o de agente organizador do conhecimento nos processos de ensino e de aprendizagem, fortalece a prática docente e contribui para o desenvolvimento do pensamento teórico dos estudantes.

Palavras-chave: Teoria da Reorganização. Mediação. Computador.

1 Introduction

The advancement of digital technologies, the use of teaching platforms, technological devices and social networks in today's societies have been impacting the school environment, given the prohibition of the use of cell phones in schools (Angelini, 2025), criticism of active methodologies (Oliveira, 2024) and the consequences of excessive use of these devices in children's lives (Patel; Filip, 2018). Such technologies should influence, over the coming years, the development of school education and child learning, requiring in-depth analysis of this impact on the School. This emerging situation, on a global scale, brings to the field of school education the need for research that deepens the knowledge about the forms of access to information within the School and, especially, about the transformations in the ways of teaching and learning, among other related themes.

This article is part of the doctorate of the first author, whose research was developed in this line of inquiry, having as theoretical foundation the Historical-Cultural Theory. One of the authors of this theory used to deepen the issues surrounding these technologies was Oleg Konstantinovich Tikhomirov (1933-2001), a Russian psychologist who studied human-computer relations. He states that computers are instruments capable of reorganizing

the thinking of human activity. That is, although these machines do not replace humans in their cognitive activities, from this (human-computer) relationship arises a new form of mediation related to the activities of human beings and the appropriation of knowledge. This author made important contributions with his Reorganization Theory, in which the computer is the protagonist in its analysis of contemporaneity. This leads us to understand that the computer, as a cultural instrument, acts as a mediator in the teaching and learning processes and can assist in the development of students' theoretical thinking (Tikhomirov, 1981, 1999).

From this perspective, this article, part of a theoretical and bibliographical research with a historical-dialectical materialist approach, aims to problematize school teaching and learning with regard to the use of computers, based on the Didactic Reorganization Theory, focused on the human-computer relationship.

As the beginning of this discussion, we emphasize our conception of the human being as a historical and social subject, who develops and appropriates knowledge through social relations, in the culture in which he is inserted, thus expanding his cultural development (Vigotsky, 1995). From this conception, based on the Cultural-Historical Theory, some important elements that help us analyze the school environment, such as a cultural institution that reproduces and produces human cultural development, are, for example, the concepts of Higher Psychic Functions, Mediating Activity and Zone of Proximal Development (Vigotsky, 1995); Activity (Leontiev, 2021).

In this sense, Leontiev (2017, p. 39; 2021) states that human thought is historical, socially constructed and, above all, transformable, through the mediation of cultural instruments, and that: “man's acting to satisfy his elementary vital needs”. Thus, the use of the computer in school is a cultural instrument that enhances the subject's mediating activity by appropriating knowledge and for the transformation of reality, thus contributing to the formation of critical and autonomous subjects. Therefore, there is a need to modify the conception of this technology, not only assigning it the function of

didactic resource in school. We need to understand how to do this so that technologies can assist in the development of higher psychic functions and in the formation and development of students' concepts, through mediating activities that act on the learning needs that are still in the zone of proximal development, in addition to the topic regarding the initial and continuing education of Basic Education teachers. Researchers who study computing in teaching and education, such as Valente (1993, 2019, 2005) and Do Prado and Dantas (2024), have already announced the need for the insertion of technologies in school education. So, it is up to research in Education, together with the School, to investigate how to do this, with a view to promoting learning to students.

This movement, which advances in technologies, also drives the financialization, by the public sector, of the platformization of education, which overvalues technological educational resources and products geared towards capital's interests. This situation is directly proportional to the precariousness of the teaching activity and, consequently, of the public school. The use of these resources is important for teaching and school learning; however, it is necessary to deepen the discussion about their application, especially the computer, since their use is generally detached from the educational process and is at the capital's service.

It is these concepts that are dear to us and that offer us theoretical support to understand that the teacher's work is not reduced to the use of platforms, software or applications. Pedagogical practices increasingly need in-depth intentionalities about what students need to develop to learn the contents produced by humanity, so that they appropriate them for use in their lives and to contribute to the transformation of the society in which they live. Hence the need for teachers to understand the main concepts of Cultural-Historical Theory that involve learning — higher psychic functions, concept development, theoretical thinking — and teaching — intentional mediating activity, zone of proximal development, sign, tools, among others, which are related to these.

This may be the way to avoid what Monzelli (2025) states when referring to the proletarianization of teaching: the danger that the incorporation of new technologies can bring when homogenizing the educational process.

2 Tikhomirov and the Reorganization Theory

For this, the author based his studies on three theories: *i)* substitution, *ii)* supplementation and *iii)* reorganization; all directly associated with technology, cognition and education. He starts from the theory of substitution and supplementation to present, finally, that of reorganization.

The *substitution theory* (Tikhomirov, 1981) values the use of the computer as a substitute for the human being in intellectual work. However, Tikhomirov (1981) considered that such a theory does not relate human thinking to computer work. Although the computer can achieve the same results faster than humans in solving certain problems, the processes used by the computer do not correspond to those used by humans. This theory has limitations because it does not consider that thought has a non-linear path and is often different from the operations performed by the computer.

For the *supplementation theory* (Tikhomirov, 1981), the computer enhances human activity and optimizes problem solving. This is because computers are able to process a greater amount of information in a shorter time and with less margin of error, increasing human efficiency in intellectual work and being part of a process that was previously performed only by man. However, although Tikhomirov (1981) recognizes that the computer helps human beings in their activities, he argues that this theory does not consider all the multiple determinations in this process, since it values only the quantitative aspects, devaluing the qualitative ones related to thinking, which are more complex and are not limited to algorithms and strategies to be used during problem solving.

In contrast, his *reorganization theory* (Tikhomirov, 1981) highlights the role of the computer as a mediator in human activities. According to Tikhomirov (1981), the construction of knowledge involves the relationship between the human being

and the computer, because the computer, as an instrument, transforms the human being at the same time as it is transformed, thus influencing the movement of development of human activities. In this relationship, the computer acts as a psychological tool that assists in the transformation of the subject's cognitive activity. It is simultaneously re-signified due to its human use. Thus, this dynamic relationship can directly influence the constitution and development of students' thinking (Tikhomirov, 1981).

According to the same author, there are two ways of reorganizing psychological activity in a human-computer system: the first refers to computer activity when performing mechanical processes, in order to accelerate the activity in question; the second relates to the intellectual activity of human beings, which is transformed and incorporated by the computer, that is, the thought activity that was previously performed by humans now becomes part of the computer (algorithms). This process distances people from a given creative activity. Thus, what was once a human activity with ends and objectives motivated by the challenge of resolution, now becomes only a planned action, essentially, as a function of the computer (Tikhomirov, 1981).

On the one hand, this movement is important, since such incorporation of human cognitive activity by the computer, in the face of new human needs, makes it possible to solve problems. However, Tikhomirov (1981) highlights this importance only if the creative process of solving the problem is configured as a collective social need.

Just as language plays a role in the organization of thought, problem solving, especially through the use of the computer, has enabled humanity to directly transform the modes of appropriation, formation and development of thought activity. This reorganization of thought activity, promoted by the use of the computer, can drive changes in human activity by providing it with new ways of mediating its development.

In this context, the ways in which human beings, in their social relations, appropriate knowledge, that is, first in interpsychic relations (with others, with the environment) and then in intrapsychic relations

(psychological, cognitive), allow them to internalize new knowledge and to relate it to already learned knowledge. This process, when developed especially through an intentional mediating activity, favors the development of higher psychic functions, such as: voluntary memory, voluntary attention and conceptual thinking (Vigotsky, 1995).

In this sense, the computer can effectively be an intentional mediating tool in the regulation and reorganization of student intellectual activity, which, in addition to the creation, search and storage of information, has the function of developing conceptual and theoretical thinking, throughout schooling, transforming the use of technology and human activity.

Tikhomirov (1981, p. 278) points out that:

The cases of great interest are not those in which the computer takes over the solution of some problems solved earlier by humans, but those in which a problem is solved jointly by humans and computer, i.e., “human-computer” systems proper (Tikhomirov, 1981, p. 278).

Thus, this conception of the human-computer system, by the aforementioned author, has fundamental implications for the School, as it presupposes the need to reorganize the teaching, curriculum and conceptions of all those involved in this process, including the family, in order to change the teacher-student-knowledge school relations. It has a direct impact on the choice of didactic-pedagogical and curricular references, since the concepts to be taught, the teaching methodologies adopted and the teacher's role as a teaching organizer mean the search for intentional mediating activities that prioritize the students' learning needs, with the purpose of developing theoretical thinking.

3. Computers as Thought Mediation Tools

The computer is both a machine and a tool. Marx (2020) explains in his text *Machinery and Modern Industry*, in book I of *The Capital*, that the master craftsman's driving force to manipulate his tool produced perfect carvings in wood.

The machine, in turn, in order to work, needs external driving force, such as the coming, for example, from water, animal, coal or even electricity, in a transmission mechanism by series of axes that transfers this driving force to the machine tool, which produces benefits for humans.

The computer, as a machine-tool, transforms labor relations, as it extends the workers' hand, eyes and body, complementing their work activities perfectly, for example: fitting small parts into an engine; cleaning the house by means of household utensils, etc. Thus, this cultural tool also assumes the function of mediating human work, enabling, in this process, the appropriation of new knowledge by workers. For example, in the pandemic, teachers and students at all levels of education appropriated knowledge that involved social networks, conversations and distance education, production of materials suitable for distance learning, among other learning that modified teaching activity and student learning, resignifying the subject's thinking and forms of relationship with reality, through a specific collective need (Tikhomirov, 1981, 1999; Leontiev, 2021).

We understand that new needs arise throughout the development of humanity, and technologies, tools and machines act both to meet these needs and to transform reality through human activity (Leontiev, 2021). Computers are machines and tools that are constantly incorporated into other machines, other mechanisms, other artifacts, to make it possible for more people to access them. Today, we increasingly see computers become useful, either in the palm of our hands, with each new application and digital media, or in the form of tablets, watches, notebooks, among other technological devices, which impact and reorganize human internal activity, being able to both potentiate and negatively influence the formation and development of theoretical thinking.

Regarding this subject, Beleti Júnior (2003, p. 24) already stated that:

[...] theoretical foundations that deal with the formation of human thought and, in particular, theoretical thinking, linked to the appropriation of scientific concepts, can offer elements to advance the understanding of computational thinking, as a particularity of theoretical thinking in general (Beleti Junior, 2023, p. 24).

In this sense, the computer, when inserted in the context of teaching and learning, can enhance the access, production and reorganization of knowledge, allowing the student to appropriate scientific concepts and develop theoretical thinking critically, with the mediating activity intentionally planned by the teacher (Davidov, 1988).

However, we want to emphasize that new technologies, especially the computer at school, tend to be used in order to favor the commodification of the capitalist mode of production, which aims to alienate the worker. An example of this is the massive propaganda by governments regarding the introduction of computers in schools, as a sign of the school's change towards the new century. This situation is highly dangerous, since the historical and concrete forms of labor relations are forgotten, putting in their place the precariousness of the teacher's work, which dispossesses him of his social function, limits his creativity, making him hostage to ready-made content with no real meaning for students (Monzelli, 2025).

Teaching work is characterized by the socialization of systematized knowledge (Saviani, 2013). Thus, the teacher needs autonomy and freedom when teaching, in order to enable students to appropriate this scientific knowledge produced by humanity. Thus, the School becomes the place par excellence for the critical understanding of reality, through the appropriation of systematized and organized scientific knowledge to meet the learning needs of students, through a computerized environment.

4 Final considerations

We resume the objective of this article, which was to problematize the discussion about school teaching and learning, with regard to the use of computers, based on the Didactic Reorganization Theory, specifically in the human-computer relationship.

The theoretical research of bibliographical nature, with a historical-dialectical materialist approach, had as theoretical contribution the Theory of

Oleg K. Tikhomirov, because we understand its relevance to the Cultural-Historical Theory and, consequently, to a teaching practice sometimes focused on the school didactic organization from the use of new technologies. Throughout the text, we highlight the importance, in particular, of the computer as a cultural instrument or machine-tool, since, in both cases, it should not be used in a way that is detached from the teaching processes and learning needs of students.

Based on the Reorganization Theory and the Cultural-Historical Theory, we discuss that the assumptions of both theories are essential for the introduction of the computer in school, having as understanding the concepts of intentional mediating activity of the teacher; zone of proximal development of students; need for the development of higher psychic functions, such as voluntary attention, voluntary memory and conceptual thinking, both of teachers and students, through their teaching and learning relationships, activity, theoretical thinking, reorganization of activity and human-computer relationship.

The computer, when inserted in the didactic organization of teaching work, can enhance the development of students' theoretical thinking, favoring the learning of content that has meaning and significance for students. In this direction, the teacher assumes the role of organizer and problem posing of knowledge. This conception breaks with the technicist and instrumentalized logic, which should not be associated with school education

By recognizing the computer as an integral part of a human-machine system that reorganizes human thought, we argue that its presence in school should not serve the logic of replacing the teacher's work or automating teaching, but, on the contrary, should strengthen the praxis activity of teaching, favoring the appropriation of scientific knowledge in its critical and socially referenced dimension.

Finally, we highlight the need to expand and deepen research in the field of education and computing, considering the theoretical, methodological and social impacts of the use of digital technologies in the school environment. It is essential that public policies and pedagogical proposals involving the use of

computers are committed to the integral development of students and to valuing the role of teaching, avoiding processes of commodification and massification of teaching.

The challenge facing contemporary school education is to critically incorporate technologies, with the aim of training subjects who can transform the society in which they live, making it increasingly humane, egalitarian in rights and duties, with the collective good in mind. In research in Education, the challenge is to deeply investigate the ways in which the School relates the human to the computer, so that this technology meets the challenge posed to school education.

La Teoría de la Reorganización de Tikhomirov y su Aplicación en la Educación Básica: Computadoras como Instrumentos de Mediación del Pensamiento

RESUMEN

En este artículo, abordamos la reorganización del trabajo didáctico docente en el contexto del uso de tecnologías digitales, con énfasis en las computadoras, a la luz de los supuestos de la Teoría de la Reorganización y la Teoría Histórico-Cultural de Tikhomirov. La investigación bibliográfica teórica, con un enfoque materialista histórico-dialéctico, busca problematizar la discusión sobre la enseñanza y el aprendizaje en las escuelas, en relación con el uso de computadoras, con base en la Teoría de la Reorganización Didáctica, específicamente la relación humano-computadora. Para ello, buscamos comprender cómo la computadora, como instrumento de mediación cultural, reorganiza la actividad cognitiva y actúa como un recurso que favorece la formación del pensamiento teórico, contribuyendo al desarrollo de funciones psíquicas superiores —memoria, atención y pensamiento conceptual— esenciales para la apropiación de conceptos científicos. Finalmente, concluimos que su uso, al integrarse en una organización del trabajo didáctico basada en presupuestos histórico-culturales, en la que el rol del docente es el de agente organizador del conocimiento en los procesos de enseñanza y aprendizaje, fortalece la práctica docente y contribuye al desarrollo del pensamiento teórico de los estudiantes.

Palabras clave: Teoría de la reorganización. Mediación. Computadora.

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