

Who sharpens the sword of Damocles and who tunes the tambourine friend? Reflections on the relationship between the worker and his means of work

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Abstract

The text brings together theoretical approaches and practical aspects – these, lived by one of the authors – about the use of tools and their relationship with the person who works. For this, it deals with the concept of work and work process (Marx, 1978, 1985; Santos, 2010), briefly follows the transformations that the model of neoliberalism has imposed on the worker (Antunes 2018; Viana, 2000), without miss the point of the worker’s subjectivity in the work process, as resistance and as self-affirmation (Sennett, 2013). It reports in detail a field experience, goes through telecommuting, talks a little about the work of the judge, opens up possibilities for linking these reflections and empiricism with musical language, and ends by connecting the new model with collective resistance.

Keywords: machine tool; work process; educational principle of work; telework; workers’ resistance.

Introduction

For what we intend in this text, we use Marx’s contributions (1985, 2020) on the work process and machinery; Sennett’s discussion (2013) on handcrafted work, with empirical reports of the production of social technology, analyses of the craft of toolmakers, and the experience of a labor judge. We also rely on the analysis of fragments of Capra’s reflections (2008) about Da Vinci’s exceptional achievements, and we will try to understand the relationship – through some songs – of the worker’s intimacy with his tools. We also report on a concrete experience – the construction of a “respirators” for use by COVID-19 patients. A good part of the conclusions, thus, were drawn from our observing and doing, as well as from listening and feeling the work of others.

As we know, it is a long human march to the advent of the mastery of techniques that guarantee the existence of the world we know. If today some narratives make us believe in the centrality of a “school-based professional education,” work, in its empirically, has never ceased to be also a source of learning practices and values.

For Marx (1985), work is the foundation of our humanization, a means that allows us to produce things that are useful for the production of existence

For Marx (1985), work is the foundation of our humanization, a means that allows us to produce things that are useful for the production of existence. The mobilization of work to solve real problems, often bringing a result that is pleasing to the eye, ear, touch, and taste, it is something as old as itself.

It would be the case, perhaps, to ask: in the face of all that has been thought and said about people who work, why pursue the intimacy of the relationship between them and their tools?

As much as it may seem like that, it is not about satisfying simple curiosity – but a way of getting to know a part of the world of work at its starting point. And investigating this aspect involves an ethical commitment, in the sense of contributing to transform it.

Therefore, the exposition of the research begins with a generic approach to work in general, and then deals with the relationship between the worker and the tool, in its various dimensions. It discusses the effects of the tool on the person and vice versa; and, weaving these and other connections, it describes some aspects of the factory, the machinery and the product. To make the ideas presented clearer, the text uses the lyrics of some songs. Although briefly, and contrasting with the worker, it talks about the tools of the teleworker and the judge. And it ends with a brief discussion of collective resistance, linking this focus, once again, with the central theme.

Although synthetic, the research may be considered relevant, as far as the topic has been little studied in our field. In addition to a vast bibliography, it makes use of reports of concrete experiences – also giving voice to male and female workers.

The hypothesis gravitates around the existence of an intimate relationship between the worker and his work tools, which would not have been eliminated at all by the Taylorism-Fordism system and would still be present in the work environment – such as the so-called “tacit knowledge”.

As we said before, our hope is to be able to contribute a little not only to the knowledge of the work process, in its concrete life, but to its eventual improvement in the future, with a view to providing greater dignity to the person who works.

Work and subjectivity

Serres (2000) perceives work as a “struggle against noise”. It is just that, without it, the elements that make up the world we live in could crash much more easily. Thus, for example, the harbors would fill with sand, the sugar would sink in the cup, the fox would raid the hen house... For Serres (2000), working is choosing, organizing.

Besides showing itself as a way of organizing or reorganizing things, solving situations, working is, at the same time, printing a personal, or collective, signature on what one does. According to the toolmakers themselves, the tool is their face (Santos, 2004). This possibility is noted by Sennett (2013, p. 20): “The craftsman’s awareness of materials in the long history of brickmaking, stretching from Mesopotamia to our own time, a history that demonstrates how anonymous workers can leave traces on inanimate things”.

The most beautiful and the worthiest of the work are the workers; but they are also the most complex element, since they express singularities, holding a historical heritage of social relations with their own culture. Marx (1985) was astute to note that it is the living work, the worker, that gives meaning to dead work:

A machine that does not serve in the work process is useless. Moreover, it succumbs to the destructive force of natural metabolism. Iron rusts, wood rots. Yarn that is not used for weaving, or for knitting, is spoiled cotton. Living work must seize these objects, awaken them from the dead, transform them from only possible use values into real and effective use values (MARX, 2020, p. 299-230).

Sennett (2013) provides us with a good clue to inquiries like these. According to him, one way to see the meaning of things is to know how they are made. Quite rightly, much is said about how much the social relationship between those who do is revealing of the way and conditions of doing. And perhaps it is very revealing about doing the relationship between workers and the means of work they use. Again, with Sennett (2013, p. 18), we know that the “contents of Pandora’s box can definitely become much less frightening; we can achieve a more human material life, if only we understand how things are made”. Contrary to a supposed neutrality, as seen in Oppenheimer, Sennett tells us that technique does not have a nobility in itself, what is great is knowing what the result of a certain work activity is for. The technique would also be involved by an ethical sense.

Reflecting on the worker’s relationship with his instruments can highlight the threads that the body/mind weave serves to compose the educational principle of work

The archetype of the one who does it well, who knows well the details of his doing and gives meaning to what he does, appears in Sennett (2013) as the craftsman, or what we could call the artisan¹. He warns us, by the way that the expression “craftsmanship” can refer to a lifestyle that disappeared with the advent of industrial society, which, however, would be misleading. He explains: “Craftsmanship designates a basic and abiding human impulse, the desire for a job well done (benfeito)² by itself” (SENNETT, 2013, p. 20). Therefore, it serves as much for a text writing activity as it does for metal forming and/or for the tasks of a doctor.

Reflecting on the worker’s relationship with his instruments can highlight the threads – often invisible – that the body/mind weave serves to compose the educational principle of work. It can also

help us understand the various types of production, as well as the mobilization and formalization of the means and objects of work (SANTOS, 2004).

The zeal of a lathe operator or an artisan – whether in a carpentry shop or in the samba school halls – does not take place in an ethical and aesthetic void. Although, the more the work approaches a source of pleasure, the greater is the integration between the subject and his work, as well as with the means used.

It is also true that people react creatively to what they dislike – albeit on an unconscious level. At work, this circumstance leads us to look for what went wrong and try to find ways out.

In other words, the work bears the marks of subjectivity. The worker has never been a passive subject. Therefore, the Taylorism/Fordist prescription, as well as any other, never really complete (SANTOS, 2004; 2010). Even if it wanted to, the worker would have no way of not affecting the object he produces, or even the tool that uses. Or vice versa.

The worker and the means of work

The richness of the worker's relationship with his tools can come up against prejudices stemming mainly from the idea that one could separate manual labor from intellectual work. Sennett (2016, p. 20) points out that the tradition of craft practice "focuses on the intimate relationship between hand and head", noting that the crystallization of this prejudice is most pronounced in Western civilization.

In capitalism, simple elements such as the subordination of labor force and the control of capital

Marx brings two propositions that will be useful to us – about the work process and machinery. According to him, the work process, in any era, can be apprehended by its simple elements – the subjects, the means and the objects of work, the means of work are a complex of things "that the worker places between himself and the object of work [...]. The object which the worker takes direct possession of, abstracting the collection of ready-made means of subsistence [...] is not the object of work, but the means of work" (MARX, 1985, p. 150). In another moment, Marx reinforces the relevance of the means of work, when he writes that "it is not what is done, but how, with what means of work is done, that distinguishes the economic epochs" (MARX, 1985, p. 150).

In his thinking, therefore; the importance of the means of work leads us to both the machinery and the tool itself. Moreover, this distinction is not at all simple and has occupied pages and pages of his work.

In capitalism, simple elements such as the subordination of labor force and the control of capital. It is from this political necessity that the combination of the technical division of work as an interference in the means of work arises. The consolidation leap of the bourgeois order will happen with big industry, with the capacity to radicalize the use of machinery, that is, the reduction³ of the worker's interference in the means of work. The itinerary that leads us to the machine tool

starts from the relation of the worker to the tool. In Letter to Engels, Marx discusses his initial impressions about what would distinguish the machine from the tool

The English mechanics (mathematicians), in their casual way, call toll a simple machine and machine a complicated toll. [...] But now, if we look at the machine in its most elementary form, there is no doubt whatsoever that the industrial revolution derives not from the driving force, but from that part of the machinery that the Englishman calls the working machine; therefore, not, for example, replacing the foot that moves the spinning wheel with water, or steam, but transforming the spinning process itself, or eliminating part of human work that was not just exertion of power (like moving the wheel pedaling) but re-elaboration, which has an immediate effect on the material to be worked on (MARX; ENGELS, 2020, p. 337).

The tool is an extension of the worker's body, of his motor system; its importance accompanies the use of his hands, feet, and all senses. It is possible, at some level, to objectively gauge the potency of their gestures. But it is also present – to a greater or lesser extent, no matter – his creative, singular, and reactive subjectivity (BARATO, 2008; SANTOS, 2004).

The machine tool is the product of an attempt to objectify the tool; at the limit, it expresses the quest for the automaton, an effort not always successful – at least not entirely.

Often, when a worker knows how to use, manufacture, and/or re-standardize a means of work, we usually praise his “good technique.” However, as Machado (2010) notes, it is necessary to recover the meaning of such an expression.

For Plato, the works that depend on a *techne*, whatever they are, are “*poiesis*” and their producers are all poets (creators). [...] In the Latin language, the equivalent of *techne* is the word *ars*. It is also interesting to note that, at first, the word *art* was used to designate very methodical manufacturing procedures that required special expertise (MACHADO, 2010, p. 84).

Sennett (2013, p. 30) also teaches us that, “at its highest levels, technique ceases to be a mechanical activity; people are able to fully feel and think deeply about what they are doing when they do it well.”

In this way, we can believe that the relationship between the worker and the means of work has the power to interfere in the ethics, aesthetics, and science of work. There are numerous empirical references and a good number of theoretical readings for this theme (CAPRA, 2008; SANTOS, 2004).

The science born of experience in Leonardo da Vinci

Leonardo da Vinci, the genius of the Renaissance collects a plethora of great achievements. It would not be an exaggeration to recognize him as an exceptional craftsman. After all, throughout his life, he projected, designed, painted, sculpted, and built prototypes that attest to a unique genius.

Capra (2008) points out that Da Vinci showed great artistic gifts from an early age. He lived in Renaissance Florence and spent his 12 years of learning in a workshop, where he developed some of his formidable skills. His master was Verrocchio, the most famous artisan in Florence. Then he became a master artisan himself (CAPRA, 2008). But where would such talent have come from?

In Da Vinci, as in many others, the body and mind are integrated in the understanding of work and in the making of oneself through work

Da Vinci (apud Capra, 2008, p. 89) exalts the place of experience, by refuting a supposed resistance from academics of his time: “they do not know that my studies are more valuable because they originate in experience, and not in what others have said, and it [the experience] is the mistress of those who have written well.”

Interesting to think that in Da Vinci there is an integration of knowledge and skills. The engineer Da Vinci owes a lot to the sculptor Da Vinci, and the sculptor to the painter Da Vinci, and vice versa. These powers that made him a genius were developing together, helping and questioning each other on the same construction site.

Both Sennett’s (2013) craftsman and toolmakers give a measure of the fact that a craft work, however much it involves manual activity, is not devoid of systematized domains (SANTOS, 2004; SENNETT, 2013). For these and also for Da Vinci (CAPRA, 2008), there is an exceptional relationship of the concept to experience, calculations, spatial vision, experiments, memory, and illustrations. Everyone gets carried away by a curiosity that sometimes seems infinite.

Creator of absolutely fabulous things, Da Vinci – who left clues for this writing of ours – shows us that intervention on a given matter can be facilitated by an important degree of mastery over human faculties, such as sight, memory, hearing, touch and smell. Da Vinci knew himself in order to know what was external to him, and it seems that the knowledge of what was external to him – such as the means of work – improved his knowledge of himself.

There is no point in establishing a hierarchy, wondering which of the senses would have helped Da Vinci the most – or whether it was the engineer Da Vinci who helped make the artist Da Vinci, or the other way around. We could also question why engineering could not be in the field of the arts. In Da Vinci, as in many others, the body and mind are integrated in the understanding of work and in the making of oneself through work.

Artisan, tools, lyrics and music

An old popular saying believes that musicians spend half of their lives playing instruments and the other half tuning those instruments. The result often improves our lives. Musical instruments are past work – Marx’s dead work – and have, as we know, distinct characteristics of form and content. And they contain particularities. Some of them, for example, may require greater sensitivity, less force and greater precision; with others it will not be the case. According to Evelyn-White, one of

the earliest celebrations of the craftsman is found in a Homeric hymn to his god, Hephaestus (apud SENNETT, 2013, p. 31)

Sing, muse of the clear voice, the celebrated abilities of Hephaestus. With Athena and her shining eyes, he taught glorious crafts to men all over the world – men who previously lived in mountain caves, like wild animals. But now, they have learned occupations thanks to Hephaestus, famous for his art, they lead a quiet life in their homes all year round.

Sennett (2013) sees in this hymn a celebration of the craftsman with the common good. He even identifies in the original language of the text that “the word employed in the hymn to designate the craftsman is demioergos. It is a combination of public (demios) and productive (ergon)” (SENNETT, 2013, p. 32).

Brazilian musicians have too made their contributions to thinking about workers and means of work in an idealized way. We look at the lyrics of two sambas, whose songwriters used art to subvert Marx (1985) and give feelings to dead work. These two sambas build an interesting fetish; they personify objects, give poetic life to percussion instruments so that they describe how they feel when used. They, the percussion instruments, refer to the samba musician who handle them, in a plot that mixes the daily life of the workers under the baton of the craftsman/instrument relationship, with what, in theory, would occur physically with the instrument itself.

Composed at different times, “O surdo (The bass drum)” (1975) and “Pandeiro é o meu nome (Tambourine is my name)” (1977), like two good old friends, speak of their fate and seem to compare the physical reflexes of when they are “played”, a form of toil like that of many Brazilian workers:

The bass drum ⁴

Friend, what an irony of this life
 You cry on the avenue
 For my people to rejoice
 I hit you hard
 And here inside the chest a pain destroys me
 But you understand me
 And he says that a bump from love doesn't
 hurt
 [...]
 My bass drum seems absurd
 But you listen to me Much more than the friends at the bar
 Don't let the pain hurt you more
 For by your beat
 I stop my crying
 and start to sing.
 My bass drum I hit your skin hard

I only hear your cry
 That applause comes to console.
 [...]

My bass drum man, old friend and partner
 From the avenue and from the yard,
 Of samba parties and solitude
 Don't let me get tired Forget about that hug
 And undo and compass the beat of my heart.
 [...]

Much more than the friends at the bar
 Don't let the pain hurt you more
 For by your beat
 I stop my crying and start to sing
 My bass drum I hit your skin hard
 I only hear your cry

That the applause comes as a consolation
 [...]

Tambourine is my name⁵

They said that my partner
 My friend bass drum seems absurd get hit by everything
 Nobody sings samba
 Without him be spanked

Have not heard that your partner
 Tambourine
 friend It also takes coconut from the same coconut tree
 Gets spanked while smiling for people to sing

Tambourine
 It is not absurd but it's my name
 I do not call myself bass drum but I can handle hunger
 Tambourine does not eat but can be beaten

To the people who vibrate in the strength of the Brazilian sound
 It is not just the bass drum or just the tambourine
 There's a family playing nice
 You singing, playing and hitting us
 Going through it all so nonchalantly
 Doesn't know the pain of the instrumental

Percussionist oh, percussionist
 Singing samba you can hit the tambourine
 Percussionist oh, percussionist
 Singing samba you can spank the tambourine

In some cases, minor accidents in workshops often provoke lines like, “It’s the profession coming in!” For many workers, the exercise of their craft depends on an intimacy with their means of work. It is not just something objective. It is as if a tool requires a blood pact with whoever handles it. There are other expressions that indicate the bond between a worker and the tool whose thread is compromised – which provokes expressions like “the tool is screaming!”, or “this tool is ungrateful...”

Even the use of an apparently crude tool, such as a sledgehammer, requires a body posture, a coordination between arms and mind so that the intensity of the handling ensures that the sledgehammer fulfills its role of hitting with force and, at the same time, that the reaction of the impact does not cause a rebound effect on the arms. The worker develops the ability to use force in order not to be shocked and to avoid a consequent muscle contracture.

The poetics of those sambas give notice of a little of all this. In the end, from a physical point of view, to work is to act on the structural properties of an object – which may require overcoming physical and chemical resistances. Imagining what happens to an object and/or a tool is one way to understand certain manufacturing. What happens to a polymer when it is being injected, or extruded⁶? And, in this same process, what it happens to the spindle that carries the polymer to the mold? And the mold itself, why must it be polished? What about metals, leather, and silk? What about the paper, the clay, the marble, the paint?

The relationship with the tool builds bridges with the work process because it actually involves an attunement between body and mind, between subject, means, and object. This relationship, exactly because it is under the command of body and mind, also indicates a regulating capacity, which according to Álvaro Vieira Pinto (2005) is the “supreme gift” of machinery.

The same way as in the song they are talking to each other, the tools exchange ideas with the workers. In the interstices of the prescription, they perceive them almost as living people; although they compose the instrumental of domination, paradoxically they are their friends, their partners. The relationship between body and instrument ceases to be merely objective and enters the world of subjectivity. In “Casa de Papel”, an award-winning television series, the character Palermo, distressed but still full of hope, caresses and kisses the machine that would suck up the stolen gold and dump it away, begging it to work – which it eventually does.

The case of a prototype respirators: aspects of a lived experience

We look now at the experience of mobilizing the technique in the face of a technological limit, posed by one of the biggest problems in confronting COVID-19, which was the lack of pulmonary ventilators – the so-called “respirators”.

In March 2020, in a mechanical workshop of the Laboratory School of UFMG, three teacher colleagues, after 30 years, meet again in search of an alternative for

artificial respirators, which would be low cost and quick to manufacture. The work began with conversations via WhatsApp and emails. The group felt mobilized by a hope and some convictions. The hope was to have a technical background up to the challenge, thanks to the experience on the factory floor and a diversity in educational background – since the group was composed of a mechanical engineer, a mathematician, and a historian.

Although none of them knew clinical engineering and the pulmonary demands of a person, the belief was that everything in a hospital – from the needle to the CT scanner – was in a factory before it was there, and passed through the hands of workers. Thus, the group concluded that it was enough to interrogate the work process to be able to manufacture a lung ventilator.

The first step was to get a mechanical construction workshop – in this case, the one at the UFMG's Certificate Program, Coltec. The second was to understand how a respirator "breathed".

In the first face-to-face meetings, the use of "our own body" was called upon to organize the work process. Under the conductor's baton of Marx⁷ (2020), we saw that, just as the machine tool is the part of the machinery that replaces human knowledge, the respirator could be divided into parts; but the central point, in this case, it should be human breathing. The "artificial respirator proposes to replace the lung", and that is its machine tool correlate. Thus, "our body" did indeed seem to be a reliable source for the first assessments. And in fact, for the first few days, it was our only source for this approach to the "machine tool".

These first attempts required us to think more deeply about breathing, about how to use the body

"It has to be something approaching normal breathing!" a colleague said, who then breathed in and out, trying to show with his own body the breathing effect. The colleague made the same move and at the end asked, "Is that it?"

"Too fast, is not?" one of us questioned. And once again, one colleague breathed in the air, while the others tried to keep up with the breathing. We saw there that the rhythm was a bit personal.

These first attempts required us to think more deeply about breathing, about how to use the body, and also made us think about the principle of how respirators work. We also looked for information in other sources and initiated contact with the community of clinical engineers. We have learned that breathing takes place over a narrow range of variation in frequency, volume, and pressure.

Despite our clinical lack of culture, we concluded that it would not be possible to wait; we really had to start doing and learn by doing. In that workshop, we were the subjects of the work process; we had some means of doing it, but we lacked non-toxic materials, glass, stainless steel or some polymers. We opted for polymers – lighter, cheaper, and available in the scraps of Coltec and of the Hospital das Clínicas of UFMG. Another part we bought with our own resources.

From then on, a double effort was made, to acquire and build the means of work to make the prototype of the respirator, and even after that to try to understand, more and more, what it meant to breathe. It seemed curious because breathing is what we have been doing since forever, but its artificial version requires numerous domains – “machine elements” to principles of physics and chemistry, and even the law.

From the beginning, we opted for an artifact whose shapes would fit the available means of work and/or that we could build in the workshop. In this way, there was a strong relationship of the team with the existing tools and some of their scientific extensions, the Coltec machine tools. At all times we have had to interfere with the means of work, and in some cases manufacture them. The workshop, which served us well, was not equipped for this demand. The limits of these means of work have been overcome by our interference⁸. The team modeled and sharpened cutting tools, as well as developed devices to hold the parts. The physical properties of polymers – which in a scale-up situation can be obtained by injection or extrusion – required a series of readjustments to the machine tool for machining. We also create lubricants.

It was necessary to develop a certain sensitivity in handling the whole process, so as not to damage the fragility of the object. For that in addition to the lungs, we use our hands, eyes, and touch to imitate breathing. These skills, together with our school and experience knowledge, most of the times collective, were mobilized to build our main “machine tool”, the respirator.

The first prototype tests to verify compression, suction and air sealing were done manually with domestic bladders, gloves and/or birthday balloons, and the measurements were carried out with water column manometers, handcrafted, whose accuracy is proved comparable to digital instruments.

By April 2021, the Compas prototype lung ventilator – this was the name we gave it – went through four versions, all with 100% national technical basis, analogical instrumentation, low cost and fast manufacturing. In the last two bench tests, and with a breathing simulator from the Hospital das Clínicas, UFMG, it was verified the production of air with flow rate, frequency and volume control in the required clinical parameters⁹.

Experience has shown us that technique can be crucial – especially when science is insufficient. Learning to use our own bodies, and making the best use of tools and machine tools were practices that did not impose a technical division on the group. Everyone did a little bit of everything. The result indicated that it surpassed imported technology and matched it in achieving results.

Toolmakers' experience reports¹⁰

Human making does not occur in a vacuum, and this statement holds true for the piecemeal work of big industry as well as that of an artisan. There are several conditions for a job to be well done. The control over his physical power and his

mental faculties can give the worker virtuosity for a better use of the tool and/or the machine tool, as some excerpts about the toolmakers' activity will show us (Santos, 2004). In a large number of situations, toolmakers mobilize their tacit knowledge to ensure the quality of the work, drawing on an ability to bring new meanings to sophisticated machinery, to correct engineering prescriptions, and frequently invoking the unity between body and mind. We look at one of the testimonies, showing the use of an "abstraction effort" as a resource to understand certain technologies, as well as to facilitate conversation with colleagues:

If the guy doesn't imagine what you're talking about, he doesn't see it, he doesn't learn, in fact, he has to see it to understand what's being said. In tools, you learn every day, but the experienced toolmaker learns more. Why do you learn more? Because he sees more objects. The toolmaker's mind has to get inside the tool, at least it was with me (TOOL 1, apud SANTOS, 2004).

For some toolmakers, as you visualize the machine tool, you can also better understand why certain things are required on it:

When you analyze the project well, you already have it in mind. Without knowing the designer, you know what he is already thinking, you already know what he thought when he designed that tool. For example, a toolmaker called me on Saturday because he could not understand something. He saw it in the drawing, but he could not imagine it working, so it was from that point on that I took it and we sat together, I took it and simulated it, I was drawing and imagining it. At this point I saw what he had designed. When you design, you design the lines and they are stopped, so I saw together with him, we observed that situation. I talked to him: look, the designer thought in the following way: "this wedge will lean against this side, it will cut on this side." Not necessarily the drawing told it, but it was looking at the drawing and imagining, that I could only consider it that way, or else it would not work. The designer had thought of something, we sat there for half an hour, but then I understood what he was really thinking. He thought the operation this way and consulting other people, afterwards, to clear doubts, the engineering staff, the object is the way we had imagined it (FERRAMENTEIRO 2, apud SANTOS, 2004).

The "abstraction effort", while making it easier for them to understand a colleague's reasoning, also allows them to re-appropriate the knowledge of their work group for their own knowledge. Sennett (2013) asks about the use of information technology in engineering and the possibility of harm to a more solid formation.

Drawing the bricks by hand, tedious as it may be, leads the designer to think about their materiality, to deal with their solidity, as opposed to the blank space represented on paper by a window. The CAD¹¹ prevents the designer from thinking in terms of scale, which is different from pure and simple size. [...] what appears on the screen offers an impractical coherence, composed in a unified way that never occurs in physical vision (SENNETT, 2013, p. 53).

To mobilize their knowledge, toolmakers also recognize that “knowing how to use the body” can give them an advantage over the designer:

The designer has a big problem today. Before he worked with a clipboard, now he works at the computer on a 20-inch screen at most. Our tools, besides having several components, sometimes 700 or 800, measure almost 3, or 4 meters. And there is more, on the computer you do not pick up with your hand, you do not hear and see the pieces directly. We look, listen, even to use our vision there are tricks that must be more difficult with the computer (WORKER 3, apud SANTOS, 2004).

Another statement reveals how “knowing how to use the body” can receive contributions from other knowledge, such as notions of mechanical drawing and geometry:

Usually, you look at the piece in a horizontal plane, you can see that the surface is a little wavy, when the surface is with a constant finish. The other point is the horizontal, when you see the piece between the curvature and the plane, you cannot see it on the ground. When you can not see it, you have to feel the piece, you run your hand over the surface of the piece, you know if it is wavy, if it needs more finishing, and a radius, for example, we call it a broken radius, that it is when the ray has a corner, this corner is actually nothing more than the encounter, where the drawing of the ray ends and where it begins. This point has to have exact concordance in the plane, if it does not have concordance in the plane it will have a corner, and this corner you only observe by touch, you pass your hand and feel, wow, this radius here needs a better finishing (FERRAMENTEIRO 4, apud SANTOS, 2004).

With the toolmakers, memory and history also appear as components of knowledge; moreover, they allow the amalgamation of school knowledge, which they are not passive when they are in front of the machinery, contrary to what some unsuspecting person might imagine. There can be no doubt that workers think all the time.

Check it out, do you see this grinder here? She is actually pretty good if you look at her age. But the grinder is a final machine, it is the last machine before assembly, if I kill a part in the grind, I am losing the entire service of the mill lathe and the rest of the process. This grinder is very resourceful, but here it is full of backlash. If another guy comes along, he is going to get a bit of a beating, that is why the mallet is necessary, otherwise you would not be able to do much of anything. You see, in this case you just have to apply a little pressure, or take a little less because it will cut more. There are times when you want to give it another pass, then just repeat, without taking anything, she takes it off herself, takes more material. So, in this case I use the machine's defect in my favor (FERRAMENTEIRO 5, apud SANTOS, 2010).

The judge's tools and the teleworker

The labor judge, of course, is also a worker. As a judge, its most obvious tool, over time, was the pen – with which it signed his sentences. But since at least the first decades of the last century, the typewriter has crept in between the two, making room for another character – the audience typist.

By writing his sentence by the hand of the other, and with the mediation of the machine, the judge reinforced the idea of a supposed neutrality, which even today the Justice strives to maintain. The typewriter and the typist himself were added to the talar garments and the high platform, serving to separate – at least in the collective imagination – the character who condemns or absolves from the flesh and blood person who is hidden there.

But the judge also manipulates so many other tools (VIANA; NUNES, 2019). Some are invisible, as happens not only with technical terms, such as “contumácia (contumacy)”, but especially with refined Portuguese, *castiço* (of quality), which replaces “surge (arise)” with “exsurge (appear)”, “pedido inicial (initial request)” with “peça proemial (proemial piece)” or “apoio (support)” by “espeque (prop)”. Even the posture of the lawyers, the parties or the witnesses, conforming to the judge's power – and thus confirming it – enhances the authority of the judicial decision and that of its plaintiff.

On the visible plane, although with aspects that are still invisible, the judge uses details such as his position at the table, or even the table itself, which separates him from ordinary mortals; he can also use a Brazilian flag beside him or even a crucifix on the wall, even though we live in a secular state. At the limit, you can use the wall itself as a tool, having it painted in a color that favors the climate, as happened some time ago in Belo Horizonte (VIANA; NUNES, 2019, p. 210).

Today, it not only has the typewriter given way to the computer, but the pen itself threatens to disappear with the digital signature. In fact, the physical process has practically gone out of the picture: everything or almost everything is virtual. The problem – for the judge – is that the new tools, usable at a distance, may end up eliminating, in another respect, this very distance.

On the one hand, the parties and the lawyers no longer feel – or not so much – your physical, flesh-and-blood presence, which can reinforce your image of being different, and at the same time indifferent to what is not on the record. In this sense, the judge seems even more ethereal, abstract, neutral, as if hovering in the clouds.

On the other hand, however; plaintiffs and their lawyers do not suffer the same stresses of a courtroom either. Being almost always in their homes, surrounded by friendly, comforting objects, they also feel this way – at home – even though they are participating in a procedural rite. In this way, the same judge who is in the clouds can be pulled down to earth at any moment, as some of the harsh clashes with those other characters have shown.

Paradoxes similar to those seen in the case of the judge and the other actors in the hearing are present in private life activities, where the worker also stays at home – a phenomenon that has become especially common since the beginning of the pandemic.

But there are also important differences. On the one hand, being at home can make the worker feel more at ease – or even more empowered – sparking in his or her heart impulses for autonomy and, as the case may be, even a spark of rebellion. As much as the machine itself – the computer – summons him to work, he has it right there on its desk in his room or office, and sometimes he can even choose when to use it – whether before, after, or during coffee. Nothing prevents, for example, working in shorts or pajamas, even when the company requires a tie; and he no longer sees, does not feel the physical presence of another body next to his own, watching over his gestures and movements, even those that are not directly linked to keyboard activity.

The relationship of the subjects of work to the means and objects of work is therefore both objective and subjective

On the other hand, as we said, that same machine that serves as his tool can exert an attraction on him, inducing him to work, as demonstrated by IBM's own research (VIANA, 2000). Also, while working, surveillance can be even more focused on what he does or fails to do. As you know, there are programs that detect even the briefest of moments when your fingers move away from the keyboard. Thus, although the recent labor reform has removed the teleworker from the rules relating to working hours, thus conveying the idea that his activity is not subject to time control, reality points in another direction¹².

Tools and collective struggles

The empirical evidence, in an almost endless number of situations, confirms Marx's (1985) statement that "man", in the act of working, besides changing the nature that is external to him, ends up changing his own nature. The relationship of the subjects of work to the means and objects of work is therefore both objective and subjective. Tools, as we said, are, as a rule, extensions of the human body. The effects of this extension may not cease when a particular work activity ends. Work forms and deforms. Calluses on the hands, muscles, scars and/or dirt in the pores of the skin are temporary, or permanent, tattoos that can reveal the craft of the bearer of these marks. Perhaps, it is the most coherent expression of the term "incorporate", which registers the worker's relationship with certain tools¹³.

The hands that use the tool are also used by it. Little by little, day by day, the pliers that shape the wire shape the man who produces the wire. You can stretch it on one side, bend it on the other. But this does not mean, as we have seen, that the two moldings always obey the prescriptions. On the one hand, the molding on the wire can escape – even minimally – what the company has planned for each small phase of the object's construction. In this case, the worker's hands expresses marks

on what he is making, and the very tool he is using can bend over the years to the weight of his fingers. On the other, the molding on the wire man can also deviate – albeit disguisedly – from what the company planned for its construction. If in the presence of the boss, grease-stained hands hide in the pocket of his overalls, on strike they can show themselves in the form of a fist. Thus, in the same way that Taylorism methods, as we said, we could not appropriate all the tacit knowledge of the workers, Fordist disciplining was not able to completely cool down resistance struggles. Although more contained, they persist – at least in potency.

It is true that the strike – especially since Fordist times – has acquired a contradictory profile: it is rebellion without being revolution. It is also acceptance. After all, what the striker wants, in refusing subordinate work, it is subordinate work itself, albeit under new conditions. This ambiguous character is present even when the strike uses, as a strategy, the factory's own rationality (MARONI, 1982). Thus, stopping the machines does not mean denying them forever – but only for a while. For it will be necessary, as we said, to go back inside the factory, an implicit condition of the strike itself. In other words, the worker needs the elements of the factory even in his struggles – to make them happen. And this necessity not only makes it difficult for the unemployed to strike, but also sets the terms of employee struggles, as well as drawing the boundaries of collective bargaining. Nevertheless, even the strike of the last two centuries – rebellious, but almost always conformist – might, here or there, escape its limits, might see more deeply than it seems into workers' hearts, leaving seeds of a rebellion greater than itself.

Today, more than ever, the oppressed embodies the values, practices, and even the feelings of the oppressor

In this sense, it may be necessary, at the outset, to relativize a little the statement – coined by Giovanni Alves (2011) and repeated a thousand times today – about the existence of a true “capture of the subjectivity” of the worker by the post-Fordist model, or even by the neoliberal system as a whole. Subjectivities have always been captured, since the system has never stopped producing its ideology, contaminating hearts and minds – whether through open discourse, or through the most varied business strategies, from the construction of worker villages to the invention of the uniform, or from the choice of the “standard worker” to the promotion of May 1st parties.

It is true that this process has become more sophisticated and deeper. Today, more than ever, the oppressed embodies the values, practices, and even the feelings of the oppressor. But the phenomenon, so well-studied by Paulo Freire (1996), comes as no surprise. However, in recent times the phenomenon has intensified. And this intensification happens not only as an effect of new techniques of personnel management, but as a byproduct of the cultural – and emotional – revolution that has been with us since at least the Enlightenment, but especially since the 1960s of the 20th centuries.

In fact, today we are much thirstier for equality and freedom; we want to feel light, free and loose, and also empowered. And the company takes advantage of this (BOLTANSKI; CHIAPELLO, 2009), offering us, for example, short-term contracts, supposedly autonomous services, and sometimes even a formal treatment – especially in terms of speech – that can blur the line between appearance and essence, making us forget that we are being exploited.

Perhaps we can say that the ideology of capital today tries to make the worker a kind of clone of his employer, constructing in the plane of facts something similar to the legal figure of “confusion”¹⁴. Thus, it eliminates the Other, at least under the subjective aspect. And in this way it really makes resistance difficult, since there is no way to resist oneself. In this sense, yes, it can be said that the difference with the previous model is not only quantitative, but qualitative. In any case, even this “subjectivity capture” may not be that perfect. As with the appropriation of tacit knowledge, which was not as complete as imagined, it is quite possible that the “capture” was not so profound as to completely erase the possibilities of future resistance – which may be being built in the underground of the present.

In this sense, it is interesting to observe how our ways of living condition and train us for the life of stress that the company demands. And stress not only as an effect of stressful work, but even as a cause – or a condition – for that work to take place in a stressful way.

Even the spirit of competition, a traditional element of the business class, spreads among the workers. And the so-called “labor reform” has been contributing to this, as it does, for example, by encouraging premiums, or by creating divisions in worker protection. If correct, this hypothesis can be compared to the future imagined – both in books and movies and at scientific events – for relations between humans and machines. Having finally learned to think for themselves, they may one day challenge us by pushing the limits set by their creators.

The strike and the computer

The case of the teleworker, working at home, even if tuned to networks, may not weave the same threads of solidarity as the factory environment and the tools themselves. Being at home, in itself, already establishes a differential. Being in my house is different from being in our workshop. Although this “our” does not indicate belonging, in the sense of ownership, it points to a common place, where everyone shares a third or more of their lives, experiencing similar pains and dreams. Nothing prevents people from bonding even without sharing the same environment; but in the case of a union for work, the tools, machines, and the environment as a whole make a lot of difference.

The absence of a physical contact – or at least close, in terms of space – can also make the attunements between the bodies a little difficult, or reduced. In this sense, research shows that even the light touch of a waiter on a client’s arm increases the

number of tips, just as it makes the number of pedestrians willing to stop for a few minutes to answer questionnaires grow (VIANA; NUNES, 2019). Perhaps it is not illusory to believe that this same worker – captured, but at the same time charged with energy and feeling or wanting to feel empowered – will one day go off the rails, in which case he will be using, as a weapon, the very management tool that the company has used to control him.

However, the new tools, especially in the orbit of the internet, open up a thousand and one possibilities for collective struggles, as can be seen in practices ranging from the use of robots to sabotage the company or the occupation of public and private spaces to the various street demonstrations, often with a strong political connotation – such as flash mob, funk music, slam poetry (GOMES, 2013). And these opportunities, of course, are not only open to the teleworker, but to everyone with a computer – or, more accurately, a union with a computer...

Summarized conclusions

In our view, the research made it clear that the relationship between the worker and his tool is much richer and more complex than it seems. An extension of his arm, the tool brings him new experiences and also experiments him – demanding a constant thinking, and also a constant doing, beyond the prescriptions themselves – which does not mean that they are not important, and even indispensable, for the elaboration of any work. In this sense, the research could conclude that in fact it cannot be said that the Taylorism-Fordist system has eliminated the construction of the so-called “tacit knowledge”. They still exist, and certainly will always exist, because there is no way to completely separate hands and brain, feeling and reason. And the tacit knowledge is largely born from the use of the tool.

The tool which is built by man also builds him. And the construction of both he and she is reproduced, to some extent, throughout each workday. The tool could also be seen as one of the many important links that connect workers with each other. In this sense, the common use of the tool helps make the strike possible, and the strike itself, in turn, can be seen as a kind of tool in the construction of rights. Without a common space for the common use of the tool, resistance thus becomes more difficult, as in telework. However, the computer, as well as the new tools created by it, open up new and different perspectives.

Broadly speaking, the hypothesis was confirmed. There is indeed a curious relationship between the tool and the toolmaker in the capitalist factory: he forges it, it forges him; he subjugates it, it subjugates him; it conditions his gestures, but allows him brief, secret freedoms; and as much as it serves to oppress him, he uses it – transformed into machinery – to oppose oppression. Without the pliers, the turquoise, the boiler, the screwdriver, or so many other tools, there is no way to work, which makes non-work paradoxically impossible. Ultimately, the tool both makes and undoes the work and the worker, also affecting resistance struggles.

This possibility appears in some experiments, in factories recovered by workers, in case of they lead not only the production, but the goals of production and the way of organizing that production. In these cases, the production of knowledge of experience can mobilize other social relations, less coercive and crossed by less hierarchical values of educational paths. These experiences of collective pact, as a rule, are linked to immediate needs, when not urgent, to guarantee survival, and end up indicating perspectives that avoid playing workers against workers.

The rich relationship between the worker and his tool brings empirical evidence that technique is never separated from politics, that the epistemological subject is not divorced from the axiological subject. (BARATO, 2008; SENNETT, 2013). Here is a password that is open about the ethical status in the production of labor knowledge. Finally, can we work to improve the world? If knowing how objects are done, as Sennett (2013) would say that already improve the world, mobilizing the expanded understanding of technique, its collective dimension, it can be interesting. This is no mere idealistic aspiration. In addition to the recovered factories, we have examples of the so-called social technologies that, even systematized by the knowledge of the concept, are largely “intellectual domain” of social movements to solve environmental, social and economic problems, as well as cultural expressions.

The ethical perspective of labor knowledge does not contradict the marks of subjectivity with the collective interest. In fact, it is an excellent opportunity to know in order to do and to do in order to serve, in a kind of version of Paulo de Freire’s statement that “nobody teaches anybody, everybody educates themselves in communion”.

Prescription is a necessity of any work process, whether in self-managed enterprises, in craft guilds, or even in enslavement (SANTOS, 2010). However, in the technical division of work, prescription is the supreme hierarchy. Thus, for many workers, escaping the prescription is a form of resistance. In our point of view, any approach to workers’ knowledge should avoid treating them as residue of prescribed work. If the tool and/or the machine tool are a form of prescription, and they usually are, overcoming this type of prescription may require knowing how to use the body, a dexterity with the means of work, with the tool.

This knowledge, as we have seen in the craftsman, in the toolmakers, in the construction of the prototype of the respirator, in Da Vinci, in the examples of the judge and the teleworker, and in the songs are contextualized, have materiality, go through social relations and rely on memory. Therefore, workers’ knowledge is not residual. They think all the time. In Vázquez (1977) there is an appreciation that allows us to take the workers’ practice of observing, experimenting and validating their interventions in the work process itself, and not in calculations, as an expression of the anti-creativity of work: “this prefiguration of the real radically differentiates the activity of man from any other manual activity that could apparently appear with it” (VÁZQUEZ, 1977, p. 190).

However, for ethical reasons, and to avoid any other interpretation, it is important to make it clear that the interest in discussing the relationship between the worker and his means of work does not in any way mean to mythologize his virtuosity or that of his collective, to the detriment of school knowledge. On the other hand, there is an enormous possibility of rethinking school education, whether professional or not, based on knowledge from experience.

This perception that work as a space of ethical values can have profound consequences for thinking about the pedagogical dimension, especially in professional education proposals and/or training with workers, since the consideration/validation of workers with the expressions of their experience and points of view can remind us, or not let us forget, that the false separation between theory and practice made us subordinate the second term to the first, and thus, in an impoverished analysis of practice, not recognizing that it itself, the practice, contains knowledge that will not always have a theoretical correspondence. This understanding does not minimize the importance of theoretical formulations, but it calls for another understanding of the practice, whose effect is the understanding of the subject of the practice and its forms of production, mobilization, and formalization of knowledge.

In the case of the school, which we would not like to leave aside in this reflection, we know that it already has many prescriptions, bibliographic and documentary references, laboratories, and related instruments. Perhaps the space should be widened to incorporate real work, without the concern that practice should “always” be formalized in theoretical form. We emphasize that the practice would not be a unenforceable end of systematization, but that it contains, and is contained, an itinerary of construction of own knowledge that are not contradictory to what is most advanced in science and/or technology, but may have levels of domains that escape it. Knowing how things are done, and why they are done, is at the beginning of contextualized education.

We dare to say that, while the world is not a collection of automatons, understanding the relationship between the worker and his means of work, in a “complicity” that the commodity has not destroyed, or in the deformations that the prescription sometimes imposes, it is a way to see how ethics and aesthetics intertwine at work and how this could support other possibilities of science and technology. Therefore, starting from an educational principle of work to a pedagogical principle of work.

Notes

¹ The name “artífice (craftsman)” is also used in the Portuguese language. However, in several passages in the book, Sennett talks about craftsmanship. Also the title of the book in Spanish is: “El Artesano.”

² It looks like this in the Portuguese edition. In our view, the use of the term “benfeito (benefit)” seems to be a translation problem. The word “benfeito (benefit)” brings us to benefactor, while “bem-feito (well done)” refers to an activity performed with care.

³ Note that we said “decrease”, not “eliminate”, the worker’s interference in the means of work.

⁴ Composed by Totonho and Paulinho Resende (1975).

⁵ Composition by Chico da Silva (1977).

⁶ Both are manufacturing processes that conform a given material to a mold, usually with hardened and hyper polished steel. Such characteristics of the mold are due to the enormous physical effort that these processes cause.

⁷ In a letter, Marx reminds Engels that he had asked him earlier about the selfactor [automatic spinning machine]. He goes on to ask: “In what way did the so-called spinner act before this invention? The selfactor is intelligible to me, but not the previous situation” (MARX; ENGELS, 2020, p. 337).

⁸ To avoid the risk of implying that the technique we mobilized was devoid of school knowledge, analytical geometry, strength of materials, and fluid mechanics were very useful and decisive.

⁹ The patent application was filed on 12/16/2020 for the prototype COMPAS, Cooperação, Mutualismo Pró Saúde, with Protocol BR 10 2020 025685 8. The patent is UFMG’s property. There appears as inventor: Geraldo Márcio Alves dos Santos, Eliezer Borges, Vladimir Damasceno, and Giovane Azevedo.

¹⁰ In Brazil, the impulse for tools came from the policy of nationalization of parts in the mid 1950s. The work process in a tools presents characteristics that do not favor the division of work. The same complexity that makes fragmentation difficult requires toolmakers to mobilize knowledge of many different kinds.

¹¹ Computer aided design. Today, there is an infinity of programs for developing drawings with computer resources. “Artificial intelligence” has a lot of presence in this business. However, Sennett’s observation remains valid, as the toolmakers themselves attest.

¹² It is possible that some judges begin to conclude, through interpretation, that the rule would not apply in case there is, concretely, time control by the company or even when the simple possibility of a control exists.

¹³ As in the risk that Ulysses took in the “Odyssey,” perhaps those who do not carry in their bodies the marks of their time will not be identified by their own.

¹⁴ As when creditor and debtor merge into one person.

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