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The open and free society in Popper and Feyerabend and undergraduate students' perceptions of its aspects

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ABSTRACT
The text explores social, political, and economic influences on science, focusing on Feyerabend and Popper's theories on the relationship between science and society. It defends the idea of a "free society" where methodological plurality and democratic participation are fundamental to the production of scientific knowledge.

Keywords: Science, Society.

INTRODUCTION

Epistemology is a field that seeks to understand how the process of knowledge production occurs. While at first glance the term tends to assign a secondary role to popular knowledge (SILVA JUNIOR, 2022), a closer look at epistemological models reveals that they "were conceived either a priori to solve specific philosophical difficulties, or post hoc to fit a small number of preselected examples, it is not surprising that none of them could correctly tell the whole story or even large parts of it" (LAUDAN et al., 1993, p. 9). Thus, they are loaded with subjectivity. This proposal, in turn, even if not discussed in depth by some epistemologists, finds support in others, such as Kuhn (1982), Feyerabend (2011a; 2011b), Popper (2012; 2013b), Bunge (1980), and Laudan himself (2011). Of these, Feyerabend and Popper have works that deal specifically with the relationship between social aspects and the functioning of science.

A study of Popper and Feyerabend's biographies reveals some points in common between them: both were born in Vienna, in 1902 and 1924, respectively; both developed critiques of the development of science; both were strongly influenced by debate circles, in Popper's case the Vienna Circle and in Feyerabend's case the Alpbach seminars; both were attracted to discussions about the social context throughout their education, having experienced the horrors of war firsthand and developed their works "The Open Society and Its Enemies" and "Science in a Free Society," which bear some of their marks.

Given the context described above, this paper aims to examine, mainly based on Feyerabend and Popper, the influences that social aspects have on the direction of science, focusing on their indications related to political and economic aspects in which science is

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immersed. Having presented the references to these two authors, we will now present the data obtained through targeted interviews with students from five courses at a state public university, one of the purposes of which was to seek to understand whether and, if so, to what extent they consider that scientific research in their fields is impacted by economic and political issues, thus observing the extent to which Popper and Feyerabend's propositions are accepted in the statements of these students.

DEFINING FREE AND OPEN SOCIETIES

Several points could be explored based on analyses of Popper's “The Open Society and Its Enemies” and Feyerabend's “Science in a Free Society.” In this paper, however, we will focus on their definitions of a free or open society, the way in which subjective elements can direct scientific research, and the extent to which political and economic issues can affect this type of research.

Differentiating between open and closed societies, Popper offers an objective definition: “the magical, tribal, or collectivist society will also be designated as a closed society, and the society in which individuals are confronted with personal decisions as an open society” (POPPER, 2012, p. 218). Although simple, this definition offers room for questions and reflections, one of the main ones being whether we live in an open or closed society. Thus, throughout their writings, these authors point to a series of issues that contribute to the closure of society.

The links between science and society are highlighted as relevant by various authors. Bunge (1980, p. 49), for example, argues that the scientific community “cannot exist in a social vacuum; if we are interested in stimulating or inhibiting scientific development, we must consider it as an aspect of the integral development of human society.” Kuhn, in turn, assumes the possibility that the social sciences offer answers to their questions that are as firm as those of the natural sciences (1982), while Laudan searches history, philosophy, and sociology for causes to consider certain decisions made in science in certain contexts to be rational. Although these authors at some point weave relationships between society and science, Popper and Feyerabend ultimately stand out on this point due to the depth they offer on the subject and the focus given to social issues in particular works.

Starting with Feyerabend, in his defense of a free society, he addresses social issues and responds to opposition directed at his work “Against Method.” One of his highlights is the explanation that his proposal for anarchism would be a remedy for epistemology and the philosophy of science and not for politics, that is, it is something to be used while dealing with a

disease or evil (in this case, the bias of science), but not after its cure (FEYERABEND, 2011a). For this reason, “Against Method” would be a strategy to make science open, not a substitute system. Something so vital that it can be said that “in the sciences [...] we often follow a specific line of research not because it is considered intrinsically perfect, but because we want to see where it leads” (FEYERABEND, 2011a, p. 26), thus, “there is no ‘scientific method’; there is no single procedure, or set of rules, that is present in all research and guarantees that it is ‘scientific’ and therefore reliable” (FEYERABEND, 2011a, p. 122). Thus, something that would be sought in a free society would be the freedom to adopt a methodological plurality when investigating science or any other area.

Among the characteristics of a free and truly democratic society, according to Feyerabend, is the expectation that people have the freedom to promote whatever doctrine they want, as long as they do so by their own means (FEYERABEND, 2011a). It is important to note, however, that wanting a system in which everyone has an equal right to express their opinions does not mean that everything is accepted individually, as it is possible, without contradiction, to advocate this right and still ridicule and accuse others of incoherence (FEYERABEND, 2011a).

Another point related to freedom of belief is that related to the financing of proposals. In the author's opinion, it is considered that

> Citizens have the power to express their opinion on the administration of any institution to which they contribute financially, either privately or as taxpayers: public colleges and universities, research institutions supported by public funds [...] are subject to taxpayer evaluation [...]. If California taxpayers want their public universities to teach black magic, folk medicine, astrology, rain dance ceremonies, then that is what the universities will have to teach. The opinion of experts, of course, will be taken into account, but they will not have the final say. The final say is the decision of democratically constituted committees, and in these committees, lay people are in control. (FEYERABEND, 2011a, p. 118).

Even though considering the proposal to teach black magic, astrology, or, in other words, something like flat-earthism in universities or schools may seem absurd, its argumentative basis is actually quite simple: it is up to those who pay (the general population) to decide where to invest their money. This is because in a free society, the choice between theories is made on their merits and not because of pressure from a group. In other words, allowing others the right to express themselves and use their own resources to defend their beliefs does not mean that we believe they have any merit, nor does the fact that the government decides where to invest mean that the money being used for this purpose is its property.

Still on the issue of funding and the power attributed to experts, Feyerabend considers

> Would it perhaps be better for taxpayers to accept the experts' assessment? No, and for obvious reasons. [...] First, experts have capital invested in their own playpens [...]. Second, scientific experts almost never examine the alternatives that may arise in discussion with the care they presume to be necessary when a problem in their own field is at stake. (FEYERABEND, 2011a, p. 167).

On the first point, the fact of receiving funding from a single source can in itself bias judgments. On the second point, we tend to be more tolerant of the flaws in the theories we follow than in systems we do not master. On this point, Laudan points out that empirical problems are often ignored until someone can offer an explanation for them (LAUDAN, 2011). Along the same lines, Kuhn indicates that during periods of normal science, “failure to achieve a solution discredits only the scientist and not the theory” (KUHN, 1982, p. 111), which will only be questioned when its anomalies become evident.

Still based on Feyerabend's positions, as he considers that “in cases where the work of scientists affects the public, the latter would even have an obligation to participate” (FEYERABEND, 2011b, p.21), what would underpin a free society would be the possibility for all taxpayers to be able to choose in an informed manner where to invest. Obviously, they are not expected to have an in-depth understanding of the areas of expertise, but considering that choices are made on merit, and science is undoubtedly worthy of merit, it would be expected that choices in favor of science over other areas would be proportional to the clarity of the return it brings to society, that is, considering the possibility that the best choice is to follow what science advises and that this is presented in an appropriate way to society, without overvaluing some areas and undervaluing others, there would be no reason to worry about whether this will be understood as the most advantageous path. Within this context, science would only be disadvantaged if it remained distant from the society that finances it, or if it actually had proposals with little merit.

Even though Feyerabend's position may raise doubts about the general population's ability to judge where resources should be invested, the author is not alone in his views. In 1981, when discussing racial and gender bias in science, Gould recalls that in Plato's republic, “social and economic roles faithfully reflect people's innate constitution” (GOULD, 1999, p. 4), referring to the passage in which Socrates explains that he would deliberately lie to the people by telling them, " you are all brothers in this city [...] but the god who shaped you, those among you who were fit to rule, mixed gold into your composition [...]; silver for the auxiliaries; iron and bronze for the farmers and other craftsmen" (PLATO, 2008, p. 109–110). Gould goes on to explain that today “one aspect of intellectual strategy has changed. Socrates knew he was telling a lie” (GOULD, 1999, p. 4), while the researchers he points to would believe that by using science

they were bringing findings of truth and not their prejudices.

This same criticism of Plato's system is made by Popper, but in relation to political systems (such as those of Plato and Hegel) in which a ruling class believes it has the right to govern regardless of the opinions of the governed, believing that by deceiving them, “it is always success that counts.” If the lie was successful, then it was not a lie, since the people were not deceived as to its substantive basis." (POPPER, 2013b, p. 83) or in which, as expressed by Plato, “the wise should rule and govern, and the ignorant should follow them” (POPPER, 2012, p. 155). Although the idea of government by the wise is seductive, Gould (1990), in discussing how American eugenics identified those considered imbeciles, clearly brings out the social bases that underpinned such judgments. Thus, the position that the general population is not qualified to judge science should only indicate that it needs to receive a better qualified and critical education.

Still on the role played by education in forming a society capable of judgment, Feyerabend argues that “a democracy is a group of mature people, not a collection of sheep led by a small group of know-it-alls” (2011a, p. 108) and that such maturity "needs to be learned. And it is not learned in [...] today's schools, where students are confronted with dried-up and falsified copies of past decisions; it is acquired through active participation in decisions that still need to be made." (2011a, p. 108). In other words, “it is necessary for [society] to know not only the concepts, but also what science is, the problems that triggered the studies, their methods, the expected results, and the consequences of their applications.” (LIMA; CORAZZA; LUSTINA, 2019, p.89)

Returning to Popper, he criticizes Plato's model of republic, which preaches “a monopoly of education by the ruling class, combined with the strictest censorship, even for oral debates” (POPPER, 2012, p. 168), a system in which the “philosopher-king [...] must [...] be ‘more courageous’, since he must be determined ‘to minister many lies and deceptions’ – for the good of the governed” (POPPER, 2012, p. 176). Given this context, the choice of what will or will not be taught, and the places that will or will not receive funding, involves a series of power relations, which will not necessarily be the same as those assumed by other authors when they focus exclusively on what can or cannot be accepted as scientific.

If, from the perspective of restricted scientific systems, assuming a set of beliefs as fundamental and, to a certain extent, unquestionable, as proposed by Kuhn (1982) and Lakatos (1978), makes the decisions to be made more agile and precise, the same cannot be said of political systems, in which assuming a single position, whatever it may be, contributes to the closure of society, because while from the point of view of those who live in a given area,

following its rules is something natural and rational, for those who observe these same rules from the outside, it is easy to recognize them as arbitrary and biased.

Thus, when making political decisions, according to Feyerabend, the ideal would be to adopt a stance in which, when considering the methodological plurality observed in the history of science, one takes into account that “rationality is not the arbiter of traditions; it is itself a tradition or an aspect of a tradition. Therefore, it is neither good nor bad, it simply is” (FEYERABEND, 2011a, p. 36), as well as that in situations that require decisions, “rationalists and scientists cannot argue rationally (scientifically) in defense of the incomparable position of their favorite ideology” (FEYERABEND, 2011a, p. 98). These positions are reinforced by Agassi, who makes clear the subjective burden of scientific theories, pointing out that “obviously the theory ‘a theory is scientific if it is empirically testable’ is not empirically testable” (AGASSI; PARUSNIKOVÁ, 2017, p. 533), a position also reinforced by anthropologist Descola, who states, “I do not question science, which would be absurd; what I contest is the idea that cosmology, which made science possible, is itself scientific. No, it is not; it is historical, as are all cosmologies” (DESCOLA, 2016, p. 48).

If the exercise of breaking with ethnocentrism, as the belief that the best system for judging other cultures is always the one we follow may seem challenging, works such as those by Miner (1956) and Bohannan (1966) contribute to understanding, respectively, how biased the view we adopt in our society can be and how enriching it is for our own field to review it from other perspectives.

One of the arguments put forward when considering science and scientists as the best judges for decision-making is the supposed objectivity and neutrality of science. For Feyerabend, “this is how intellectuals try to convince their fellow citizens that the money paid to them is not wasted and that their ideology should continue to occupy the central position it now holds” (2011a, p. 40). For the author, “the standards of such a debate are not ‘objective’; they only appear to be so because the reference to the group that profits from their use has been omitted” (2011a, p. 40).

What happens, according to Feyerabend (2011a) (but also in Kuhn and Laudan), is that once something is treated as fundamental to science, any questioning directed at the field is no longer taken seriously. Popper supports this idea by pointing out “that this civilization has not yet fully recovered from the shock of its birth—the transition from tribal or ‘closed’ society, with its submission to magical forces, to ‘open society,’ which liberates man's critical powers” (2012, p. 17), going on to discuss the different moments in history when the idea of the existence of a chosen nation was used to justify discourses of racism, eugenics, or superior class, which seek

to naturalize the idea that certain groups should govern and others should be governed.

Still on the subject of subjectivity and decision-making, Popper states that “there is no doubt that we all suffer from our own system of prejudices (or ‘total ideologies’, if you prefer that term)” (2013b, p. 261), meaning that the accuracy of a statement does not lie in minimizing margins of error, but rather in recognizing the possibility of errors. This means that scientific objectivity lies in the fact that, in order to “avoid misunderstandings, scientists try to express their theories in such a way that they can be tested, that is, refuted” (POPPER, 2013b, p. 262). Thus, the fact that in an open society “anyone can criticize is what constitutes scientific objectivity” (POPPER, 2013b, p. 265), but this requires that the population be able to make this judgment in a qualified manner.

Continuing to question the priority that science should have over other sources of knowledge, Feyerabend presents two reasons that are often cited to defend the superiority of science: “it uses the correct method to obtain results; and there are many results to prove the excellence of the method” (2011a, p. 122).

As for the first point, to refute the idea of a single method being used, it suffices to compare approaches from different areas, such as ethnographic (or autoethnographic) experiences and variance analyses between population data, to observe that the data collection instruments, treatments, conclusions, expectations of generalization, and possibilities for retesting are distinct in these systems.

With regard to the second reason, Feyerabend argues that the superiority of science over other areas would depend on the fulfillment of two requirements: “(a) no other view has ever produced anything compatible, and (b) the results of science are autonomous, owing nothing to non-scientific agencies” (2011a, p. 125). As for the first requirement, it ignores the value of traditional knowledge and communities other than scientific ones, both current and past. To take it as true would be to ignore the contributions of in-depth works on the evolution of scientific thought, such as those by Bachelard (1996). As for the second requirement, it suffices to know that, at the national level, CNPq and CAPES are funded with public money and that, on a global scale, the Web of Science platform is linked to the Clarivate company to verify that scientific results are often not independent of other agencies and are not politically neutral.

As for attributing superior knowledge to science, Popper, in criticizing Plato, identifies that “his philosopher is not someone dedicated to seeking wisdom, but rather someone who is proud of possessing it. He is an educated man, a sage” (POPPER, 2012, p. 182), who, possessing a privileged position of power, believes he is capable of replacing one social system with another in a manner similar to “a picture painted on a canvas that has to be erased before a new one

can be painted” (POPPER, 2012, p. 208), in a situation where decisions are made by someone outside the system.

According to Popper, an example of this attempt to replace systems and their practical results in science can be observed in the relationship between Hegel and Frederick William, then king of Prussia, who offered state approval for his proposals without considering their feasibility (POPPER, 2013b). A similar proposal for state protection of certain lines of research is denounced by Feyerabend (2011a), who adds to it criticisms related to the practical results of economic investments made by the state, citing as an illustrative example the low gain in knowledge resulting from the expenditure of billions of dollars on special programs to take man to the moon, compared to the intellectual gains of a philosophical nature in other fields that do not receive the same emphasis or equivalent resources.

Another issue considered by the authors regarding the receptivity of scientific research within society is the clarity with which scientific terms reach it. In addition to the difficulties associated with the vocabulary of the fields themselves, there is the aggravating factor that decision-making and resource allocation in the political sphere are carried out by people who do not have a deeper understanding of the applications of science, thus leading to decisions that deviate from the rationality intended by science because, as expressed by Laudan, “ no sensible rational evaluation of any doctrine can be made without a broad knowledge of its historical development (and the history of its competitors)" (2011a, p. 272) and, as indicated by Feyerabend, at certain moments the choices between theories are not based on rationality, but on the use of propaganda and psychological tricks (2011b).

Another factor that would explain the favoritism shown toward certain lines of research would be the possibility of technical use of scientific findings. As an example of this, it is pointed out that after the invention of the telescope, the ruler “immediately realized the military value of the telescope and ordered that its invention [...] be kept secret” (FEYERABEND, 2011b, p. 121), later indicating that even the law discriminates against certain knowledge as heresy and that there are “many legal, social, and financial obstacles that assertions of knowledge face” (FEYERABEND, 2011b, p. 170) to be overcome before they can be considered valid.

With regard to the dissemination of knowledge, Popper and Feyerabend point out some attitudes that contribute to the closure of systems. One such intervention would be Plato's aforementioned proposal that the state should intervene and, if necessary, use deception to prevent movement between classes (PLATO, 2008). He also proposes that education be controlled by the state, with children isolated from their parents and other contaminants until they reach the age of 10 (POPPER, 2012), since "the institution that, according to Plato, must care

for future leaders can be described as the state's department of education. From a purely political point of view, it is by far the most important institution in Plato's society" (POPPER, 2012, p. 169).

Regarding Plato's emphasis on education, it is obvious that to think that education in the Republic is the same as that which is used today in schools and universities would be a great anachronism. However, the validity of Popper's reference remains valid. In Plato and his Republic, education is presented as training offered so that people can work as efficiently as possible within the functions for which they were predestined and from which, for the good of society, they cannot be removed (PLATO, 2008). In current terms, school is still a privileged space for education and socialization.

Some positions defended by Hegel and Marx would also contribute to the closure of society, such as the belief that conflict between nations or class struggle are the basis of the history of all societies (POPPER, 2013b). Popper also attributes to Marx the idea that the capitalist system itself, by exploiting the governed, forces them to unify, however, believing that “the class-conscious proletarian is the proletarian who is not only aware of his class situation, but also feels proud of his class and is totally sure of its historical mission” (POPPER, 2013b, p. 138) so that there is not even a desire to change class, despite considering that even in a just society the proletarians “despite all this ‘justice’, would not be much better than slaves. For if they are poor, they can only sell themselves, their wives and children in the labor market” (POPPER, 2013b, p. 147). According to Popper's reading of Marx, the loyalty of the proletariat would be such that even if they did not necessarily use violence in all actions, in favor of social change they would make “the decision not to retreat from violence” (POPPER, 2013b, p. 180) being “determined to use violence to achieve their goals” (POPPER, 2013b, p. 180).

With respect to the class struggle defended by Marx, it would be something different from what occurs within science, especially in terms of intensity and objectives. While the class struggle in Marx has a known final objective, that of establishing a system in which there is no more oppression and everyone belongs to the same class through victory over the ruling class, within science we avoid visions that are seen as teleological, that is, in which the final destination is already known from the beginning. Thus, even if Kuhn (2006, 2011), Laudan (2011), Lakatos (1978), Feyerabend (2011b) and other epistemologists criticize and even try to reduce each other's propositions to absurdity in their writings, such clashes could not be classified as war or even violence, coming closer to Feyerabend's position that defending freedom for everyone to express their opinions and seeking followers for their lines does not mean uncritical acceptance of other people's positions (FEYERABEND, 2011a). Furthermore,

the way in which science views these clashes of theories and confrontations between areas is not as a search to definitively supplant one system by another, but within the logic exposed by Bachelard that “truth is the daughter of discussion and not the daughter of sympathy” (1978, p. 81).

Finally, considering the ideal conditions for building a free society, what one would expect in Feyerabend would be a state that enjoys the same independence in relation to science as it should have in relation to religion (2011a) because, as pointed out by Popper, attitudes such as thinking with the class inevitably lead to a closed type of thinking (POPPER, 2013b) in which passionate attitudes are adopted. These, in turn, are dangerous to the extent that among all political ideals, “perhaps the one of making people happy is the most dangerous. It invariably leads to an attempt to impose on others our scale of ‘highest’ values in order to make them understand what seems to us to be of greatest importance for their happiness” (POPPER, 2013b, p. 283).

UNDERGRADUATE STUDENTS’ PERCEPTION ON THE INFLUENCE OF SOCIAL ISSUES ON SCIENCE

Having discussed some of the influences of social aspects on scientific practice, the aim is to verify the perception that undergraduate students have about these relationships in their own courses. To this end, students from five undergraduate courses at the State University of Rio Grande do Sul (Uergs) were chosen as research participants, with whom we dialogued through guided interviews (PÁDUA, 2004). In total, 63 students were interviewed about different aspects related to the perception of scientific practice within their courses. Of these, 21 were studying Agronomy (Agro), 15 Food Science and Technology (CTA), 14 Bioprocess Engineering and Biotechnology (EBB), 8 Environmental Management (GA) and 5 Pedagogy (Ped). This participation was obtained by sending approximately 175 invitations to students in each course, with a larger number of invitations being sent to courses with lower participation (for the GA and Ped courses, 242 and 225 were sent, respectively). Considering that data collection was carried out through interviews, before they were carried out the project was analyzed and approved by the Research Ethics Committees of the institutions involved (UFRGS and Uergs), being approved in both with CAAE 48745721.9.0000.5347.

Throughout the interviews, a series of information was collected related to the way in which students perceive research in their courses. However, this work will especially address the effects of factors such as politics and economics on the research carried out, which, once carried out, was transcribed and subjected to a process of discursive textual analysis (DTA) of

the speeches based on the methodology of Moraes and Galiazzi (2016).

DTA is a methodology used to conduct discourse analysis in search of new relationships and emerging meanings. It is a process with four successive and cyclical stages: the texts are disassembled in order to construct units of analysis; interrelations between the units are sought by categorizing them; new meanings and possible readings are sought based on the established relationships; a self-organized process naturally follows in which a new understanding of the discourses is achieved, allowing the cycle to begin again (MORAES; GALIAZZI, 2016). One of the differences between DTA and other data analysis methodologies is that it favors the identification of contextual meanings.

Once the interviews were conducted and analyzed, the main positions identified in the participants, with regard to impressions on politics and economics, were categorized and tabulated (Table 1), enabling a series of considerations to be made, in addition to parallels with the positions of Popper and Feyerabend.

Table 1 – Units of analysis resulting from interviews with students from 5 undergraduate courses regarding their perception of the impacts of politics and economics on course research

	Agro	CTA	EBB	GA	Ped	TOT
Politics and economics have a great influence	7	8	8	2	4	29
Those who define or direct what would be relevant problems would be the government and companies	11	7	7	3	0	28
Economic demands influence more than politics	5	1	6	4	1	17
Government finances what is interesting to it	8	2	5	1	0	16
Lack of funding for scholarships or human resources greatly impacts the possibility of conducting research	5	4	3	2	1	15
Lack of funding is reflected in lack of equipment or materials	3	4	1	1	1	10
Political and bureaucratic issues hinder research in all areas	1	3	4	0	1	9
As it is a public institution, politics has a great influence	2	0	4	1	1	8
Politics and economics are also affected by the ability to disseminate research	0	2	2	2	0	6
The fact that funding is provided by governments is seen as something negative	1	2	2	0	0	5
Politics influences more, because they are the ones who make the laws	1	1	1	1	1	5
Political issues that occur in other countries have national repercussions	1	4	0	0	0	5
Areas with potential for economic return benefit	2	0	1	0	0	3

Source: Authors (2023). Caption: Agro: Agronomy; CTA: Food Science and Technology; EBB: Bioprocess Engineering and Biotechnology; GA: Environmental Management; Ped: Pedagogy; TOT: total.

Starting with the common position shared by Popper and Feyerabend that politics and economics profoundly affect the development of science, the analysis of the data indicated that among the 63 interviewees, 29 demonstrated that they shared this belief. Regarding the extent to which each of them influences, the predominant thought was that economics influences

research more than politics (17 of the 63 participants). Even in some cases in which more importance was formally given to politics, this was done within a bias of funding source, as expressed by an Agro student:

> I think politics interferes much more because I do my internship at a public institution. I believe that economics does not interfere as much, [...] as I do my internship at a public institution and we are living in a time of crisis, there are cuts: there is a lack of staff, sometimes there is a lack of equipment, something like that, you know?

In the speech of this agronomy student, other issues that were pointed out were also raised, such as the impact on research being greater in his course because it is a public institution (8 of the 63 participants), as well as the weight that politics has in economic issues, such as in the granting of scholarships and payment of employees (pointed out by 15 participants) and in the purchase of equipment (according to 10 participants).

Regarding the importance of granting scholarships and financing equipment in scientific training, it is important to note that in the country a large part of the research is carried out in public institutions, making their success contribute to Feyerabend's expectations that “a democracy [is] a group of mature people and not a collection of sheep guided by a small group of know-it-alls” (2011a, p. 108), as well as to the fight against the political model criticized by Popper in which “a monopoly of education by the ruling class, combined with the strictest censorship, even for oral debates” is advocated (POPPER, 2012, p. 168), a model paid for by the population, but which serves the ruling class.

Still on the subject of the direction of research funding and its contribution to the construction of a free society, some of the speeches illustrate the importance of the issue. The first was given by a student who had already graduated in the area of natural sciences and who sought a second degree at EBB, who illustrated political and administrative issues that interfere in research:

> [...] I believe that one of the biggest problems we have today in research in Brazil is the poor management of public funds that are released for research. [...] Researchers should have a little more freedom, because man, everything is so bureaucratic. Nowadays, to buy something you have to sign 80,000 papers and even manage to buy [...] a gel to do PCR. It's very, very bureaucratic. You have to get 3 or 4 quotes [...]. Let's put out a bid to see who will charge the lowest price and then it will take 3 months to buy a little packet of gel.

In her speech, the student brings up both the idea that political and bureaucratic issues hinder research (common to 9 of the 63 participants), and the idea that the purchase of materials by the government is something negative (common to 5 of the 63 participants). She also

reaffirms the problem indicated by Feyerabend (2011a) of having as judges in decision-making processes people who are distant from the area they are judging, or in the case of purchasing materials to be used by third parties, ignoring the issue of quality.

Regarding bureaucratic and financial obstacles, they are so severe that they sometimes discourage people from continuing in the field of research, as expressed by a CTA graduate who, when introduced to research in general terms (without having yet addressed the topics of this article), stated: “[...] because of the way [my advisor] was, I had even thought about going into the field of science, research” but that, however, she was “quite discouraged by this change in government [that occurred in 2019]” due to “funding cuts, scholarship cuts, [which] ended up impacting my decision not to follow that path”, adding after some time: “I felt discouraged from doing science in the country, in the sense of research. Because in order to do science [...] you have to have resources, [...] and the resources that have to come, have to come from the government”, taking into account that “the inputs are extremely expensive, the reagents are extremely expensive, the equipment is extremely expensive”. Thus indicating through their speeches the direct impact that funding has on the development of researchers, something also central to Popper and Feyerabend.

Despite her discouragement with the path of being a researcher, the student also stated: “we need science, without science we can’t do anything”, thus expressing the position that science deserves high esteem and is the best path to follow. This idea was reinforced later when she brought up the relevance of the research by the Butantan Institute that led to the development of the CoronaVac vaccine: “[people] are always suspicious: oh, CoronaVac is worse than Pfizer, I don’t know what. Dude, how do you know? Did you become a vaccine sommelier?” At first, her statement suggests that the population is prejudiced not against science, but in relation to national science. Thus, on the one hand, it is possible to question the ability of the general population to judge scientific discoveries and the urgency to offer them better qualified training; on the other hand, however, it ends up indicating the judgment that once something has been discovered by science, it can be unquestionable. This last point is something repeatedly indicated by Feyerabend (2011a) as something inherent to the social logic in which we live, even if it is criticizable in its essence.

Another point to be highlighted in the speech of the same student concerns political issues. At one point she said “[...] people are very hostile, they are very much: creating a pet politician. What they fail to understand is that politicians serve only the people. What people do is the opposite”. At times, this speech is similar to Popper’s descriptions of the functioning of closed societies, to the extent that all responsibility for events is placed in the hands of rulers.

The direct consequence of this for Popper, but also illustrated in the transcribed speeches, is that the development of the area becomes dependent on the goodwill and financing of the ruler.

Also highlighted in the same set of speeches was the link between financing and the government, a view that is close to the Platonic ideal criticized by Popper (2012), as well as the ideal of state defended by Hegel and Marx (POPPER, 2013b).

Another point highlighted by the student was the issue of valuing local research, something whose importance was perceived in her outburst after talking about the CoronaVac vaccine: “it is so expensive to import technology from other countries”. In this regard, Bunge's (1980) position is especially relevant, for whom one of the requirements for science to be considered as developed in a location is the existence of incentives for both basic and applied science, which would provide a certain independence in relation to research carried out in other countries. Regarding this issue, it was also noteworthy that of the 5 students who indicated that they believed that political issues that occur in other countries have a national impact, 4 were in the same course (CTA) as the aforementioned student.

Still on the issue of financing, students also indicated the possibility of research being sponsored by companies, as expressed by an Agro student:

> [Agronomy] is heavily influenced [by economic issues] because large companies sponsor research, right? Just as much as the government institutions that conduct research. So I believe that this part is heavily influenced by both politics and economics. A company will look for what will generate a return for itself as well.

In his speech, the student brings up the idea that topics that have the potential to bring financial returns tend to be favored (common to 3 of the 63 interviewees). In the case of government-funded research, similarly, there is a belief that funding is directed to topics of interest to the government (according to 16 of the 63 participants), as well as that those who define what would be relevant problems would be the government and companies (indicated by 28 of the 63 participants). Some of these ideas were reinforced in the speech of an EBB student: “In my opinion, from the moment there is an economic interest, research is directed, and this is the case in any area, right? In any course, the economic side ends up influencing a lot”. The speech of a GA student also indicated the possibility of direction by the government: “no matter how much we want to study something, if the government, right? In the case of economics, politics, is against it, it will be more difficult to obtain resources and everything else, so we can be boycotted”. These statements indicate an alignment between the students' perceptions and Feyerabend's on the topic.

Regarding the origin of funding, whether public or private, and the impact of this on

research, the statement by an EBB student stood out:

> In countries like Brazil [...] we depend a lot on the current government, right? However, now, in countries like the United States [...] the ones who dominate are private companies, right? [...] So, the research generated in the area of Bioprocess Engineering and Biotechnology goes much further, often not because of a good person, but because of the financial issue. [...] So, we have a very strong economic issue behind it and with that the economy, politics is interested and comes in behind.

In light of his response, I ask whether we could say that one of the systems, Brazilian or North American, would be better than the other, to which he responds:

> Look, with all due respect: no. I see several mistakes in both, because like this [...]: in the private sector, I will demonstrate two mistakes, you will have the interest of a larger elite, you know? So then it's that thing, you won't always dedicate yourself to research to help the world, right? You will dedicate yourself to research to help that elite, that country over there. Now, a federal issue, like, in our case, depending on whether the government cuts funding or not, manages it poorly or not, it will end up harming itself and harming the students' research.

The student's speech highlights the fact that private research sometimes serves an elite, so that "you won't always dedicate research to help the world", but to private issues, suggesting that even when applying accepted methodologies within science, it is possible to work with strong biases. On the other hand, in public funding there is a risk of funds being directed, as indicated by Feyerabend (2011a).

Regarding the response given to the lack of funding, the position presented by a CTA student is worth highlighting:

> [...] there was a year when there was a change in politics and then we ran out of scholarships and all the scholarship holders were volunteers, right? But I think that politics and the economy, first of all, are intertwined and they directly influence the work of scientists. So, we need resources and also the economy, it will affect the people with whom scientists will interact. So, we often change our path due to these policies, right? So we have to adapt all the time, right? Because of the policies.

In this speech, in addition to the statement that as researchers “we often change our path because of these policies”, which illustrates the direction that politics gives to science, criticized by Popper and Feyerabend, special attention is drawn to the statement that due to funding cuts “we ran out of scholarships and then all the scholarship holders volunteered”. In this regard, drawing a parallel with Popper’s description of Marx (2013b), it is interesting to note that while in Popper the idea of voluntarily offering services in favor of establishing a cause is presented as absurd and a challenge to the application of Marx’s system, the student’s statement, on the

other hand, indicates volunteering as a natural response to funding cuts. Even if one can try to justify volunteering in research projects as a possibility for students to gain experience, the naturalization of this process should at least be criticized, since it is a situation that would hardly survive intact strangeness such as those proposed by anthropologists such as Miner (1956) and Bohannan (1966).

Regarding the awareness of budget cuts among the general population, a Ped student commented:

> [politics and economy] affect us a lot, because with every cut we see on TV, in education, we cry inside here, because we rely on these resources. [...] we see more and more resources decreasing, teachers having to work harder. Even the teacher I work with in the morning, when she arrived to work at this school, at this daycare, she had practically no toys. Why? The school had no resources, the city had no resources to give to the school. So she brought her own things, her children's toys.

In her speech, the student highlights the impacts that politics and economics have on her own work routine, in addition to research situations. Her speech can be compared with the criticisms that Popper directs at Marx, when he believes that in favor of social change the working class would make “the decision not to retreat in the face of violence” (POPPER, 2013b, p. 180) and even “use violence to achieve its goals” (POPPER, 2013b, p. 180). It turns out that as the government cuts funding and receives donations from teachers in response, which allow the system to continue functioning, the resistance that is being offered is of a different order than the use of violence, which is precisely one of the arguments raised by Popper as a criticism of Marx's system.

To better contextualize the issue of a nonviolent response to budget cuts (which in other contexts are characterized as patrimonial violence), it is useful to refer to the definitions made by Hannah Arendt when she proposed that “power and violence are opposites; where one dominates absolutely, the other is absent” (2021, p. 73). It turns out that, given the situation described, the reading that is made in light of Arendt is that if, in the face of government violence - of not honoring financial obligations - a nonviolent resistance is observed that prevents the consequences of neglect, it is because the real power in this situation belongs to the teachers and not the government itself. This conclusion is equally clear, when considering the constitutional definition itself that “all power emanates from the people, who exercise it through elected representatives or directly” (BRASIL, 2019, art. 1), such that in the case of evident inefficiency in the exercise of power by elected representatives, the exercise of direct power is still left as the people's response.

Regarding the conclusion that power belongs to those who can lead others to action, this

is a basic principle of “The Republic”, with the difference that the way in which Plato’s philosopher-king guaranteed his power was through a government that encouraged lying as a benefit to the people of whom one is the guardian, that is, while Plato seeks to facilitate the exercise of power through the closure of society, in the case of resistance to the scrapping of education what is sought, in the case of the teacher presented, is to use power in order to form subjects for an open society.

In opposition to the proposal to resist government cuts, some participants (5 of the 63 participants) considered that politics influences more than the economy, since it is responsible for drafting laws, and researchers have no means of circumventing its restrictions. As expressed by an Agronomy student: “I think the main thing is politics, right professor? Without politics, agronomists cannot work. Because they are currently the ones who make the laws”. When asked about how laws affect research, he responded: “Okay, with the laws that are created, for example, in a certain area there is a law and the agronomist wants to produce, but there is a law that is preventing him from producing, so he will not be able to, he has to do other things or look for something else” and then emphasized that a series of agricultural pesticides have their sale regulated. A GA student stated: “environmental management is very much linked to public agencies and now they are constantly trying to change resolutions, change laws, things that can harm [...] the environmental area and the enterprises as well”.

It was noteworthy that both students presented previously position political agents as external elements: “they [...] who make the laws”; “they try at all times to change resolutions, change laws”. This separation and division of society into the dichotomy “us” and “them” is the target of criticism in Popper, who, when exposing Hegel’s theory that “the State, by its very essence, can only exist through its contrast with other singular States” (POPPER, 2013b, p. 80), also points out that the demarcation of borders in Hegel is the demarcation of enemies to be fought. If from Hegel's point of view war between nations is the driving force of history and if in Marx history is based on class struggle, what would be desired for the development of science according to different epistemologists would be something different: an environment of dialogue and arguments (BACHELARD, 1978; BUNGE, 1980; KUHN, 2006; LAUDAN, 2011; POPPER, 2013).

Regarding the basis used by governments to make decisions, the statement by a CTA student drew attention, who pointed out:

> Everything we do today is political in some way, right? [...] Unfortunately, in our country, where we have an incentive... the lack of incentive for research, right? [...] So, if a country's economy and its politics are against, let's say, a study, if a guy goes there, for

> example, and publishes a study saying [...] that transgenic corn is carcinogenic [...]. Like, [...] the guy proves by A plus B that it really is a 50-year study, with I don't know how many thousand people and control groups, everything is correct, as it should be within the standards, and then some person A or B comes along, not necessarily a politician, but who has a very big political influence and says that that's not how it works. It ends up interfering, right? Because people say, gosh, I did all that work and it was wasted by someone who isn't even in the field, by someone who doesn't even know, someone who doesn't even know what they're talking about.

In his speech, the student considers the possibility of serious and well-founded research being invalidated based on the opinions of people who are not in the field and who have economic interests tied to the results they are questioning. A similar point is made by Feyerabend, however, questioning the excellence of scientific knowledge in comparison to other sources of knowledge. In his critique, Feyerabend (2011a) points out that sometimes science criticizes other areas without knowing them, claiming resources for itself to their detriment. Drawing parallels between the student's positions and those of Feyerabend, it can be concluded that the use of power or influence in decision-making is not something linked to a defined group, but rather the condition of enjoying power.

Regarding the power exercised by the economy, repeatedly cited by Feyerabend (2011a) as a contributor to the closure of society and regarding the influence of global demands that act on local policies (pointed out by 5 of the 63 participants), an Agro graduate stated:

> [...] in fact, it's like this, it's no use, our world today is a capitalist world, we know that we depend on several environmental factors, but money rules, and often money rules people who don't have a more enlightened point of view [...]. The problem is that the world is labeled with half a dozen grains, you know? It's soy, corn, wheat and you stay with that and the system works for that. [...] It overvalues some things and they forget about others. So, regional values end up being lost to global values. Today we know that the Chicago stock exchange there controls soy and the producer here can pay whatever he wants, can receive whatever he wants, but the one who controls is there, right? So you produce and depend on another country.

Another issue raised by interviewees was that the extent to which universities are able to provide social returns makes it easier to receive incentives from the government, as expressed by a GA student:

> [in the city where the unit is located], the people who are currently governing have a strong identification with Uergs, but of course, for other reasons as well, not just because they think about environmental preservation, right? But because the university's work helps a lot, right? But there are other places, because I live in [another city], there is another way of thinking that is much more distant from these environmental issues, right?

In his speech, the student indicates that by understanding a system it becomes easier to use it for one's own benefit. This logic is reflected in the criticisms made by Popper (2012;

2013b) and Feyerabend (2011a) of political systems, with the difference that in these systems, understanding the systems is something planned and prior to their execution.

Another point observed was the position of some participants that in the same way that politics and economics affect science, science also affects them (position of 6 of the 63 participants). According to a CTA graduate:

> When you do science, you can't just think about the method. You have to think about who you're going to reach with the method you're using. There are also variables, let's say in the environment. How much you're going to affect not only the economic side of money, but let's say: when you do waste management, you have to understand the process you're developing or the one you're already involved in, and you have to know the consequences of each action you're going to take.

In her speech, the student presents some applications of the research carried out in her area which, in turn, end up being incentives for investments.

A final point highlighted in one of the speeches was that much scientific information does not reach the public in an appropriate way, as expressed by an EBB student:

> I even found it funny the other day, [because] I have a hamster and on its box it is clearly stated that all the products used are non-GMO. [...] I think there is sometimes a lot of misleading advertising in this, you know? [...] I think there is a lack of information, you know? For the public about GMOs. The European Union does not accept that tobacco is GMO. It can have millions of harmful effects, it kills, it causes cancer, but it cannot be GMO, because the public will not accept it. They do not accept that it has been modified. Like, there is a lot of misinformation, you know? Like, something that could reduce, because whether you like it or not, when you smoke most of what you are ingesting is something bad for your body. And if you manipulate it there, making the plant GMO, it will help. But the European Union does not accept it. And it is one that asks Brazil to export the most.

In his speech, the student discusses the impact of the lack of information on the acceptance of technologies and products developed by science, which is one of the central issues for the development of an open and free society, as well as for ensuring that science receives its due credit. It is no surprise that, as indicated by Popper (2012), one of the most important steps towards the closure of societies is precisely the control of what is taught from the most basic levels of education.

CONCLUSIONS

Popper's "The Open Society and Its Enemies" and Feyerabend's "Science in a Free Society" are works that denounce the evils of a closed society, doing so after their authors had witnessed the horrors of war and had been changed by it. In addition to the basis that these authors have for addressing social issues, both are basic references when discussing the way in

which scientific knowledge is produced. Thus, the implications that they point out of social issues on the development of science are highly relevant.

Among the main points made by Popper and Feyerabend about the closure of society are the concentration of power in the hands of specific groups (such as government officials, companies or researchers themselves), the requirement of subservience to funding groups and the very possibility that those in power have of making the system favor their permanence in decision-making positions. In addition to these issues, another factor that favors the closure of society is the restriction of access to reliable sources of information and the very failures of communication that exist between science and society, which on the one hand require unquestionable faith in their findings, but on the other hand make it difficult for the population to access positions of power.

When Popper and Feyerabend's observations were added to the students' own perceptions, it was possible to identify a series of common points, starting with the perception that scientific work is deeply impacted by political and economic issues to which it is subjected. Some of the most direct ways in which students reported perceiving this were in situations involving some type of demand for funding, such as research grants, equipment or laboratory materials. Regarding the importance of political issues, there were two opposing positions among the participants: on the one hand, some students identified their relevance in terms of having the power to impose and modify laws to be followed, while on the other hand, the idea was expressed that the more one understands how politics works, the more one can use it to promote research development.

Regarding the students' perception of the direction of research, their conclusion was close to those of Popper and Feyerabend: governments and companies preferentially finance what is in their interest, which is why Feyerabend's argument that science sometimes moves more through the ability to make propaganda than through paths considered rational should be taken seriously.

Regarding the considerations directed at research conducted at a national level, the idea was expressed several times that financing the country's research with public funds was a negative thing, partly because the government has an opinion in areas that are not its domain and partly because of bureaucratic problems. It was also noted that even if research were conducted at a national level, it would be strongly influenced by international issues.

Finally, it was positive that, when faced with the question of how much politics and economics affect the areas of study of undergraduates in the five courses, most participants not only took a stand, but also presented arguments in defense of their conceptions, indicating that

they are in some way aware of the political issues that surround them and that, at times, guide their research. Given this observation and the contributions of Popper and Feyerabend, it becomes possible to glimpse, although elements inherent to closed societies are also observed, at least some of the fundamental elements for the construction of a truly open society free from bias.

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