

Year VII, v.1 2026 | Submission: 02/06/2026 | Accepted: 05/06/2026 | Publication: 08/06/2026

## The Cognitive Representation of Science, Technology, and Innovation by Graduate Students Graduation from the University of Brasília

*The Cognitive Representation of Science, Technology, and Innovation of Graduate Students at the University of Brasília*

The Cognitive Representation of Science, Technology and Innovation of Students of Postgraduate at the University of Brasília

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**Abstract:** This essay aims to understand the perception of graduate students at the University of Brasília (UnB) living in the University Student Residence - Graduate Student (CEU-POS/UnB) regarding science, technology, and innovation at the local and national levels, as well as how these valuations impact their professional life projects. Therefore, it intends to emphasize both the structural properties of the Science and Technology Policy (STP) and the culture of the Brazilian scientific community. On another level, it will describe the perception of these young students, which will not be interpreted merely as a valuation of the present, but will attempt to describe these subjectivities as life projects that reveal their reflective capacities in conducting the actions necessary for their professional life project and the "pursuit of the good life," that is, that respond to the influence of the established scientific structure and ethos. This essay consists of a pilot (exploratory) case study that uses, as data collection methods, the application of a questionnaire (survey) and participant observation.

**Keywords:** Science and Technology Policy (STP). Individual representation. Young researchers. Agency and reflexivity.

### Introduction

Social thinkers in the field of science and technology have focused their research on analysis of the development and implementation of specific policies in this area and in understanding of the behavior of scientists as a scientific community. On the one hand, they analyze laws, rules and guidelines; on the other hand, they evaluate the behavior of the scientific and research community, both internally and in its relationship with society and its various actors (DIAS, 2011, pp. 324 and 325).

Based on the interpretation of Latin American authors in science and technology. (CARLOTTO, 2013; DAGNINO, 2007; SCHWARTZMAN, 1979), I intend in this essay to do a dense description – that is, an objective description and a value-laden interpretation. concomitant (GEERTZ, 2008) – of the insertion of young postgraduate students into the community scientific/researcher, understanding their individual representations of the relational sphere scientific and how these young postgraduate students organize their professional life project. starting from the intuitive intersection they have of academic training and the job market. specialized.

The unit of analysis in this essay consists of young students pursuing a master's degree. and doctoral studies at the University of Brasília and live in the Graduate Student Residence of the

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UnB. The age range of the group under analysis varies from 23 to 51 years. Because it is an exploratory study, I will not make any distinction between students based on their area of knowledge, although I have awareness of the need for classification to better understand the constituent aspects of the case in question.

Data collection was carried out using two techniques: the application of a questionnaire<sup>1</sup> (survey) and participant observation. Because he is a resident of the Postgraduate Student Residence and To gain at least a basic understanding of the subjects in the primary unit of analysis, I made use of the moments of Leisure and relaxation to record expressions of anxieties, frustrations, and life plans. professional, which commonly occurs in these conversations and reveals the dramas of the area of knowledge to which the student belongs and how these structuring factors are considered in the act of individual action in the professional life project.

This essay is divided as follows: in the first part, I will give a brief review of Bibliography on science and technology policy (STP), listing the main interpretations. Regarding innovation and technology in Brazil, this structural aspect is important for interpretation. microsocial representations, which I will discuss later. In the second part, I will describe the representations. I will discuss the individual accounts of graduate students and elaborate on the hypothesis that their reports are... considered practical sociological reasoning (GARFINKEL, 2018, p. 93), as they align with the structural considerations of thinkers in the field of science and technology regarding a disconnect between the research community and the productive sector, this separation being one variable of the difficulty of the country's socioeconomic development. But, in my analysis microsocial and biographical, this translates into the difficulty young postgraduate students have in having a professional career as researchers and even the dramatic fear of not being able to exercise their profession, due to the market's difficulty in absorbing skilled labor. In the third And in the last part, I speculate on the relationships of mutual influence between the scientific and economic spheres. to enrich, at least minimally, the interpretation of community autonomy. Brazilian scientist/researcher and the difficulty of promoting technological innovation in the sector. Brazilian productive.

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<sup>1</sup> The Likert scale, part 2 of the questionnaire, was taken from Carlotto's dissertation (2008). Access the questionnaire: <https://forms.gle/wd6y3WSncXBG3Dc98>.

## Structural Aspects of Science and Technology Policy in Contemporary Brazil

Science and technology policies constitute a field of sociological study that encompasses structural aspects of the relationship between the State, science, and economic production. In other words, this field of study researches the ways in which states, through Public policies promote and translate social knowledge into technological innovation, with the intention of impacting industrial production, using progress as the justification. development of countries. This term, science and technology policy (STP), originates in first half of the 20th century.

The relationship between science, technology, and economics takes on institutional dimensions after the During World War II, the State encouraged closer ties between these spheres by creating civil laws, statutory rules and regulatory guidelines that govern relations between scientific and economic institutions. State intervention is the recognition of the role of Science and technology played a crucial role in the Allied victory in the war, and from this, the term politics emerged. Science and Technology Development (SCD) and National Innovation Systems (NIS), making science and technology more accessible to all. Technology is an important variable for the progress and economic development of countries. central (BAGATTOLLI; DIAS; SERAVIN, 2018).

In Brazil, the emergence of the PCT and, later, the SNI, is a result of economic strangulation caused by the imbalance in the trade balance between the values of primary products exported and manufactured goods imported in the years of 1950. Given this situation, the Brazilian state was pressured to consider industrialization. Nationally, unlike developed countries, Brazil did not have a scientific community consolidated; the specialization of scientists themselves took place in other countries. One of the first The measures taken by the Brazilian State were to strengthen the scientific community and enable the emergence of industries in the national territory.

The role of the Brazilian state has gone beyond the regulatory function present in other countries. central, becoming the demiurge of the scientific and industrial spheres, having to intervene several times. through policies that encourage action and foster closer ties between the scientific community and the sector. Productive – I will elaborate on this topic later.

In this way, in the 1950s, the Brazilian State established a policy with the The goal was to promote the rapid industrialization of the country; to this end, it made the economy more flexible. national, with the intention of attracting foreign capital and the arrival of foreign companies. Another

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The measure was to import foreign technology to meet the demand of the national industry at that stage. from its infancy, since the scientific community was still in its early stages.

Regarding the training of scientific human resources, already during the military period, in the years of In 1960, there was a strong investment in the training of scientists nationwide, which resulted in strengthening the Brazilian scientific community and its autonomy to train its own members. The model of scientific training in central countries, geared towards meeting specific demands, was then superseded. The formation of the scientific community and its autonomy<sup>1</sup> They became known as the policy of supply and demand (DAGNINO; THOMAS; DAVYT, 1996, p. 22).

In the period from 1960 to 1970, Dagnino et al. (1996, p. 23) affirm the perverse contradiction. between technology transfer and supply-side policies, because they are mutually exclusive and because they do not generating a feedback mechanism, leaving local scientists and their technologies idle, since both domestic and foreign industries opted for importing ready technologies. Amid this unpredictability, the military government intervened with the linkage policies, in 1980, which aimed to promote interaction between universities and companies in the productive sector, in a model strongly inspired by National Innovation Systems (NIS) (CARLOTTO, 2013, p. 90).

The linking policies between universities and the productive sector were restricted to some areas considered strategic to national interests. The main function of The policy of linking scientific knowledge aimed to create industrial demand capable of absorbing scientific knowledge. and technological development of Brazilian universities. To this end, key sectors were chosen to be linked. The other sectors not directly covered would be affected by the effect of stimulus overflow.

The difficulty in integrating national science and technology with the productive sector, Currently, it remains with the same dilemmas as in the mid-20th century. On one hand, a On the other hand, there is a university supply that cannot be absorbed by the productive sector; industries that "prefer to import technology packages or acquire obsolete technologies from

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<sup>1</sup> When the military government promoted the strengthening of the Brazilian scientific community within the framework of the Brazilian Plan for Scientific and Technological Development (PBDCT), the meaning of autonomy was associated with the training process of scientists and the development of basic science, without the need to train scientists in other countries. Currently, university autonomy is associated with administration and political decision-making. Between 1975 and 1977, the military government invested approximately US\$ 2.5 billion in the PBDCT (BAGATTOLLI; DIAS; SERAVIN, 2018, p. 354). The model for training the Brazilian scientific community was partly inspired by the "non-interventionist" (or supply-oriented) scientific policies expressed in Vannevar Bush's report, *Science, the Endless Frontier* (CARLOTTO, 2013, pp. 62 and 65).

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multinational companies." That is, a relatively cheaper and less risky practice than the development of proprietary technology" (BAGATTOLLI; DIAS; SERAVIN, 2018, p. 363).

From the perspective of the scientist-researcher's social interactions, this structural arrangement The Brazilian science, technology, and market landscape imposes serious limitations on the exercise of its... profession, especially for young postgraduate students. Up to this point, I have talked about what is objective in science. and in Brazilian technology; from here on, I will describe the response to the influence of this structure, taking as a case the subjectivity of young postgraduate students who reveal their biographical contexts and the subjective concerns of an objectivity that is not always grasped in its entirety – as outlined in this topic – but which, intuitively, relate to to science and technology policies.

Undoubtedly, young scientists have been concerned with their life plans for a long time. I remember Max Weber's famous lecture, given in 1917 to young university students. Germans, entitled "*Science as a Vocation*". Weber warns him about the existential uncertainty of The practice of science: in science, vocation alone is insufficient, there is "nothing to do with it." in a way that gives him the certainty that one day the possibility will open up for him to occupy a position that will allow him will provide means to live decently" (WEBER, 2001, p. 26).

### **From structure to social interactions: contexts, concerns, and reflexivity in life. professional development of young students at Ceu-Pos/UnB**

The young person's experience at university allows them to learn, in practice, the limits and the potential of the academic environment. Although young people do not use the technical language of Sociology, the practical knowledge externalized in conversations about life projects. The professional profile reveals the structure of science and technology in which they are embedded as subjects. It is precisely in the individual narrative of the postgraduate students residing at CEU-POS/UnB where I will describe the main obstacles facing Brazilian science and technology, previously mentioned from a structural perspective, but now on an individual scale. I will also highlight moments in which these young people overcome or succumb to limitations. structural frameworks of science and technology, from which they construct their representations of science.

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and Brazilian technology, important for guiding and developing a life plan<sup>1</sup>. But, before proceeding, I will provide some important descriptions to contextualize this case.

The University Postgraduate Student Residence of the University of Brasília (CEU-CEU-POS/UnB) was founded in the 1990s. Located on the Darcy Ribeiro campus, CEU-POS/UnB is a 3-story building with 18 apartments, intended for master's and doctoral students originating from other Brazilian states and other countries. Each apartment was designed for 4 residents. Each apartment is exclusively occupied by the same sex, that is, there are 9 apartments for women and 9 for men.

Despite the building's structure being deteriorated due to a lack of physical renovations, the demand for the number of students competing in the selection process for new resident positions has been higher than the number of places offered. CEU-POS/UnB offers certain advantages to students, residents, whether due to its location within the university or the savings on rent, because, in Brasília, rents are extremely expensive.

### **Concerns, projects, and micropolitics of students in the science and technology landscape. Brazilian**

An interesting finding from the questionnaire answered by graduate students is that almost everyone considers the private sector to offer the best job opportunities; however, most students want to work in the public sector. Six students responded that their area of expertise is... Knowledge leads to greater employability in the private sector, but personal professional development is... to work in the public sector. When questioned about this "incongruity," the justification is that the public sector offers "stability," "financial growth," and "security."

When these six students were asked about the specific area in which they intend to work in the public sector, the answer was unanimous: "in higher education teaching." The role of researcher, strictly speaking, is not among his priority intentions. Among these students is Jorge, Jorge, 30 years old, is currently pursuing a doctorate in ecology (biology). He believes it is difficult to pursue research and teaching simultaneously and believes that dedicating oneself to it is a vocation. research under the conditions offered by Brazilian universities, in which a large part of the time is spent on teaching. Even so, Jorge wants to be a professor at a public university.

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<sup>1</sup> When discussing concerns, life plans, and the pursuit of a good life, I am drawing on Archer (2016). When discussing the choices and future perspectives of graduate students, I am describing the reflexivity of these individuals.

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or at a Federal Institute, considering that they offer greater advantages, such as those mentioned.

Previously. Research is not among his goals.

Jorge says he decided to continue his studies in postgraduate programs because of an experience he had. Bad experience working as a teacher in private primary education: "The pay is low and there are high expectations." excessive." Even though there are other jobs in the private sector, such as, for example, in "research In the context of "laboratory" and "field research," having only an undergraduate degree restricted him to teaching in the public school system. Private basic education. Jorge's pursuit of postgraduate studies is motivated by the job market. Prioritize professionals with a doctoral degree, without necessarily requiring research experience. stricto sensu.

One student pointed out that, even with greater chances of employability... In the private sector, they still prefer the public sector, where the number of vacancies is reduced and competitive. But there is financial stability. Currently, the number of public competitions for teaching positions in The number of graduates at the higher education level is small, which is different from years ago. This generation of graduate students... I interviewed someone who lived through the peak of university expansion and the relative appreciation of the teaching profession. in higher education in the first decade of the 2000s and, having been socialized in the environment The university's pluralistic approach involves students planning to remain in this space; however, no student has ruled out... possibility of working in the private sector.

This perspective from graduate students reflects a trend in Brazilian income, according to which Public sector employees are well-paid compared to those in the private sector. Evidently, There are particular cases that reverse this income distribution. In 2013, those who earned above Those earning R\$3,000 (R\$36,000 annually) were among the top 10% richest, and a significant portion of that group was... composed of public servants (SOUZA, 2016, p. 232). Therefore, by inference, the income The salary of a university professor in the public sector falls within the so-called "middle class." "Salaried worker." But this so-called "financial appreciation" of public sector employees is restricted to the elites. from the civil service itself, such as the judiciary and federal security forces. The professor of Higher education and other public service professions are vulnerable to the ups and downs of economic cycles in the country, in which purchasing power can decrease during periods of high inflation<sup>1</sup> .

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<sup>1</sup> Even at the height of the Brazilian economic crisis of the 1980s, public servants had their salaries indexed to inflation, which allowed them to maintain purchasing power (SOUZA, 2016, p. 303). Today, because of the pandemic, public servants have had their salaries frozen for two years. Even before the pandemic, the spending cap stipulated a salary freeze as a preventive measure to maintain the public spending ceiling. The Judiciary and the military received a 40% salary increase, which was intentional to cushion future losses.

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When graduate students report their plans and externalize their projects, For them, doctoral and master's degrees only denote the level of status they need. to achieve, given the need imposed by competition in the private sector. The "practical" side of Postgraduate studies – the practice of research – are not as relevant to the private sector; therefore, they are not very popular among students . Nevertheless, postgraduate studies do train human resources. High-level professionals, but on average, poorly paid.

The average rate of low pay in the private sector may be related to The imbalance observed by PCT theorists is between, on the one hand, the high supply of resources. skilled human resources and, on the other hand, low demand in the productive and service sectors that They require high levels of education, which makes the salaries lower compared to those of... public sector.

There were two young people who assessed the private sector as having greater chances of employability and that they intend to work in it. Both are from the agronomy course, but from Different specialties. One young woman conducts research on irrigation and crop monitoring using drones; the other young man conducts research related to seeds. It is It is emblematic and expected that only agronomy students would show interest in working in the private sector, given that it is a dynamic sector of the Brazilian economy, In recent decades, it has made progress in the use of science and technology in production.

However, when speaking with these agronomy students, both highlighted the performance In Brazil, they work with multinational agribusiness companies, and it is within these companies that they intend to operate. The companies mentioned operate in the segments of seeds, agricultural pesticides, machinery and Grain logistics. These companies annually promote the selection of qualified personnel by midway through the trainee selection process. The required profile is to have, at a minimum, a bachelor's degree and fluency in English. If accepted into the trainee program, the professional will work in the company's management sector, fulfilling functions related to process management, without any connection to research or any other related tasks. Activities that require technical knowledge in the field of agronomy.

Both graduate students who want to work in the public sector and those who Those who want to work in the private sector share the same perspective: they will be far removed from research. to complete their academic training. Obviously, those who want to work in higher education teaching can. they may choose to work in research or even step away if they take on administrative roles in universities.

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<sup>1</sup> There is probably a latent difference between basic research and applied research in this "disinterest".

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In any case, the university manages to produce highly qualified people at the postgraduate level. but they are unlikely to pursue research as a profession, due to the existential difficulties of the job. Paid researcher positions are almost nonexistent in the country. Biographical professional projects. Postgraduate students residing at CEU-POS/UnB point to a concern. pronounced existentialism; perhaps the socioeconomic profile and social origin explain the absence of a discourse close to scientific vocation among the participants of the pilot study.

### **Relations and Autonomy between the Economic and Scientific Spheres in Brazil**

It is common, when discussing Brazilian science and technology, to relate it to development. socioeconomic situation of the country. The conclusions are unanimous: the science produced in universities Brazilian companies, in general, have no application in the local industrial sector.

The factors that lead to this disharmony between innovation and productivity are associated variables such as: (1) importation of technologies; (2) low perception of risk regarding efficiency (3) lack of interest from businesses in national know-how. In At different historical moments, the Brazilian State attempted to reverse this disharmonious situation by through linkage-based and neo-linkage-based policies, which aimed at bringing the The action of economic agents and scientific action, but it was unsuccessful.

However, I have the impression that some variables, in the case of S&T, could to contribute to the sociological explanation. By analyzing the scientific and productive structures, good Part of the explanations makes them watertight by excluding the structural relationships that link them, which namely, Brazilian economic policy. In this regard, Bagattolli et al. (2018, p. 369) state: Programs, plans, and instruments are designed to stimulate innovative activities, but the The performance of companies operating in Brazil does not seem to keep pace with these incentives. The reason Therefore, we believe, the deficiency lies in the formulation process of the Brazilian Science and Technology Policy, in which the Innovation seems to be the ultimate goal. [...] Constraints associated, for example, with The maintenance of high real interest rates in the country should not be disregarded and perhaps will be. just as important, or even more important, than the supposed lack of an innovative culture in local companies, diagnosis that has underpinned many of the actions taken within the scope of science policy and Brazilian technological.

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What I mean is that the Brazilian productive sector is not attractive to the owning classes<sup>1</sup>, given the risk of no return on investment, compared to other Economic activities available in the country, such as the purchase of government bonds. In 2020, the sector The industrial sector accounted for 26.6% of the national GDP. The branch of the productive sector with the greatest dynamism. It's agribusiness, the only sector to grow in 2020. I don't mean to imply that the economic elite... Brazil may be insignificant. I draw attention, however, to the economic policies practiced. In Brazil, this is especially true given the high interest rates that have prevailed since the industrialization policies from the 1950s.

For the owning class in Brazil, buying government bonds is more attractive than investing in some branch of production as a "businessman" or even as "Investor" in the stock market of companies. The advantage in buying government bonds stems from of two intrinsic characteristics of the Brazilian case: (1) the high interest rate brings a return (1) advantageous liquidity in the short and medium term when buying government debt securities; (2) the investment Public debt presents a lower risk rate than other types of debt.

The increase in the interest rate is justified in two situations. The first situation occurs when a country seeks to attract national and international resources to invest, for example, in public service. The second situation occurs when the country is experiencing a period of recession and the Economic agents save money, which leads to deflationary stagnation. Apart from these situations... Intrinsic to the economic system, there is the political decision that justifies this practice for a long time. period. In this regard, Keynes says: At the same time, investors in government bonds achieved considerable wealth at the beginning of the century. Success in three aspects. The "security" of your investment was even considered so as close to absolute perfection as possible. His capital appreciated uniformly [...]. But

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<sup>1</sup> [...] many arrangements have been devised to separate the administration of property from its possession. [...] (1) that in which the owner, although abandoning the administration of his property, retains possession of it – that is, of the land, buildings and machinery or whatever accompanies it, **this type of ownership being typified by the holding of ordinary shares in a public limited company**; [...] (3) that in which the owner permanently leaves his property in exchange either for a fixed perpetual annuity in money, or for a determined sum of annuities plus the payment of the principal in money, or for a determined sum of annuities plus the payment of the principal in money at the end of the term – a case typified by mortgages, bonds, debentures and preferred shares. **This third type represents the full development of Investment.** [...] in the 20th century divided the owning classes into two groups – the "businessmen" and the "investors" – with partially divergent interests." (KEYNES, 1976, pp. 13 and 14). Keynes makes an analytical distinction between "businessmen/ordinary stock" and "investors/preferred stock," although, in reality, both categories are not clearly separated. An investor who buys government bonds can be considered an investor, but a government bond is not a stock and its dividend is not related to productive profit; it is indexed to the interest rate, constituting another category. In developed countries, this is considered a conservative investment due to its low...

return.

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Government papers had also combined the virtue of stability with that of appreciation (KEYNES, 1976, p. 14).

However, a sharp drop in the interest rate is unlikely to lead to a change in the social psychology of the owning class, which may invest in risky operations that, in the long run... In the long term, they can be characterized as "speculative bubbles." That said, it is possible to resize the assertion that Brazilian businesses demonstrate a lack of interest in national technology in other words: the disinterest of the national business community goes beyond a lack of willingness to innovate through national technology; their interest in the productive sector is, in fact, a lack of interest. To paraphrase Keynes: accumulation in Brazil is unproductive.

In this way, a PCT, even a well-designed one, will basically have an inductive effect on the academic community; it will hardly induce the Brazilian owning class to invest in industrial production, which in Brazil is dominated by multinational companies.

It is important to consider Brazilian economic policy in science and technology analyses. I don't have... There is no doubt that the epistemological delimitation of the object of analysis is essential for the progress from the research and the way in which canonical works were defined generates results significant.

### Final considerations

Preliminary results on the individual representation of post-graduate students Undergraduate students residing at CEU-POS/UnB have an impact on science and technology. directly impacts their life plans. Those who want to work in the public sector aim to exercise their careers from teaching at the university level. Those who want to work in the private sector aim for managerial positions of large multinational companies. These considerations still need verification. rigorous, but it is possible to perceive that the interest in research, both as a means and an end, The life plans of graduate students living at CEU-POS/UnB are lacking. precisely because they assess the difficulty of obtaining a steady income from this activity.

From a practical standpoint, the bottlenecks in Brazilian science, technology, and industry. These problems will not be solved solely through policies that rely on specific financial principles; even investment policies will face challenges. Financial strategies in the productive sector, based on the model of national champions, are doomed to failure. Extensive state reform is important to create an environment conducive to the emergence of a Entrepreneurial social psychology capable of absorbing the specialized workforce from the university.

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I consider isolationist university autonomy a variable that can be overcome, but...

The determining cause of this overcoming is external to the scientific community.

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