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TRAINING ENGINEERS IN A MACHINING LABORATORY: KNOWLEDGE, GENDER AND *GAMBIARRA*

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Abstract

This paper discusses the process of training engineers, from observations of a machining course in a Mechanical Engineering program. Data collection and interpretation were subsidized by the history of engineering in Brazil, as well as the sociology of professions. Thus, it was understood how the systematized knowledge of this group is used to indicate internal, hierarchical positions within the profession and in relation to external groups. Data points to a hierarchization based on the opposition between academic training and improvised practices from the factory floor, despite the close relationship of these professionals with such practices. This opposition carries strong, symbolic violence when faced with the gender variable in the process of training these engineers.

ENGINEERING • PROFESSIONAL EDUCATION • SOCIOLOGY • GENDER RELATIONS

FORMANDO ENGENHEIROS EM UM LABORATÓRIO DE USINAGEM: CONHECIMENTO, GÊNERO E GAMBIARRA

Resumo

Este artigo discute o processo de formação de engenheiros a partir de observações de uma disciplina de usinagem em um curso de Engenharia Mecânica. Subsidiaram a coleta de dados e sua interpretação a história da engenharia no Brasil, assim como a sociologia das profissões. Assim, entendeu-se como o conhecimento sistematizado desse grupo é mobilizado para marcar posições hierárquicas internas à profissão e em relação a grupos externos. Os dados apontam para uma hierarquização fundamentada na oposição entre formação acadêmica e práticas improvisadas do chão de fábrica, a despeito da estreita relação desses profissionais com tais práticas. Essa oposição assume contornos de forte violência simbólica quando deparada com a variável gênero no processo de formação desses engenheiros.

ENGENHARIA • FORMAÇÃO PROFISSIONAL • SOCIOLOGIA • RELAÇÕES DE GÊNERO

FORMATION D'INGÉNIEURS DANS UN LABORATOIRE D'USINAGE : SAVOIR, GENRE ET RAFISTOLAGE

Résumé

Cet article traite du processus de formation d'un groupe d'ingénieurs, à partir d'observations réalisées lors d'un laboratoire d'usinage dans un cours de génie mécanique. L'histoire de l'ingénierie au Brésil et la sociologie des professions ont subsidié l´interpretation. Grâce à cela, il a été possible de comprendre comment la connaissance systématisée de ce groupe se mobilise pour marquer les positions hiérarchiques internes, mais aussi par rapport à des groupes externes à la profession. Les données montrent qu'il existe une hiérarchisation basée sur l'opposition entre formation académique et pratiques de rafistolage improvisées en atelier, malgré la relation étroite qu'il y a entre les professionnels et de telles pratiques. Cette opposition prend les contours d'une forte violence symbolique face à la variable de genre dans le processus de formation de ces ingénieurs.

INGÉNIERIE • FORMATION PROFESSIONNELLE • SOCIOLOGIE • RELATIONS DE GENRE

LA FORMACIÓN DE INGENIEROS EN UN LABORATORIO DE MAQUINADO: CONOCIMIENTO, GÉNERO E IMPROVISACIÓN

Resumen

Este artículo discute el proceso de formación de ingenieros a partir de observaciones de una asignatura de maquinado en un curso de Ingeniería Mecánica. Se subsidió la recolección de datos y su interpretación de la historia de la ingeniería en Brasil, así como la sociología de las profesiones. De este modo se entendió como el conocimiento sistematizado de dicho grupo se moviliza para marcar posiciones jerárquicas internas a la profesión y en relación a grupos externos. Los datos señalan una jerarquización fundamentada en la oposición entre formación académica y prácticas improvisadas del piso de fábrica, a pesar de la estrecha relación de estos profesionales con tales prácticas. Esta oposición adquiere contornos de fuerte violencia simbólica cuando se encuentra una variable de género en el proceso de formación de tales ingenieros.

INGENIERÍA • FORMACIÓN PROFESIONAL • SOCIOLOGÍA • RELACIONES DE GÉNERO

THIS ARTICLE IS ABOUT THE ENGINEERING PROFESSION. IT IS AN OLD AND HIGHLY PRESTIGIOUS profession in Brazilian society (DINIZ, 2001; COELHO, 1999; MARINHO, 2015; PATACA, 2018). In order to better understand the reproduction of this status in contemporary society, an analysis of the training of future engineers was carried out. The research was carried out from August 2018 to August 2019, in which a machining discipline was observed in a mechanical engineering course at a university institution.

Machining is part of the large manufacturing area and deals with the roughing of parts by machines or tools to give the desired shape to a final product. It is, therefore, a very practical and fundamental area in mechanical engineering courses. Machining is at the heart of metalworking companies.

The analyzed machining discipline was divided into a theoretical part and a practical part, which was carried out in a laboratory of the institution. Observations were recorded in a field diary after each meeting. Such observations were analyzed and compared with the historical and sociological literature on engineering as a profession in Brazil.

The initial hypothesis was that the difficulties faced by this profession would be reflected in the training of future engineers, as it is closely linked to production. First, due to the difficulties in an economic environment of decreasing the relative weight of national industries in the Gross Domestic Product (GPD) and the increase of their financial, technological and patrimonial dependence in relation to foreign companies since the re-democratization. Second, due to the difficulties of this profession in an economic environment with little tradition of business investments in research and development (CARLOTTO, 2013; GUTIERREZ, 2011; INSTITUTO BRASILEIRO DE GEOGRAFIA ESTATÍSTICA, 2016; FEDERAÇÃO DAS INDÚSTRIAS DO ESTADO DE SÃO PAULO, 2019; BRASIL, 2019). The data, however, exceeded expectations.

The sociology of professions has always emphasized the close relationship between knowledge and professional practice, critically pointing out aspects of closure and interprofessional disputes that define and limit the mobilization of that knowledge in the exercise of the activities of a certain group. Professional knowledge and expertise are fundamental for the effective solution of problems as a factor of status and power of the group.

This research sheds light on this double character of knowledge and on how it is treated at the time of training and socialization of aspirants to a highly prestigious profession in Brazilian society. As a profession inserted and in close contact with the different moments of economic production, one of the difficulties of its members is to work with, on the one hand, a systematic body of codified knowledge (institutionalized in engineering courses) and, on the other, with an experiential knowledge built, as the natives say, on the "factory floor". Based on this tension, the way professionals mobilize and refer to experiential knowledge, to the know-how on the "factory floor", reveals stratification schemes and extra and intraprofessional conflicts. The valuation implied there brings up the theme of gambiarra, traditionally understood in a pejorative way in Brazilian society.

Empirical research has also faced the issue of gender, in what is a traditionally male professional environment. It was observed that this variable sharpens the stratification schemes and conflicts of the profession, inserting an element of characteristic symbolic violence.

The investigation deals only with a specific and very localized case of a professionalizing discipline in a mechanical engineering course, but which brings interesting contributions to the sociological debate about the dynamics of this group and its formation and socialization processes.

PRACTICE AND KNOWLEDGE WHILE FORMING AN ELITIST PROFESSIONAL GROUP

Brazilian civil engineering was born in the imperial period (COELHO, 1999). It is heir to an essentially military engineering thought, concerned with the colonization and defense of Brazilian territory by the construction and planning of strategic fortress cities (PATACA, 2018). The Royal Academy of Artillery, Fortification and Design, in the city of Rio de Janeiro, created in 1792, has been deployed in some of the today's existing engineering training institutions (BRASIL, 2019).

With Independence and the development of an agro-export economy that is more dynamic and open to the world market, the development of the coffee economic complex started a process of industrialization and diversification of national capital (banking and commercial). As a result, engineers stood out as key agents in this process, both in civil society and in political society, as the agro-exporting sectors needed a complex infrastructure to modernize their activities - railway network, telegraph lines, sanitation, water and gas supply and public work in general (MARINHO, 2015).

However, the excessively bookish and encyclopedic training, combined with the lack of practical experience of Brazilian engineers, meant that the first major modernizing ventures in the country were conducted by English engineers (often not graduated). In these construction sites, Brazilian engineers, with their degree rings, were subordinate to English and American practitioners (COELHO, 1999).

The proliferation of enterprises and, as a result, the increased demand for engineering knowledge opened space for national professionals. They then created civil associations (such as the *Clube de Engenharia* and the *Instituto Polytechnico*) and had a strong political presence on the national scene, holding important public positions and directing the *Estrada de Ferro D. Pedro II* (MARINHO, 2015). Both this elite of high-ranking officials (if not heads of executive powers) and the mass of salaried engineers worked mostly as civil servants. Either they effectively commanded public life, or they were responsible for examining contracts, drafting opinions and supervising works, bypassing activities that were considered too "mechanical" (BENCHIMOL, 1992; COELHO, 1999).

As the main professionals to master applied mathematics, the engineers of the time placed themselves as an authority before other social agents in this intense process of modernization of the country (MARINHO, 2015). They even advanced on jurisdictions that, in principle, would belong to medical doctors, such as public hygiene. The association of medical concerns with urbanization projects by engineers has existed since the 17th century (PATACA, 2018). In addition, given the anarchic state of medical theories of the imperial period and a rate of therapeutic efficacy comparable to any of the empirical practices of healers and apothecaries of the time, the training of engineers in the exact and natural sciences guaranteed them greater recognition and legitimacy to work in transformation processes of Brazilian cities, making them cleaner and healthier (COELHO, 1999).

At the end of the 19th century and beginning of the 20th, the professional identity of the engineers was developed around the idea of modernizing the country, for which they demanded recognition. It was a representation of the profession based on ideals of progress and that Brazil owed engineers the possibility of reaching civilization (MARINHO, 2015). With authoritarian habits and aristocratic values, however, these engineers, when promoting modernizing projects, erected monuments to themselves, such as Avenida Central, in Rio de Janeiro at the beginning of the 20th century, before solving the serious water supply problem in the Federal District (COELHO, 1999).

The formation of this professional group in the midst of a conservative modernization agro-export slavery regime implied a particular relationship between professional knowledge and its practice. The historical aversion to manual labor, tainted by slavery, made the elaboration and mobilization of the knowledge of these professions an emblem of their hierarchical position in society. This exacerbated, in professional practice, the valorization of supervisory and command functions in detriment to the execution of practical work and the functions considered more "mechanical". Professional performance was marked by authoritarian and elitist aspects, sustained

by the bookish education of Higher Education at the time and typically expressed in the violence of urban reform in the city of Rio de Janeiro, then the country's capital (SEVCENKO, 2018; BENCHIMOL, 1992; CUKIERMAN, 2007; COELHO, 1999).

The formation of national engineering, in this sense, is the most well-finished expression of how technical-scientific knowledge, theoretically founded on an enlightening rationality, can ally and be associated with archaic practices.

As Oliveira (1994) and Coelho (1999) argue, the 1930 coup was strongly supported by medical groups (health workers) and engineers. These were supporters of national engineering that put issues related to democratic freedoms in the background in favor of national interests, to which their professional knowledge would be able to offer solutions. This authoritarian and corporatist performance would be endorsed during the Vargas era with the creation, by force of the State, of the Regional Councils for Engineering and Agronomy (Crea).

During the military regime, although the market for engineers had expanded enormously with the complexification of the Brazilian industrial park (GUTIERREZ, 2011), there was the preservation of archaic procedures in the high echelon of public administration, which carried out large and strategic projects for technical-scientific and industrial development. There is abundant literature on personalist (marked by the projection of personalities on the projects) and on personhood relationships (criteria for financing and personnel recruitment to carry out the projects, which included friendship and sponsorship by key regime authorities) in the execution of these development projects, for which predominantly physicists and engineers were recruited (FERNANDES, 1990; CARLOTTO, 2013; ANDRADE, 1999).

Despite the undeniable transformations that the country and its professional markets have undergone, fundamental and persistent characteristics of engineering as a profession in Brazil stand out. They unfold into a tension, still operating, between command or supervision and execution or practical activities. The data collected in this research show the reproduction of this fundamental tension. The traditional discredit of activities considered "mechanical" (today referred to by the natives as operational) and the enhancement of supervisory and command functions are a fundamental conflict in the training of engineers, since their profession is inextricably linked to practical activities and to the development of applied knowledge. More than that, with the data collected and analyzed in this research, it can be observed that even gender inequalities in the training of engineers and their associated historical symbolic violence (CASAGRANDE; SOUZA, 2017; LOMBARDI, 2006) are expressed in this fundamental conflict, sharpening it. Thus, it is necessary to understand sociological aspects of the relationship between knowledge and professional practice.

SOCIOLOGY OF ENGINEERING AS A PROFESSION: CODED KNOWLEDGE, CERTIFICATION AND *GAMBIARRA*

The fundamental difference between profession and occupation is that the former has theoretical knowledge as an important resource for later application in their activities. Occupations, in general, control techniques and procedures, and, therefore, remain hostage to any technological change in society (ABBOTT, 1988; FREIDSON, 2009).

The constitution of a profession requires specific training, with a systematic theoretical reference that shapes a professional culture. At the same time, it is common to speak of expertise, which, as a reliable and stable activity, is institutionalized. In general, expertise is inseparable from forms of professional accreditation and certification in Higher Education institutions, which test it in exams (FREIDSON, 1998; DINIZ, 2001; RODRIGUES, 2002).

Expertise and its forms of accreditation, therefore, are sources of professional authority. They confer relative autonomy to members of a group at work because of their knowledge's complex nature and its difficult access to laypeople. This strengthens the capacity for self-regulation,

inspection and definition of professional performance criteria with little external interference. According to Diniz (2001), accreditation is a prerequisite for professional practice, enabling social closure and the monopolization of a service. Thus, privileges are maintained and the necessary qualification of who can exercise a certain activity is controlled.

For Abbott (1988), the elaboration and systematization of the abstract knowledge of each profession is a fundamental resource in disputes between professions, between professions and related or subordinate occupations and even internally between strata of the same professional group. Professional knowledge, according to the author, is important to ensure the hierarchical position of the group, which can then delegate operational and routine activities to less prestigious occupations or less qualified technicians (such as the relationship between engineers and factory workers, doctors and nurses, judges and court technicians, etc.). This hierarchy is, therefore, a general phenomenon and is linked to what, within the professional group, is considered creative and intelligent work as opposed to routine and repetitive work.

In addition, an abstract and codified body of knowledge guarantees the survival of the profession, as it allows it to adapt to different historical contexts and concrete circumstances. Through it, the professions identify situations that can be the object of their attention and performance. In this sense, says Abbott (1988), these groups build socially relevant problems, convincing society that a certain natural or social phenomenon can be addressed based on their analytical categories and their intervention and therapeutic instruments, all duly and consistently aligned with the professional conceptual system.

However, if a profession, within its jurisdiction, encounters situations for which it is still unable to make the appropriate inferences based on its coded knowledge, it uses stopgaps. They are ad hoc solutions, which solve a problem without a theoretical and systematic understanding of the issue. A profession that relies excessively on this type of solution can be perceived with suspicion, as it does not present a coherent argumentative line that supports its professional practice, making it, on the contrary, evident that the solutions are casuistic and based on trial and error (ABBOTT, 1988).

In Brazil, it is common to talk about *gambiarra*. Solutions, adaptations, adjustments, improvised amendments, aiming at the provisional or, sometimes, definitive resolution of a problem, usually associated with *malandragem* (trickery) and the *jeitinho brasileiro* (Brazilian way). There is, therefore, a devaluation of what is culturally understood by *gambiarra* in Brazil (BOUFLEUR, 2006).

As Boufleur (2006) rightly points out, if, on the one hand, gambiarra and improvisation are associated with the lack of a technical and scientific understanding of a certain issue, on the other hand, they also concern experiential knowledge, an accumulated and uncoded know-how of certain social agents. *Gambiarra* refers, in this sense, to the solution of problems by historically incorporated knowledge. And thus one can glimpse the ambiguity of the phenomenon for professional groups; for if the main internal hierarchy is associated with the opposition between creative work and repetitive work, *gambiarra* is evidently of the first type.

That is why Boufleur (2006) speaks of moments of freedom in the relations of production and consumption through improvisation. In the context of consumption, individuals and groups bypass the technical dictates imposed by the productive process and industrialized design with *gambiarra*, with which they imprint their own expressiveness in these standardized products. In the scope of production, unpredictability also supports the practice of *gambiarras* or improvisations. The search for suitable solutions in an industry may require that they be based on the experience and know-how of employees engaged and accustomed to facing unusual situations, having to overcome deadlocks that were not foreseen at the time of planning.

This is very clear in the analysis of Pereira, Mendes and Moraes (2017), which shows how improvised solutions (since dealing with factors unpremeditated by the planning phase) in a metalworking company were all the more appropriate and creative when there was communication and knowledge and experiences sharing among company workers.

Gambiarra or improvisation can be associated with creative practices and, therefore, not routine or repetitive ones. Although they are practices related to operational activities and not based on a codified body of knowledge, they are within the scope of what requires intelligent work.

Abbott (1988) argues that this polarization is sustained by a certain elitism in the academic sectors of a profession in general. In the context of the systematization of knowledge, the imperfections and unpredictability of professional practice are not dealt with. Developing and systematizing a body of knowledge often results in a more well-finished and closed work, something unsustainable in professional empirical practice. Many strata, then, prefer the academic dimension to the practical dimension of their profession.

In the following section what has just been argued are observed and mobilized for the interpretation of the collected empirical material.

OBSERVING A MACHINING DISCIPLINE

TEACHER'S PROFILE

There were three teachers responsible for conducting the machining discipline object of this investigation, hereinafter referred to as Professor A, Professor B and Professor C. During the observations, after three weeks of class, Professor A had a maternity leave. After a few weeks without class, Professors B and C replaced her in the theoretical and practical part of the discipline respectively. After two weeks of meetings, the teachers decided to exchange classes with each other to better adapt to the needs of the subject and the students. This dissociation between theory and practice in the discipline's organization, divided between two distinct teachers, seemed, in itself, significant.

Professor A graduated in Mechanical Engineering and had Masters and PhD degrees from the Technological Institute of Aeronautics (ITA) in mechanical aeronautical manufacturing area. In class she showed a lot of experience in design and manufacturing. Professor B had a degree in Mechanical Engineering, with an emphasis on fluid mechanics, specializing in automation and control of industrial processes, and attended, while teaching classes, a master's degree in Materials Science and Engineering from the Federal Technological University of Paraná (UTFPR). Professor C also graduated in Mechanical Engineering and had a Masters and PhD degrees in the manufacturing area with an emphasis on machining from Federal University of Uberlândia (UFU).

These teacher changes made it possible to observe different perspectives in the same semester. All of them had basic training in Mechanical Engineering, being, therefore, specialists in the area, despite relatively different research areas and trajectories, which enriched the material. The three teachers have a curriculum dedicated to research to the detriment of pedagogical training, something common and frequent in teaching in Engineering (MOLISANI, 2017).

The teacher-engineer, generally, exhibits a lack of interest in didactic training, which he does not have in his initial degree (RAMMAZZINA FILHO; BATISTA; LORENCINI, 2014). Thus, the didactic-pedagogical competence is the result of a naturalization process, which refers to the maintenance of cultural reproduction, that is, one teaches from his experience as a student, based on his former teachers (CUNHA, 2006; NITSCH; BAZZO; TOZZI, 2004).

STUDENTS PROFILE

Students, thanks to the ease of running for the vacancy by the National High School Examination (Enem), come from several different states. As the course is in the interior and north of Paraná, close to the state of São Paulo, many come from this state. The fact that São Paulo is a populous state and has a more accentuated industrial development have consolidated mechanical engineering as a highly demanded degree.

Of the 44 students, only two were women, and one dropped out during the semester, including evading the course and the institution. When presenting themselves in the Machining discipline, eight of the students mentioned having taken a technical course, and five mentioned having a family business in the area of mechanics.

THE MACHINING DISCIPLINE'S MEETINGS

As mentioned, the discipline was divided between theoretical and practical classes. The theoretical classes were mostly expository, the teachers being the protagonists of those moments. The classroom was of a traditional model, with desks, whiteboards and a projector, which was used sometimes by the teachers to present slides and videos. As the subject includes most of the basic manufacturing methods, and these require a wide variety of machines that the institution did not have, students' contact with them was indirect, through bibliographic research and materials available on the internet. Thus, the contents related to drilling, milling, grinding, widening, broaching, honing, threading, boring and EDM were assimilated. The teachers passed on videos that dealt with the state of the art in thinning processes, production of pieces with a high degree of perfection, among other topics.

In the laboratory, the teachers took part only in the first classes, to introduce the machines and explain their safety and cleaning rules. After this initial period, the meetings were for students to carry out practical projects. In the laboratory there were five small lathes, two medium lathes and two large lathes. The cutter, although available, was not used during the course.

In the following, observed situations throughout the course will be exposed based on constructed categories, presented in the subtitles, which served to analyze the collected data. These are situations that express the relationships identified by the literature and that were discussed previously, enriching the understanding that one has about this profession in Brazil.

GENDER AND HIERARCHY IN THE CLASSROOM

Professor A was known at the institution, even before the beginning of the discipline, for her postgraduate studies at ITA, an institute recognized in the field of Mechanical Engineering as a highly prestigious institution.

It was interesting to see how she, from her status, "dominated the classroom". When she called the attention of students, she did it in a ironic way, in addition to giving examples of her experience in graduate school (always emphasized). In the first meeting, she played with the difference between sticking one's finger in his nose to take a "snot", which one of the students was doing at the time, and the activity of taking material from a part using machines and tools, which constitutes machining.

In another meeting, with the arrival of a late student, Professor A did not spare the jokes, exposing to everyone that the student had already done the discipline before and had not passed. The evident intention to embarrass was instrumentalized by the teacher to maintain the students' attention and submission in a typically male environment.

The facts observed during the course show the relationships of violence discussed by Casagrande and Souza (2017). Professor A, having reached this unlikely position and status in the Brazilian engineering world, reverses the relationships of violence that marked, in an institutionalized way, her training and work experiences as a strategy to ensure her position in front of students.

GENDER AND HIERARCHY FOR PROFESSIONAL EXERCISE

In order to expose the reality of the industries, Professor A showed videos of an automotive parts factory with heavy presses that generate a lot of vibration, rustic and dirty machines, hot and unhealthy places. As the video went on, she described the environments, from her own experience, as a "real hell" with a lot of heat and noise.

For the teacher, the lack of wholesome activities in these environments justified the fact that the work in these places should be performed by people serving prison sentences in the Brazilian prison system. For the "prisoners", according to the teacher, there should be no choice between working there or not. It should be "this, or nothing".

At this moment, the hierarchical relationship is well demarcated, and the delegation of operational activities to strata and groups with low status in society is evident. The position of the professional, formed by ITA and a teacher in a Mechanical Engineering course, distances herself from these environments considered degrading, unworthy and even inhuman – the symbolic reference to a hypothetical non-human underworld leaves no doubt.

There is nothing in these environments that comes close to what is, for this professional, Engineering, its procedures, techniques and knowledge. The social distance is the greatest possible: individuals condemned to serve sentences in the prison system should be responsible for these places.

It is noteworthy that, although degrading and inhumane, these environments are inescapable for a profession that deals with productive sectors. In this report, however, there is a discrepancy, in which engineering, of high prestige and referred to as a complex and well systematized knowledge, relates to those environments in a radically alienated manner. In the statements mentioned, this appears as a relationship between what is and what is not considered socially accepted (whether or not serving a sentence in the prison system) and even what is and what is not human (in this case, "hellish").

There are two issues at stake. First, the radical nature of this discrepancy refers to the archaic characters of Brazilian sociability. Professional prestige defines not only a social classification based on the performance of different skills and activities, but a separation between what is socially accepted (or acceptable) and what is not.

The second issue, which reinforces the first, is the violence related to the gender issues involved and discussed earlier. Professor A, in reaching a high position in the professional hierarchy, a socially prohibited place for women, reproduces the violence she suffered and suffers in an inverted and symmetrical way. If women are treated as non-subjects for this position that she now occupies, the most degrading jobs in factories should, in her view, be occupied by people who are socially the most disqualified, and who, therefore, should not have their will respected.

HIERARCHIZATION IN THE LABOR MARKET AND *GAMBIARRA*

Engineering is a profession that is closely linked to production, which, as Gutierrez (2011) says, gives it specific characteristics and difficulties. Despite being based on a codified and systematic knowledge, this proximity to the dynamics of the factories and to the productive environment in general, often puts in check their social status. One sees clues of that when a factory floor is considered "hellish".

Market demands, for example, constantly strain the profession. In the class on tools and their materials, Professor C talks about the real possibility of making a tool that will never wear out. He says, however, that no company could produce such a tool, as the company depends on the sales and renewal of expired or broken tools. The utility interest of the company outweighs the professional commitment of mechanical engineering, which ideally would decide for the most durable tool. The professor does not speak for or against this issue, he simply informs the students that this will be the reality that they will face in the market when they graduate as engineers.

But there is not always a complacent acceptance of labor market conditions. The profession thus experiences an ambiguity of being constitutively linked to production and, at the same time, seeking to distance itself socially.

Professor A, at a certain time of the course, talks about working in smaller companies. They have a harder time maintaining quality standards and adapting to the required standards. She then discusses the reality of some of the companies she worked for. In them, not all measurement

equipment is calibrated according to national and international standards. According to her report, in these companies the tools are calibrated in sight, and those not calibrated, hidden during inspections by the National Institute of Metrology, Quality and Technology (Inmetro).

In this case, the technical knowledge to solve a problem or to execute a process considered correct and adequate is not recognized or valued. The work is performed in a precarious way, because it is cheaper and simpler. In the teacher's speech, it is for this reason that low quality products proliferate in the national market.

This demarcation between coded knowledge of the engineer (of positive value) and the practical reality of the factories (of negative value) also appeared in Professor C.'s classes. The way he conceived the activity of the engineer was to apply, in the factory, everything that is learned in the university, being the main responsibility of this professional to supervise the factory activities. Therefore, the engineer would need to know the technique to its limit, as this would serve as a guarantee against workers who tried to deceive supervisors by working at slower rates. The engineer must be able to diagnose when a low productivity problem is human. If, for example, this happened to a machine that supports high speeds, it would be underutilized. There is only one exception to this disimbodied application of the engineer's knowledge: one should not put excessive pressure on employees, as this would not make them meet deadlines and work satisfactorily.

In the same spirit, Professor C recommends studying the subject a lot, because, for him, "the level of the engineer is high", and machining is a very comprehensive and important subject for the industry. As it is a professional subject, it puts into practice all the knowledge of physics, chemistry and materials that were seen in the basic cycle of the course. This was reiterated, at various times, by the three professors when referring to the high expectations around Mechanical Engineering. A clear process of inculcating hierarchical classification schemes among students.

It is noted that engineering polarizes not only with the worker, subordinate in the hierarchy of the factories, but also with the entrepreneurs themselves, who do not pay attention to the precision, rigor and systematic nature of engineering knowledge and technique. The latter would move away from improvisation, from trickery, from "jeitinho", in short, from gambiarra. Engineering would be responsible for the norm, protocol, quality, technical rigor and systematic knowledge. The factory floor, workers and small business owners are responsible for the know-how that leads to low productivity of the industry and to the poor quality products on the market.

Gambiarra, improvisation, *in situ* solutions that require the handling of non-codified know-how go against academic training, and this, as said in the classroom, must be mobilized against the attempts of deception practiced by the workers. It is interesting to note that these attempts of deception are also attempts to expand their margin of freedom, insofar as the workers, in the hypothetical case described by Professor C, would try to impose their own rhythm of work to the production line.

Teachers' statements, however, explicit the polarization and place themselves as contrary to the non-professional practices of the factory floor. Academic knowledge, in fact, must be mobilized in this sense, for the benefit of engineers in their relationship against workers and small entrepreneurs. The interest in the hierarchy and maintenance of the profession's high prestige is evident. This encodes social distances, which are passed on to students as a standard of their future profession.

These hierarchical schemes, however, generate ambiguity throughout the discipline. At various times, teachers emphasize the need for practical use of knowledge by students. For Professor A, the engineer always works in the "bottlenecks" to optimize the production of the factories – exactly what the experienced workers in the study by Pereira, Mendes and Moraes (2017) do. Therefore, they must pay attention to the production process and identify such bottlenecks in the factory's daily routine.

Professor C, as a didactic strategy, frequently questioned how to solve problems in hypothetical situations. He always tried to place students on the factory floor with some objective and a problem to solve. In one of those moments, he said that the practice of machining is learned more on the "factory floor" than in a "library".

The ambiguous relationship with experiential knowledge is evident. The need to inculcate hierarchy schemes among students, in which engineers must occupy positions of command and supervision, goes against the reality of this professional's performance. The first need reinforces the importance and value of abstract and codified knowledge, legitimizing the years and the rigor of studies. The second aspect, that of the reality of practical action, often places engineers in positions leveled with operators and small businessmen, whose performance depends a lot on an acquired experience.

CONTROL AND AUTHORITY IN A (EDUCATIONAL) PRODUCTION LINE

With Professor C, it was common not to tolerate delays, even those of few minutes. One day, as it was raining heavily, a student arrived ten minutes late in the classroom, in wet suits, while the teacher was calling the students list. At the end of the call, the student asked the teacher to consider his arrival in the classroom, to which he responded negatively, and said: "I don't want to hear any explanations".

According to this professor, the engineer also has to be prepared for this when at work, because "a production cannot stop", and, therefore, delays would be unacceptable.

In another situation, Professor C moved a sleepy student to the front of the classroom, after which everybody began to hear lessons on how to be a good student and their duties to the teacher and the subject of the course.

It was repeatedly warned in the classroom that, in the work of the mechanical engineer, the precision and expertise of the measurements are of great importance for the proper execution of his work. That the error in measures or actions taken at the factory can directly result in the dismissal of the professional. The teacher encouraged students to imagine being in a factory whose boss ordered something that was not known because, at the time of their formation, "you didn't pay attention in class". The engineer, in this case, would have failed with the profession.

The constant demands always pointed to the overlap between the school-university environment and the factory environment. The meetings of the discipline were conducted as a kind of simulation of the factory environment, and a constant reference in that environment was the "boss", who threatened his subordinates with the possibility of immediate dismissal. Paying attention in the classroom was imperative, as the dismissal would be certain in case "bullshit" was made, like breaking a tool or losing as instrument.

This speech resonates the discussion in Areosa and Dwyer (2010) about the blaming of subordinate workers hierarchically in a company for work accidents – the so-called "human error". An ideology of power that neglects all social relations that lead to accidents. An argument that meets this article's discussion in sociology of professions regarding the demarcation of hierarchies that is exercised through professional knowledge.

Another figure always present in the hypothetical situations narrated by Professor C was the trainee. According to him, this was the beginning of the engineering career in a factory. The work environment was always imagined as something hostile, in which the intern is not well payed and can be fired at any time. This was systematically instilled in the students. After a few meetings, the students, on their own, reproduced the statement that any mistake in the production line would result in dismissal.

When Professor C cited as an example a breakdown or failure in the production of an engine block and its technical consequences, which could happen if the work was done in a "sloppy" way, a student immediately said that, in this case, the consequence, in addition to others, would be the dismissal of the operator, as it would be a great loss for the company. At this moment, the teacher compromised and said that it is not always the fault of the operator, but it could be the engineer who planned the process.

It is interesting how, in the student's speech, the hierarchy scheme and socialization are mixed in this environment that presents itself as, at the same time, factory and school. The teacher, at the end, paid attention to a certain sense of responsibility that the engineer must have as a supervisor and planner of a production line.

FINAL CONSIDERATIONS

It is noticed, in the constitution of the profession of mechanical engineer, rigid hierarchical schemes, symbolic violence in general and, more intensely, in gender relations. Students are inculcated with these classificatory schemes, and they are taught to reproduce them once formed.

At first, the arbitrariness and violence with which these asymmetric schemes are inculcated has to do with the ambiguity inherent in the profession, which, despite having high prestige in society, faces the factory floor and operational issues in its jurisdiction. The group's effort to preserve its status is, in this sense, intense and arbitrary. The social distance that one wants to establish from operators and small entrepreneurs, averse to formal knowledge and the protocols of the profession, is arbitrary and dissonant with their practical reality, which requires attention and the construction of know-how based on everyday experience, such as teachers themselves later recognize.

But the intensity of the arbitrariness and the violence imposed are related to the history of the profession in the country. From a manorial past, Brazilian society seems to hold higher education diplomas as social status insignia much more than certification of institutionalized expertise. This reinforces the aspect of closing the market by the certifications dealt with in the literature of sociology of professions. Something common to all reality of the professions, but that here it acquires a character of dehumanization even.

In this last aspect, the consequences that the historical patriarchal relations of Brazilian society have for the formation of professions and their markets are evident. It is perceived as urgent the need to discuss the processes of training engineers in the country, especially in relation to the gender issues involved. Despite this theme appearing in the new Engineering Curriculum Guidelines (BRASIL, 2019), it is empirically perceived how far one is from an egalitarian formation and, in this sense, more attentive to the issues that are posed for the modernization and trans-nationalization of the labor market.

Furthermore, the ambiguities and arbitrariness involved in the process of training engineers are an obstacle to intentions to qualify professionals for contemporary challenges. The ability to appropriate and generate an environment of rapid technological changes, which, in fact, calls into question many of the activities now performed by these same professionals, is impaired if a good part of the efforts to train engineers are focused on preserving professional status.

The most interesting thing is that this effort to preserve status occurs under the idea of systematic dedication to the disciplines. Criticizing this reality, therefore, is not easy, since the most particular and corporate aspects of professional training are hidden behind its most characteristic and internally valued element, that is, codified and institutionally endorsed professional knowledge.

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