Critical technological competence in Health

In a near future, hopefully, the practice of operators of Health systems, policies, programs, and services, will require an inter-transdisciplinary, interprofessional, multi-referenced, culturally sensitive, and politically responsible posture that fosters quality with equity. To achieve such an image-objective, which socio-political and vocational profile will define this professional? For their practice to be effective, creative, and able to solve problems, which principles, values, and attitudes will we need to develop and cultivate? Which knowledge, skills, and competences will be minimally necessary?

To answer these questions, we can start with a broader (although superficial) approach to professional education in general.

In medieval universities, the education of subjects occurred through general studies (*studia generali*) comprising two sets of arts that were called liberal arts: *trivium* (logic, grammar, rhetoric) and *quadrivium* (arithmetic, geometry, astronomy, music). In colleges and schools of the modern era, with the emergence of the capitalist mode of production and liberal individualism, the so-called mechanical arts were introduced as practical knowledge, management strategies, and productive techniques, adjusted for a vocational and specialized higher education.

In today's world, globalized, complex and diverse, interconnected, increasingly accelerated, in need of solidarity and sensitivity, we should reflect on the pertinence and, perhaps, necessity of returning, in higher education, to the concept of general education. To achieve this, we can imagine a *pentavium* composed of five general elements: (i) linguistic competence (mastering of the mother tongue and of at least one lingua franca, defined by the area of professional activity; (ii) research qualification (analytical reasoning and interpretability skills to produce knowledge); (iii) cultural sensitivity (empathy and capacity for sensitive hearing, with ethics and respect for human diversity); (iv) pedagogical competence (didactic skills necessary to share knowledge); (v) critical technological competence (deep understanding of the means of practice and their implications).

In the field of Health, to make the *pentavium* idea become more than an allegory, both today's and future professional education must search for a singular academic perspective. With a clear and critical awareness of the social implication of care production processes, new professionals need to understand the logics and mechanisms of the techniques and instruments of their practices, so that they can master application forms of technologies developed for interventions in social, individual, and collective bodies. In addition, they must have the competence of use of healthcare knowledge, practices, and techniques, enabling technological evaluation in its operative aspects, mainly cost-benefit and effectiveness. Ultimately, this is the fundamental competence of applying Health promotion technologies with their maximum level of efficacy, transforming efficacy into efficiency (cost-benefit), concrete effectiveness (with quality-equity), and sustainable transformation. This is the concept I propose to call Critical Technological Competence.

A rapid transition is currently occurring across the world, so fast that it seems impossible to measure the effects of the massiveness of technology on contemporary life. Everyday technologies encompassing highly complex equipment and processes are no longer ruled by the linear logic of value/cost based on matter-time-energy, but by the optimization of potential based on incorporated knowledge. The constitution of the value of commodities is less and

less defined by the products' physical basis (raw material, means of labor, material inputs, etc.), particularly the time used for their production, in a cumulative definition of number of hours of useful work[1].

The limits of human labor continue to be the body's limits, but the limits of automation overcome the physical thresholds of speed, precision and wear[2]. Today, automated processes may still take some physical time, with a return rate that tends to decrease, but it is no longer higher than the time required by human labor. In addition, we must take into account the geometric increase in precision resulting from the automation and miniaturization of measurement instruments and control sensors of the standardization of industrial processes' stages and components. In this context, we can have a robot producing in the limit of its program and, without any problem related to loss of quality, standard, and time delay, it is possible to multiply the units produced by the automated process by twenty, two hundred or two thousand.

A fundamental element of this production process is the knowledge embedded in the hardware of these technologies and also in the servo-control mechanisms in the programming of these machines. The intellectual product configured in chains of algorithms, conventionally called programming, becomes an essential element to a form of value constitution that does not use the same rules of understanding that were valid at the time industrial capitalism emerged. The nature, form, utility, and price of these products cannot be measured by the same standards and parameters of the classic mode of production, either[3].

Let us consider a small digital machine like any cellular phone of the current generation. In the constitution of its value and, consequently, of its price, the cost of the employed material is minimum. The time spent by human labor to manufacture it is very little, and we have to bear in mind that any miniaturized process operates practically out of the reach of human capacity; due to this, it is impossible to be made manually and, therefore, it is automated. What we pay for a device of this type covers, in fact, the intelligence incorporated in it. The digital signal processor that controls the equipment cost very little from the point of view of its materiality. This intelligence and its effects can be reproduced without physical inputs, so that, to each device, the surplus-value is theoretically replicated without costs and wear. In short, this form of adding value to the commodity is totally distinct from the conventional industrial paradigm: first, because, as it is miniaturized, it was manufactured in a process of almost complete automation; second, because the operational system and its applications do not have any materiality[4].

In this contemporary world, where memory has form, code, and dimension, the competence of mastering protocols, standards, and intervention techniques can be potentially fulfilled by automating information memorization processes. The only thing that is necessary is to know how to operate technological mechanisms of access to information. Some of these devices are so cheap (the advance of digital technologies also caused a reduction in costs, associated with an increase in obsolescence) that it no longer makes sense to waste precious storage neurospace to memorize information, nor mental processing neurospace to organize data. At this moment, we are undergoing a strong transition whose effects we do not know because it advances with great speed, intensity, and scope, even bringing an unexpected social component: subjects' inequality of access to the uses and benefits of products derived from this transition[1].

The consequences of these macro- and micro-trends in Health are countless, from emergent pathologies to new ways of dealing with old pathologies. The overwhelming explosion of the social networks, creating avatars and virtual

worlds, has consequences not only over pathological processes, but also over ways of dealing with subjects' health constitution and, in an even more evident way, over the forms of educating intellectual, technological, and managerial operators of these practices.

The main consequence of this issue regarding what interests us is that conventional transmission modes of efficient and problem-solving knowledge, through educational processes based on content and protocols for the development of skills and competences, have become irremediably obsolete. It no longer makes sense, for example, to memorize the names of the anterior and posterior ligaments of the major joints and their insertions or the names of bones' openings - the notorious foramens. Today, this type of knowledge is virtually useless; but the professional education system in the field of Health, in the majority of cases, continues to perform a pedagogy characterized by storage of contents. Instead of developing new forms of understanding models and solving problems, memorization and the learning of fixed intervention contents are still promoted, in a clinical perspective that was consolidated in methodological guidelines at the beginning of the 19th century[5], when the industrial mode of production was still being established. This moment requires another pedagogy, distinct from the one that formed the entire previous generation - our generation.

Principles of programming logic (for example, concepts of coding, algorithm, and correlates) must be part of the competence of new subjects who reach higher education[6]. Obviously, nobody needs to be a great programmer to understand such concepts and apply this understanding to the criticism of technological processes in general. Particularly in the field of Health, this is about the logics of data and information production, service provision, intervention procedures, use of equipment, as well as the very logic of professional education processes. Up to the moment, technological education has not been prioritized in the field of Health; however, some of its sub-fields, such as Neurosciences, Bioinformatics, and Nanotechnology, have advantages over the other higher education segments because their very constitution occurred within this rich interface.

We need to rethink the theme of technology on bases beyond experimental vanguard, which, many times, is limited to mere efficacy in an ideal situation of technological application. In the education of Health professionals, the issue of efficiency in interventions is becoming increasingly crucial and, somehow, it opposes the idea of competence as the capacity to solve concrete problems. Sometimes, there is efficiency to produce effects on health, with some degree of efficacy, but with reduced effectiveness. Time-consuming and labor-intensive modes of care, handcrafted intervention techniques, singular procedures of difficult operationalization, high-cost medicines, all of them can be highly efficacious but not viable in terms of a wider social outreach. We can consider that, in many spheres of life, there are useless competences, competences that know how to do things but are not capable of solving problems effectively. Now, more than before, we have technologies with the potential for solving many health problems that are maintained for economic, social, and political reasons. Ultimately, this is a crucial issue to the Health sciences, analyzed with precision and rigor since the first studies carried out by Ricardo Bruno Gonçalves[7].

In Health and in Education, the strength of social processes is widely recognized, but the synergy of the collective, very disseminated, is, in fact, seldom fulfilled. Teaching and learning models continue to be extremely individualized, which also occurs in the production of care. I believe that the education of Health professionals must include technological competence, more powerful and more critical, not only for utilitarian reasons, but to enable care

practices to have a wider outreach. To achieve this, teamwork is fundamental. The issue of collective production of care is extremely relevant in the education process because, otherwise, we will have the most perverse use of the concept of team: the one grounded on domination. That is, someone who masters a type of knowledge that enables a way of doing that becomes power in the relationship with others. When the diversity of focuses and experiences deriving from interprofessionality is neglected, the impoverishment of the practices is inevitable. Finally, I would also add this theme to the competences necessary to the Health professional: knowing how to do things together.

Although Collective Health promotion has been increasingly viewed as a need and an ideal model, the Health services' practice continues to prioritize the singular professional-patient contact. In this pattern, an entire organizational apparatus, complex and sophisticated, expensive, sustained with public resources, is fulfilled in the guarantee of a constitutional right manifested in the individualization of a given act or process. In the current politically regressive and juridically repressive conjuncture, individualism, as the ideological matrix of liberal capitalism that preaches extreme respect for individual rights, implies alienation of social responsibility, confounded with liberty, through an ideological repression that is so deep that is revealed only when social bonds, broken by inequities, intolerance and violence, manifest themselves as personal domination[8].

I see a large interface between the central issue of this text and the most crucial set of problems in the contexts of Education and Health in contemporary Brazil. At this moment, in the field of Health Education, the greatest challenge will be the recreation of education models to make the concept of Critical Technological Competence, as well as other similar concepts, become an element of transformation of the unfair, unequal, and precarious health reality that affects and afflicts the largest part of the Brazilian society.

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