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UNIVERSITY TEACHING IN "HARD" AND "SOFT" SCIENCES: ACADEMIC TRIBES, OR TOWARDS A COMMON CULTURE?

Univerzitetska nastava u „tvrdim" i „mekim" naukama: akademska plemena ili ka zajedničkoj kulturi?

ABSTRACT: *This paper critically analyzes the distinction between the so-called "hard" and "soft" sciences, with a particular emphasis on the teaching quality in these academic fields. Firstly, it presents the origin and characteristics of this popular dichotomy, as well the idea of a hierarchy of sciences in philosophy and sociology. It then points out the relative inadequacy of this hierarchy, but also its heuristic value, based on relevant and contemporary research on scientific knowledge and university teaching. In this regard, it thoroughly analyzes the concepts of academic tribes, territories, and epistemic cultures at the university environments. We argue that the anthropological concept of culture can offer valuable insights into the inner workings of physical, life, and social sciences, and claim that different academic cultures significantly influence the character of university teaching. Finally, this paper emphasizes the possibility of building a common academic culture in terms of teaching quality, i.e. a shared quality culture.*

KEY WORDS: *"hard" sciences, "soft" sciences, academic tribes, epistemic cultures, teaching quality, quality culture*

APSTRAKT: *U radu se kritički analizira distinkcija između takozvanih „tvrdih" i „mekih" nauka, sa posebnim naglaskom na kvalitetu nastave u ovim akademskim oblastima. Prvo se izlažu poreklo i odlike ove popularne dihotomije, odnosno sama ideja hijerarhije nauka u filozofiji i sociologiji. Zatim se ukazuje na relativnu neadekvatnost ove hijerarhije, ali i na njenu heurističku vrednost, na osnovu*

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relevantnih savremenih istraživanja naučnog znanja i univerzitetske nastave. S tim u vezi, detaljno se analiziraju koncepti akademskih plemena, teritorija i epistemičkih kultura u univerzitetskim okruženjima. Tvrdimo da antropološki koncept kulture može da ponudi značajne uvide kada je reč o funkcionisanju fizičkih nauka, nauka o životu i društvenih nauka, i argumentujemo da različite akademske kulture značajno utiču na karakter univerzitetske nastave. Na kraju, ističemo da postoji mogućnost izgradnje zajedničke akademske kulture u smislu kvaliteta poučavanja, odnosno izgradnje zajedničke kulture kvaliteta.

KLJUČNE REČI: *„tvrde“ nauke, „meke“ nauke, akademska plemena, epistemičke kulture, kvalitet nastave, kultura kvaliteta*

The hierarchy: the “hard” and the “soft” sciences?

> “This support of science is assured only by appropriate cultural conditions. It is, then, important to examine those controls which motivate scientific careers, which select and give prestige to certain scientific disciplines and reject or blur others.”
>
> (Merton, 1938: 321)

The distinction, antonym, or the hierarchy between the so-called “hard” and “soft” sciences is an academic and modern commonplace, with its epistemic, institutional, and socio-political history (Shapin, 2022). In some form, it has been a longstanding subject of debate and controversy in the philosophy and sociology of science (Fanelli, 2010; Simonton, 2006; Smith et al., 2002; Toulmin, 1972; Merton, 1973; Laudan, 1977; Cole, 1983). The popular belief that sciences can be divided into the “hard” and “soft” is nowadays one of the most widespread beliefs among scientists themselves, as well as among decision-makers in the domain of educational policies, with significant practical and social consequences.

Can the diverse academic disciplines be ranked according to their “hardness” or “softness”? Are some sciences more “scientific” than others? Unlike relatively neutral divisions into natural and social (or pure and applied) sciences, the “hard–soft” distinction usually carries a certain moral judgment, most often about “soft” sciences being “less scientific”, thus “less valuable”. For example, in a comparative analysis of academic disciplines such as mathematics, English language and literature, biology, and psychology (Singer, 1996), or computer science, library science, public administration, sociology, and social psychology (Ylijoki, 2000), a sort of “moral order” is revealed. This order then defines the basic beliefs, values, and norms of “academic tribes” (Becher and Trowler, 2001) or “epistemic cultures” (Knorr-Cetina, 1999) within the university.

The origin of the popular division into “hard” and “soft” sciences is relatively unclear. According to Shapin (2022), it was an expression of specific institutional, political, and cultural circumstances in the United States in the second half of the 20th century, and there was little usage of these terms prior

to the 1960s.[4] One of the first invocations of the "hard–soft" distinction was in a "technocratic" speech by an industrial engineer Gano Dunn, given to a professional association in 1945 (Shapin, 2022: 7). The American president (and a geologist and a mining engineer) Herbert Hoover also expressed concern about the lack of scientists in the United States (compared to the Soviet Union) in a *New York Times* article in 1955, criticizing students' tendency "to seek *soft* classes, not the *hard* work of science and mathematics" (Shapin, 2022: 5; emphasis added).

This division or chasm most likely originated from the biophysicist John R. Platt and his paper in the journal *Science*, where he openly states that "not all sciences are equal" (Platt, 1964). For him, the idea of equality among sciences is merely a "polite fiction", since some sciences exhibit rapid progress (i.e., high-energy physics or molecular biology), while others do not (Platt's example was organic chemistry, and not social sciences). He viewed the reasons for this rapid progress in the so-called "strong inference" (hence the "hard" sciences), or in the inductive method, with the belief that "we fail to teach our students how to sharpen their inductive inferences" (Platt, 1964: 348). Then, in 1965, Harvard's political scientist Don K. Price noted that the "rigorous scientific method" was being "gradually extended from the *hard* sciences to the *soft* sciences" (Price, 1965: 88; emphasis added), and the distinction was born.

Just a few years after Platt and Price, Harvard's sociologist (and Robert K. Merton's student), Norman W. Storer, explicitly discussed the distinction between "hard" and "soft" sciences at the Annual Meeting of the Medical Library Association in 1966 (Storer, 1967). For him, the degree of "rigor" in which a body of knowledge is organized and the extent to which mathematics is used actually determines whether a science is "hard" or "soft". "Harder" sciences are also characterized by "more impersonality" in their quotations and references, with the assertion "let me make clear that sociology is *not* a hard science" (Storer, 1967: 75). Furthermore, Thomas S. Kuhn famously differentiated sciences based on whether they have developed a paradigm or a high level of consensus in theory and methodology or not (Kuhn, 1970). Sciences at the bottom of this hierarchy exhibit less consensus, which is why Ritzer (1980) argues that sociology is a multi-paradigmatic science, while Zuckerman and Merton wrote about the different degrees of knowledge codification in sciences (Merton, 1973).

On the other hand, the basic pattern of intellectual life is not consensus, but disagreement, rivalry and conflict (Collins, 1998). There is no "abnormality" or "pathology" in the lack of consensus in the 20th-century social or "soft" sciences – while the contemporary natural or "hard" sciences are actually "unusual" with regard of their high consensus (Collins, 1994: 158). Furthermore, the "normal" mode of intellectual life has *not* been characterized by rapid discovery and progress

4 For the distinction between "hard-soft" or "natural-social" sciences in German, Italian, French, Swedish, and other languages, see (Shapin, 2022: 2). Interestingly, Nordic languages (Swedish, Danish, and Norwegian) differentiate between "dry" and "wet" scientific disciplines ("dry" referring to social sciences and "wet" to natural sciences). Additionally, in the English language, there are "hard and soft" state policies, currencies, drugs, drinks, and pornography (Shapin, 2002: 4).

(Collins, 1994: 159). Even before the "hard–soft" antonym emerged, philosophers of science critically discussed various aspects of disciplinary "compactness" (Toulmin, 1972), or the degree of sciences being more/less "codified" or "mature/immature" (Laudan, 1977). Serious efforts for demarcation between science and non-science (and pseudoscience) also have a long history in philosophy (Popper, 1962; Lakatos and Musgrave 1970; Pigliucci and Boudry, 2013).

The idea of the existence of a hierarchy of sciences is certainly much older, and it can be traced back to classical antiquity. According to Aristotle, sciences or knowledge (*episteme*) can be divided into: (1) theoretical, (2) practical, and the (3) productive sciences (Aristotle, 2018). "Theoretical" sciences include "first philosophy" (later called metaphysics), mathematics, and "physics" (i.e., natural philosophy, which includes astronomy, botany, zoology, etc.), while "practical" sciences encompass ethics and politics. Finally, the "productive" sciences aim at the creation of beautiful or useful objects, such as medicine, agriculture, ship-building, arts, etc. (McKirahan 1978; Labarriere 1997). Therefore, Aristotle attributed greater importance to the "theoretical" *episteme* or sciences which are absolute and universal (mathematics, physics), as opposed to those that are practical and, consequently, relative (ethics, politics).

In the modern age, the most well-known classification and hierarchy of sciences was proposed by the very founder of sociology, Auguste Comte (1830–42/1896; Lewes, 1853). The mathematician Comte detailed and examined six fundamental sciences: mathematics, astronomy, physics, chemistry, biology (or "organic physics"), and sociology (or "social physics"). This classification also has a historical aspect, structuring his *Course of Positive Philosophy* (Comte, 1830–42/1896). Additionally, significant early classifications and hierarchies of sciences were given by William Whewell (1840), Herbert Spencer, Wilhelm Wundt (Cogswell, 1899), and Bertrand Russell (1929). However, of all sciences, sociology has been most interested in the "hard–soft" distinction (Shapin, 2022: 9), likely due to its Comtean heritage.

For Comte, sciences develop from the simplest, and the most general (astronomy), towards the more complex, and less general (such as biology or sociology). This socio-historical scale also reflects the development of inquiry from the most distant subjects (heavenly bodies) towards the closer subject matter (animal bodies in biology, and human societies in sociology). Thus, by moving from astronomy towards biology and sociology, generality decreases and complexity increases. "Social physics" or sociology also has a double status, as the most complex science that comes after all the others, and as the ultimate science of all human knowledge. According to the Comte's doctrine of positivism, and his belief in the unity of sciences, sociology must also strictly adhere to the methodology of the (physical) sciences. Still, many contemporary sociologists view positivism with a suspicious eye and cynicism, equating it with raw empiricism and naiveté (Turner, 1985).

In other words, the "soft" social sciences are actually at the top in the Comtean hierarchy. However, the hypothesis regarding the hierarchy of sciences is nowadays understood as placing physical sciences at the top, and social

sciences at the bottom, while the life sciences lie somewhere in-between (Cole, 1983; Simonton, 2006; Fanelli, 2010). At the same time, it is interesting to note the absence of psychology from the mentioned hierarchy, since it did not become independent from philosophy until decades after Comte died. Afterwards, psychology was mainly placed between biology and sociology, with more proximity to biology (Simonton, 2015). According to one early study (Lodahl and Gordon, 1972), scientists were required to rank various sciences according to their level of development, and their responses reflected the (reversed) Comtean ordering from the 1830s, with physics at the top and sociology at the bottom.

In the broadest sense, it is commonly and popularly believed that "hard" sciences are those dealing with empirical and/or natural phenomena, such as physics, chemistry, and (possibly) biology. These sciences are perceived as more objective and/or impersonal, with their body of knowledge more rigorously organized (usually in terms of using mathematics, statistics, or quantitative data). Hence, there is an observed increase in the use of graphs, tables, or statistics in general in "hard" sciences (Smith et al., 2002). Conversely, "soft" sciences are those dealing with more subjective or interpretative phenomena, such as human behaviour or human societies (psychology, sociology, political science), and rely on less quantifiable methods (such as observation or conversation).

For these reasons, "we often view hard science as the only type of science" (Diamond, 1987: 35). An important factor in the classical hierarchy of sciences is also their predictive and explanatory success (Humphreys, 1990). This hierarchy typically relies on the presence (or absence) of the scientific method, quantitative tools, or controlled experiments, as well as criteria such as precision of findings, reliability and reproducibility, power of prediction, the speed of change, degrees of consensus, the scope or level of generality, etc. (Shapin, 2022: 3). The question also arises whether there is a continuum or a discontinuity between "hard" and "soft" sciences.

Since Aristotle, it has been argued that the "hard" sciences provide objective, universal truths about the natural world, unaffected by relative, social, or cultural factors. On the other hand, "soft" sciences are more contingent upon the social context, and their body of knowledge or objectivity can be subject to interpretation or criticism based on various personal or cultural biases, political influences, ideologies, and so on. At the same time, "hard" scientists (supposedly) assume scientific objectivity, while many "soft" scientists do not (Collins, 1989); "hard" scientists assume an external structure of the natural world that is independent of the observer or one's subjectivity, while "soft" scientists do not. Similarly, many social scientists tend to regard physical and life sciences as authoritarian and destructive (Turner, 1985; Collins, 1994) with common "biophobia" (Ellis, 1996; Freese, Li and Wade, 2003).

Finally, among the various "objective" scientometric measures proposed for evaluating sciences as "hard" or "soft" are: theories-to-laws ratio, consultation rate, obsolescence rate, graph prominence, early impact rate, peer evaluation consensus, and citation concentration (Simonton, 2006), and even the median age at which scientists received their Nobel Prizes (in physics, chemistry,

medicine, and economics) (Stephan and Levin, 1993). Among other indicators are the non-epistemic factors such as average publication rate, level of social connectedness, level of job satisfaction, goals and financial reward structures of different academic departments, and different approaches to teaching and learning in "hard" and "soft" sciences (Fanelli, 2010). In this sense, "soft(er)" sciences are often perceived as less valuable, with a consensus that it is "good" to be "hard" and "bad" to be "soft" (Shapin, 2022). This implies an implicit hierarchy of sciences even today, since "soft" sciences are supposedly less reliable, objective, and even relevant. In this regard, two questions arise: a) whether the dichotomy of "hard versus soft" is so objective, rigorous, and necessary after all, and b) what are the implications of such dichotomy on university education?

Academic tribes, territories, and cultures

Like all other social institutions, "the institution of science has its characteristic values, norms, and organization" (Merton, 1957: 659). For these reasons, different scientific and academic disciplines function as separate tribes, territories, and cultures. The (reversed) Comtean "hierarchy of the sciences" is thus reflected in many social and organizational features of academic life (Fanelli, 2010). There exists a different social organization of sciences and intellectual fields, as well as an objective and massive difference in the material equipment, sources of funding, social prestige, patterns of recruitment, and training in different scientific disciplines (Collins, 1994). Such differences are *social* and not epistemological in nature. As Merton (1938: 321) quotes Weber, "the belief in the value of scientific truth is not derived from nature, but is a product of definite cultures".

Indeed, the hierarchization of sciences into the "hard" and "soft" often overlooks the fact that *all* scientific knowledge is inherently situated within socio-cultural contexts, and that even "hard" sciences also rely on subjective judgments and interpretations (Shapin, 1995; Knorr-Cetina, 1999). As early as 1966, while testifying to a U.S. Senate committee, political scientist Kalman Silvert argued that the common distinction between the "hard" and the "soft" sciences "may not persist much longer" (Shapin, 2022: 11). Furthermore, many "soft" sciences have questioned dominant ideologies and power structures in science, such as feminist critiques of psychology or postcolonial critiques of anthropology (Said, 1978; Harding, 1986; Haraway, 1988).

Research comparing current scientific results in physical ("hard") sciences regarding their cumulativeness of scientific knowledge indicates that these results are actually *not* more consistent than those of social ("soft") sciences, which brings into question the very "hard *versus* soft" distinction (Hedges, 1987; Ylijoki, 2000; Fanelli, 2010). How can this fact be explained? In both "hard" and "soft" sciences, it is possible to distinguish two classes of knowledge: the core knowledge and the research frontier (Cole, 1983; Škorić, 2010: 303–306). While the core knowledge consists of universally accepted ideas which serve as the starting points for graduate education, the research frontier is all currently

conducted research. The "hard" sciences *do* possess common core knowledge, but there is *no* scientific consensus regarding the research frontier *both* in hard and soft sciences.

This fact also reflects the content of courses taught at undergraduate (or first-year graduate) studies in "hard" and "soft" sciences, and which is especially important for this paper. In introductory textbooks in fields such as physics, there is a relatively small number of references (around 100), while in sociology textbooks, there are usually more than 800 (Cole, 1994: 134). Therefore, researchers have long noticed that sciences also differ in terms of theoretical codification, the degree of development of scientific paradigms (Lodahl and Gordon, 1972), or the degree of scientific consensus in one's core knowledge (Cole, 1983). Codification facilitates mastery of a field since it connects basic ideas into a unified theoretical framework, and thus Zuckerman and Merton mention that decisions to enter the fields of mathematics or physics are known to be made earlier than decisions to enter one of the "soft" sciences (Škorić, 2010: 295).

In line with this, scientific papers in "soft" sciences typically feature a comparatively larger number of references or footnotes compared to "hard" sciences (Storer, 1967). Scientists in "hard" sciences are also characterized by greater social connectedness in teaching and research (Biglan, 1972b). The "hard–soft" model by Biglan has been analyzed as a distinction that can enhance the quality of research on university faculty and academic administration members (Smart and Elton, 1982), which will be discussed later. There is even a difference in academic vocabulary between "soft" and "hard" sciences, with certain pedagogical implications (Dang, 2018). In other words, the popular "hard–soft" sciences distinction has significant heuristic implications for how we conceptualize scientific knowledge and its relationship to society and education.

With regard to the "hierarchy of the sciences" by Comte, one study analysed 2434 papers published in "hard" and "soft" disciplines that have declared to have tested a scientific hypothesis (Fanelli, 2010). The frequency with which these papers reported a positive result was predicted by the "hardness" of their discipline, i.e. scientific rigor and objectivity were inversely proportional to the complexity of their subject matter. Still, the results support the scientific status of the *social* sciences, arguing that they differ from the natural sciences only by a matter of degree (psychology and psychiatry, but also physics and chemistry, reported more positive results than social sciences). Indeed, the results of physical experiments were not significantly more consistent compared to social or behavioural experiments, nor were they more cumulative (Hedges, 1987).

The reason why social sciences are not fast-progressing sciences is not due to a lack of empirical research or acceptance of scientific method, but due to a lack of analogous research technologies (or "research hardware" such as test tubes or high-energy particle colliders) compared to rapid-discovery sciences (Collins, 1994; Cole, 1994). An exception in this regard may be certain research techniques in microsociology, and the use of artificial intelligence. Mere empiricism, measurement, mathematization, and experimental methods are *not*

adequate explanations of rapid-discovery or "hard" sciences. A discipline also cumulates its knowledge by building and testing *theories*, while there is a current lack of theorizing in sociology and social sciences in terms of positing timeless laws of the social universe (Turner, 1985).

For these reasons, an Editorial of the prestigious (and "hard") scientific journal *Nature* actually "praised" "soft" science (Editorial, 2005). It is argued that "hard" scientists should "stop looking down their noses at social scientists" and get over the "disdain" for their "soft" colleagues. Additionally, it is argued that social scientists have a tougher time regarding their academic "territory" of expertise, as many amateurs and laypeople also engage with questions of culture or society. Authors (like the biologist Jared Diamond) will argue that "soft" sciences are often harder than "hard" sciences" since the (pejoratively termed) "soft" sciences are more difficult to study, and their research topics are intellectually more challenging ("a revolution in the Third World doesn't fit inside a test tube") (Diamond, 1987: 35). That is, physics has relatively high explanatory success not because of its "hard" scientific methodology, but because of the characteristics of the phenomena it studies, which "possess a high degree of invariance across contextual variation" (Humphreys, 1990: 158).

At the same time, the "hard–soft" distinction has been reasonably criticized as too binary or simplistic, as many sciences, such as economics or psychology, actually fall between these two categories. For example, questions arise about whether concept mapping represents a "soft" science or a "hard art" (Trochim, 1989), whether ecology and evolutionary biology are actually "soft" sciences (Pigliucci, 2002), or what the future holds for philology as a "soft science in a hard world" (Pollock, 2009). In the mid-20th century, there were also debates about whether sociology is actually a natural science (Bain, 1947; Machotka, 1949).[5] It is also interesting to mention that the US National Science Foundation's prestigious award for the best young scientists was given to a sociologist Dalton Conley in 2005 (Editorial, 2005). Advocating for scientific foundations for teaching students (but also educating teachers), some authors have highlighted the case of pedagogy as a potentially "hard" science (Gage, 1985).

Finally, recognizing the significance of socio-cultural dimensions of scientific knowledge, it is possible to criticize the "modernist" distinction between nature and culture (or society), and thus between the natural and social sciences (Latour, 1990). In other words, to promote a relational approach to science and knowledge (Latour, 1993), or to critique the idea that "hard" science produces objective knowledge that is independent of social factors (Hacking, 1999). In this regard, the question arises whether the distinction between "hard" and "soft" sciences is indeed a useful heuristic for understanding scientific disciplines and their teaching approaches (Smart and Elton, 1982; Simpson, 2017), or whether this concept actually obscures our view of the reality of academic life. For all

5 For Machotka, it is not appropriate to compare the character of sociology with natural sciences like physics (due to its experimental nature), but it is suitable to refer to the character of sociology as a natural science of "less precise estimates" such as geography, geology, meteorology, or even astronomy (Machotka, 1949: 12–13).

of these reasons, in this paper we argue that a more adequate approach is an anthropological one, which observes the research and teaching of scholars from different disciplines at universities from the perspective of academic "tribes" or their "cultures".

The concept of culture is highly complex, multifaceted, and subject to numerous definitions (Kroeber and Kluckhohn, 1952; Minkov, 2013). With the exception of anthropologists, most social scientists (such as sociologists, psychologists, economists, etc.) until recently viewed culture merely as a residual phenomenon or a consequence of various structural circumstances, rather than as a driving force in shaping social life (Alexander, 2003). Social institutions and organizations were predominantly examined through the lens of social stratification (power relations and inequality), while cultural identities and practices were seen as relatively fixed or trapped within the structural conditions individuals found themselves in. However, culture in its broadest sense also encompasses traditional, everyday, or "ordinary" practices and actions (Williams, 1958; Swidler, 1986). The everyday production of culture occurs through the interplay of local and global influences, through which individuals construct their identities, ways of life, and even their organizations and institutions (Giddens, 1991), including universities.

Anthropology of science, or the study of science as culture (and/or cultures of science), emerged in the 1990s as a significant and vibrant, although controversial field of inquiry (Franklin, 1995). In this paper, we argue that the anthropological concept of culture can offer valuable insights into the workings of sciences, both "hard" and "soft", especially within the academic context of teaching (Martin, 1998). Instead of a simple dichotomy between "hard" and "soft" sciences, it is necessary to discuss the various "academic tribes and their territories" that truly shape our knowledge and higher education (Becher and Trowler, 2001), and also the different (epistemic) cultures of individual scientific (sub)fields (Knorr-Cetina, 1999).

Becher and Trowler have proposed the concept of "ethnography of (academic) disciplines", which highlights the close links between academic cultures ("the tribes") and the disciplinary knowledge (their "territories") (Becher and Trowler, 2001: xiv). The characteristics of academic areas are thus distinguishable both epistemologically and sociologically. And in the current post-industrial and internationalized university environment, the "hard" and the "soft" scholars still operate within their own academic cultures, in terms of "tribalism and tradition" (Becher and Trowler, 2001: 44–46). Furthermore, their intellectual tasks are closely related to the ways of organizing their professional (and even personal) lives. The attitudes, activities, cognitive styles, and teaching practices of academics thus reflect the named academic "tribalism" and one's "disciplinary socialization": "despite their temporal shifts of character and their institutional and national diversity, we may appropriately conceive of [scientific] disciplines as having recognizable identities and particular cultural attributes" (Becher and Trowler, 2001: 44).

The first edition of *Academic Tribes and Territories* was published in 1989, and based on 221 interviews with academics and researchers in universities in the United Kingdom and the United States across 12 disciplines (biology, chemistry, economics, history, mathematics, physics, sociology etc.) (Trowler, 2014). Its main argument was that the knowledge structure of these disciplines determines the behaviour and values of academics in two realms: *cognitive* and *social*. In the cognitive realm, "hard" disciplines have well-developed theory, universal laws, causal propositions, they are cumulative and have generalizable findings. "Soft" disciplines have unclear boundaries, relatively unspecified theoretical structure, are subject to fashions and have loosely defined problems" (Trowler, 2014: 18), which was critically analysed. On the other hand, this popular perception also determines one's academic culture, identity, and teaching behaviour as a "recognizable continuty" (Becher and Trowler, 2001: 43).

In the social realm, the key issue is in the "convergent/divergent" and "urban/rural" dimensions. "Convergent" scientific communities are tightly knit, and with a shared paradigm (Kuhn, 1970), and "urban" scientific communities involve a high level of collaboration, intense competition, and a rapid information network (Price, 1986). Thus, "physics is hard, pure, convergent and urban. Sociology is soft, pure, divergent and rural. Engineering is hard, applied, convergent and urban. Economics is hard, applied, convergent and rural" (Trowler, 2014: 19). Still, there is some room for "adjoining territories", "areas of common ground" and for the "cause of unification" (Becher and Trowler, 2001: 58–63). This is especially true regarding the academic "tribes and territories" in the 21st century (Trowler, Saunders and Bamber, 2012). The further massification of higher education and its (neoliberal) market focus imply that the traditional disciplinary structures are being gradually replaced by inter– and trans-disciplinary enterprises, which bring into question or transgress the traditional academic tribalisms.

On the other hand, academic cultures or the "tribal" aspects of academia do persist and they determine one's organization, financing, social identity and prestige, knowledge construction, and teaching as well. An individual's sense of belonging to one's academic tribe is also highly symbolic and/or iconic:

> "The culture of the discipline includes idols: the picture on the walls and dust jackets of books kept in view are of Albert Einstein and Max Planck and Robert Oppenheimer in the office of the physicist, and of Max Weber and Karl Marx and Emile Durkheim in the office of the sociologist" (Becher and Trowler, 2001: 45).

In other words, scholars still cognitively and socially organize themselves along tribal and/or cultural lines of divergence and distinction, including the intellectual worship of their secular icons.

Similarly, cultural anthropologist and sociologist Knorr-Cetina (1999) has developed the concept of "epistemic cultures" as an analysis of the diversity of practice in different scientific fields. For her, the cultural gap between sciences exists not only in their methods and tools, but also in the types of reasoning, and the ways to prove one's hypothesis. Although she empirically contrasted high-

energy physics with molecular biology scientists, conspicuously similar to Platt (1964), this gap also closely resembles the distinction between the "hard" and the "soft" sciences. She also makes a distinction between (1) *sensitive* and (2) *frigid* methodology. Sensitive ("soft") methodology thus requires involvement, contact, interest, and methodological inter-subjectivity, while frigid ("hard") methodology advocates for rigid absence, distance, disinterest (or impartiality), and neutrality.

In *The Manufacture of Knowledge*, Knorr-Cetina (1981) speaks about numerous contingencies and negotiations taking place in science laboratories, or the dubious ways in which scientists offer an "image" of themselves as actors "discovering" the (hard) facts about the world around us. Thus, she argues that the method of "hard" or natural sciences is actually remarkably similar to the method of "soft" or social sciences. This idea is not new, but Knorr-Cetina was among the first to offer empirical evidence for such claims. In a "hard" science laboratory, there are also many contextual contingencies, selections, negotiations, and opportunism in research, so that scientific work represents, in a way, "laboratory construction", or the "manufacture" of knowledge (Hacking, 1999).

In relation to this, Knorr-Cetina conceptualizes the idea of different *epistemic cultures* as "those amalgams of arrangements and mechanisms – bonded through affinity, necessity, and historical coincidence – which, in a given field, make up how we know what we know" (Knorr-Cetina, 1999: 1). This concept largely challenges the idea of the epistemic unity (and the hierarchy) of the sciences, suggesting that sciences are actually differentiated into *cultures* of knowledge. Epistemic cultures represent the ethnographic practices and beliefs that constitute the stance of a particular academic culture towards its knowledge, as well as the ways of justifying that knowledge within a society. Epistemic cultures may also be in conflict, like in the case of astronomy and high-energy physics (Heidler, 2017), or in terms of different patterns of scholarly communication (Cronin, 2003). Conflicting epistemic cultures present some obstacles for learning practices across communities, especially in cross-disciplinary settings (Mørk et al., 2008).

Researching and staying with high-energy physicists at CERN, and with molecular biologists at the Max Planck Institute, Knorr-Cetina analysed the work of the world's best scientists in these fields (Knorr-Cetina, 1999). Her conclusions point to significant diversity in these epistemic cultures, and thus their differences in terms of empirical work and ways of reaching conclusions. For example, the epistemic culture of high-energy physics is transnational and cosmopolitan ("urban"), while the epistemic culture of molecular biology remains individualistic and almost local ("rural"). The social interaction and communication among these scientists is also quite different. The concept of epistemic culture actually "cuts the idea of culture into smaller parts", locating culture in micro-sociological practices in actual scientific laboratories and other environments (such as scientific conferences) where knowledge construction is practiced.

According to this research, even laboratories in different "hard" (physical *versus* life) sciences do *not* share the same model of producing scientific knowledge. Each scientific discipline, and sometimes each laboratory, constitutes a different epistemic culture that prescribes what is adequate knowledge, and how that knowledge is acquired. This concept has therefore proven useful even for analysing the epistemic culture of homebrewers and microbrewers in their own beer "laboratories" (Rodgers and Taves, 2017). However, Knorr-Cetina's findings also directly relate to academic cultures in universities. Namely, there is a kind of epistemic culture of the OECD as a global actor, and its "agenda" for higher education in terms of a "knowledge economy" (Kallo, 2021). This organization's reviews and statistics manufacture different effects within and beyond its member countries, shaping the dominant educational policies in a given society (Kallo, 2021: 1).

Finally, she critically analyses the claim that contemporary Western societies have indeed become global knowledge societies, or societies that function through expert processes and expert systems, originating in ("hard") science (Knorr-Cetina, 2007). Like Latour (1993), she problematizes this popular and modern idea, or the widespread consensus that knowledge and expertise dominate Western societies, and that knowledge and information are central motives of overall social transformation, including the education and teaching practice. This is the key reason why it is necessary to return to the concept of culture as an environment of knowledge, and to one's culture as a structural characteristic of the so-called knowledge society.

"Hard" *versus* "soft" teaching: towards the common quality culture?

In his famous lecture and accompanying study *The Two Cultures*, a chemist and a writer Charles Percy Snow argued that contemporary intellectual life is characterized by a sharp *cultural* divide between the natural sciences and the humanities (Snow, 1959/2012). For him, this constitutes both a scientific and societal problem of the highest order, mainly because scholars from the social-humanistic field are often inadequately educated in the natural sciences, meaning they lack sufficient knowledge of these sciences and their findings (Snow, 1959/2012: 14–15). Snow also referred to "hard subjects" in his "Second Look" at *The Two Cultures* in 1963. When it comes to teaching, we are interested in whether it is possible to bridge this gap, and whether these "two cultures" can be integrated into a common academic culture dedicated to teaching quality.

Numerous studies have indicated that approaches to teaching vary considerably across academic disciplines. Since the 1970's, the most significant division that has emerged in research on academic subjects and their structure and organization at universities is the division into "hard" and "soft" (and pure/applied and life/non-life) sciences by Biglan (1973a, 1973b). When 222 scholars rated their perception of similarity between academic disciplines, the results

showed clustering along three main dimensions: a "hard/soft" dimension, a "pure/applied" dimension, and a "life/non-life" dimension (Biglan, 1973a, 1973b). This perception was later empirically validated (Smart and Elton, 1982) and revisited as a relatively strong and persistent construct or a heuristic (Stoecker, 1993; Simpson, 2017).

The manner in which scholars spend their time in research and education, the type of their scholarly output, and the type of funding sources used, do point to the popular distinction between "hard" and "soft" disciplines at the universities (Stoecker, 1993: 461), despite its problematic nature in the philosophy of science. The Biglan scheme (Biglan, 1973a, 1973b) thus remains "an important framework for studying academic diversity within the higher education system" (Simpson, 2017: 463). There is empirical evidence for different levels of commitment to teaching, research, administrative work, and service in the physical and social sciences, supporting Biglan's claim (1973b: 205) that "scholars in social sciences emphasize educating the whole student" as opposed to scholars in the physical sciences. This difference is observed even when assessing the quality of scientific work by the scientists themselves (Hemlin, 1993).

For these reasons, there are also greatly different perspectives on teaching and educational outcomes among scientists in "hard" and "soft" academic disciplines. Numerous contemporary studies (Trigwell, 2002; Lueddeke, 2003; Nevgi, Postareff and Lindblom-Ylänne, 2004; Lindblom-Ylänne et al., 2006; Postareff et al., 2008; Kemp, 2013; Stes and Van Petegem, 2014; Päuler-Kuppinger and Jucks, 2017; Kálmán, Tynjälä and Skaniakos, 2020; Milutinović, Lungulov and Lazić 2024) confirmed that approaches to teaching – which combine the strategies that university teachers adopt for their teaching, and the intentions underlying these strategies (Prosser and Trigwell, 1999; Trigwell and Prosser, 2004) – vary considerably across academic disciplines. The so-called "information transmission/teacher-focused" (ITTF) approach dominates among teachers from "hard" disciplines, while the "conceptual change/student-focused" (CCSF) approach prevails among teachers from "soft" disciplines. However, some results also showed that the teachers' academic discipline is not related to conceptual change/student focused (CCSF) approach (Stes, Gijbels and Van Petegem, 2008).

In addition to research on the relationship between academic disciplines and teaching approaches, there are also studies (Matofari and Edwards, 2017; Rotidi et al., 2017) that deal with the relationship between belonging to an academic discipline (or a faculty), contrasted to one's perspectives on teaching. Pratt (1998; 1992) thus identified (five) perspectives on teaching in higher education (transmission, apprenticeship, developmental, nurturing, and social reform perspectives) which determine what teachers do, and the reasons why their actions are considered valuable and justified in terms of education policies. Current research findings suggest that one's academic discipline, "tribe" or a "culture", still represents a strong indicator regarding the dominant teaching perspective (Milutinović, Lungulov and Lazić 2024).

For example, lecturers in "hard" sciences usually emphasize teaching specific facts and concepts directly related to their professional field, while lecturers in "soft" sciences focus more on acquiring broader and more global knowledge, critical thinking skills, problem-solving, as well as the personal development, and a certain system of values in their educational goals (Rotidi et al., 2017). Based on the research involving 80,000 seniors and 10,000 faculty members, it was found that so-called "deep learning" is more prevalent in "soft" rather than "hard" fields (Nelson Laird et al., 2008).[6] There are also differences among academic disciplines (and one's gender) when it comes to teachers' beliefs and intentions concerning teaching in higher education (Norton et al., 2005).

The relation between gender, science and one's academic discipline is a particularly interesting issue, and it brings several questions in mind: a) is there a feminization in certain sciences/academic disciplines, b) which sciences/academic disciplines are more exposed to feminization, c) how feminization impacts the status of certain science/academic discipline and d) does feminization of a certain science/academic discipline contribute to the reproduction of gender stereotypes? Analysing relations between gender and "hard–soft" sciences, Light, Benson-Greenwald and Diekman (2022) clearly demonstrated a link between women's numerical representation and the label of "soft" science. They also showed that "women = soft science" effect persisted among non-scientists and people "who perceive women to be less competent" (Light, Benson-Greenwald and Diekman, 2022: 9) and "when information is ambiguous" (Light, Benson-Greenwald and Diekman, 2022: 10). Thus, one's academic discipline and the gender of the teacher are the most important predictors for the acceptance of a specific teaching paradigm at the university (Singer, 1996). Finally, advocating the scientific basis for teaching skills (as well as teacher education), some scholars also raise the dilemma of whether teaching is a science or an art (Marzano, 2018).

There is a close connection between different teaching perspectives and approaches, and one's academic discipline or academic culture (Lindblom-Ylänne et al., 2006) which makes this concept a very useful heuristic in research. After all, the choice of a specific academic field by an individual is a consequence of various personal and socio-cultural factors, which is why certain interpersonal and intercultural differences among teachers from different disciplines (and differences regarding their teaching perspectives) can be expected. This is precisely why the "hard" sciences differ from the "soft" sciences in terms of how teachers perceive and approach teaching and learning. Typically, teachers in the "soft" sciences are more interested in teaching and oriented towards deep learning compared to teachers in the "hard" sciences (Rotidi et al., 2017).

With regard to teaching, the question arises whether it is possible to bridge the gap between the "two cultures" in an academic environment. In this paper, we argue that the concept of *quality culture* (Berry, 1997; Harvey and Stensaker, 2008; Ehlers, 2009) can largely contribute to this task. Quality in education has

6 Deep learning is an approach that emphasizes integration, synthesis, and reflection in learning. It is a "quest for acquiring higher-order competencies, namely critical thinking ability, problem-solving ability and innovation ability" (Weng, Chen and Ai, 2023: 1654).

been the focus of various reform efforts over the past few decades, aiming to provide higher quality, more efficient, and more competitive education for all, as well as to contribute to establishing and enhancing collaboration among different institutions and countries. Although the meaning of the concept of "quality" can be endlessly debated, and there is no consensus on its understanding (Doherty, 2005), the term "quality assurance" in education mainly refers to all policies, evaluation and assessment processes, and actions aimed at ensuring that institutions, curricula, and acquired qualifications meet specific standards of educational quality (Lungulov, 2022).

At the end of the 20th century, new questions and answers regarding the relationship between culture and society emerged, commonly referred to as the "cultural turn" (Bonnell and Hunt, 1999), including the interrelation of culture and education. Rather than being a consequence, culture became a factor that shapes other social phenomena. At the same time, fields such as business, industry, and management focused their attention on the so-called "organizational" (or "corporate") culture, referring to the ways of life and work (language, ceremonies, rituals, values, norms, beliefs, knowledge, symbols, etc.) within a specific company (Schein, 1992). The socio-political causes for this interest can also be found in the global success and competitive quality (of products) of Japanese companies after World War II, which were then attributed to cultural factors. The logic of organizational (quality) culture was then transferred to the domain of education, marking a shift from mere regulation to cultural matters (Berry, 1997). Globalization and neoliberalization (Sardoč, 2022) of higher education imply a new understanding of universities as instruments for ensuring economic productivity and international competitiveness (Rizvi and Lingard, 2010).

There exists a "quality movement" that affects both the private and public sectors worldwide, with an emphasis on culture in the corporate context (Berry, 1997: 54). Thus, (teaching) quality and culture are not mutually independent entities, since quality arises from a broader cultural perspective (Harvey and Stensaker, 2008). After the initial interest in quality in the domain of business or industry, and if we define culture as a "way of life", "quality culture first and foremost can be a tool for asking questions about how things work, how institutions function, who they relate to, and how they see themselves" (Harvey and Stensaker, 2008: 438). The quality culture in higher education thus focuses on cultural patterns (of educational institutions) such as rituals, beliefs, values, and everyday behaviours within on-going processes, norms, and rules (Ehlers, 2009), and which is of utmost importance for genuine quality improvement.

On the other hand, it can be argued that the discourse regarding "quality" is an inseparable part of a neoliberal corporate culture, and thus a key feature of commercialization and neoliberalization of higher education in contemporary societies (Bok, 2003; Rizvi and Lingard, 2010; Munch, 2014; Busch, 2017; Tight, 2019; Sardoč, 2022). The insistence on quality can also be viewed as an aspect of the "McDonaldization" of education, in terms of emphasizing the dimensions of efficiency, calculability, predictability, and control (or governance) (Ritzer 1993/2013). Thus, the "academic capitalism", and not academic or cultural

tribalism, is actually to blame when it comes to the contemporary hard-soft schism in research and teaching by scholars. In the public sphere and the academic debate, globalization (aptly named "internationalization" with regard to universities) has come to be associated with the liberalization of markets, the privatization of public goods and institutions, the growing power of multinational corporations, and the intensification of competition, summarized under the common, and often pejorative label "neoliberalism".

The effects of the neoliberal transformation of higher education (such as running public universities like they were private businesses) and of academic research (in terms of common scientometric criteria) are also reflected in the notion about the so-called hard and soft sciences divide in academia, and which is the main subject of this paper. For example, establishing a common metric between the different sciences (and humanities) regarding academic promotion can also be viewed as a trend which simulates and legitimates market competition among scientists and their universities, and in line with the neoliberal worldviews in the context of globalized inequalities (Stiglitz, 2003; Milanovic, 2016). For these reasons, the question is not whether we need a common "quality culture" at the university or not, but rather *what kind* of quality culture we need in higher education. Is it oriented towards (better) teaching and research, or is it mainly market-oriented?

Regarding this, a "quality culture" practice and mindset can also be criticized as yet another reflection of managerial and/or corporate culture which penetrated universities (at least) since the 1990s. Trowler also described recent changes in academia as a "neoliberal attack" on their "academic tribes", since universities are "open, natural systems, and not the ivory towers of legend" which are then touched by "outside forces" such as neoliberalism (see Trowler, Saunders and Bamber, 2012). In our view, the "tribal" academic cultures still resonate as an important variable, even in the neoliberal or globalized era of cultural homogenizaton. The need to promote a common quality culture in teaching, despite its neoliberal origins, is also viewed as a move towards bridging the epistemological, (meta)theoretical, and methodological gaps between the sciences. Nevertheless, we argue that this endeavour implies the need for the "softening" of "hard" sciences, and not vice-versa, as stated by Knorr-Cetina.

Knorr-Cetina's research (1999) on epistemic cultures should therefore be understood within the context of her vision of an (uneasy) *unity* of science, without or beyond epistemic reductionism and the neoliberalization of higher education. This includes both social and natural sciences, but implies a unity based on the principles of *social* sciences, rather than the proclaimed hierarchy of sciences. The basis for this new unity regarding teaching lies in the principles of communication and human emancipation, rather than in instrumental rationality, which, in her opinion, guides natural science and technology in our contemporary societies. In this sense, we believe that the concept of quality culture (in teaching) can help us in the search for common ground between "hard" and "soft" sciences, while also emphasizing the humanistic values in education. Today, there is also the possibility of "converging epistemic cultures" on the micro-level of everyday research practices (Kastenhofer, 2007).

Although each educational institution is specific and therefore has a relatively specific ("organizational") culture, certain efforts can stimulate common cultural values and beliefs among all stakeholders towards enhancing quality. Thus, quality culture in educational institutions, in practical terms, also involves the following: encouraging and facilitating quality improvement in education, monitoring and evaluating progress in quality improvement, promoting quality partnerships among educational institutions, planning, managing, and assessing quality systems, training and consulting in quality matters, as well as providing advice directed towards management (administration of educational institutions), and similar activities (Berry, 1997: 52). Despite certain neoliberal and/or entrepreneurial doctrines, there *is* a need to promote a quality culture that enables individual actors and institutions to continuously improve their educational practices in line with public, social, and humanistic values.

Conclusions

Even though the distinction or chasm between "hard" and "soft" sciences persists in discourse, research and practice, "it is rather surprising that there is much discussion, but little evidence about (their – n.a.) difference" (Pigliucci, 2010: 13). Several research attempts have been undertaken to measure the differences (Hedges, 1987; Howard, 1993), but "empirical analyses of the content of hard vs. soft sciences have failed to find clear evidence of objective differences along the continuum" (Light, Benson-Greenwald and Diekman, 2022: 2), mainly due to the complexity of the research subject and the nature of determinism involved. Based on recent inter/trans-disciplinary trends in science, along with the hardening the "soft" sciences and softening the "hard" ones (Pigliucci, 2010), one can ask whether the "hard–soft" sciences distinction will be a (valuable) means to think about sciences in the future. Moreover, as Pigliucci asked (2010: 7), is there only one "proper way to do science"?

Despite the epistemic rationale for overcoming the "hard–soft" sciences distinction, it sustains due to entrenched habits, patterns, cultures and stereotypes. One might also question whether this distinction is just an excuse for the market-driven funding preferences favouring sciences that yield practical, commercially applicable knowledge. Also, "hard–soft" sciences distinction could be further analysed within a specific political context, having in mind the ratio between the political and scientific power and the critical potential inherent in certain science disciplines (Shapin, 2022).

When speaking of the "hard–soft" sciences distinction and teaching, the analysed facts and evidence lead to the conclusion that universities and their teaching are not homogeneous (as sciences are not homogeneous, as well), but relatively heterogeneous entities with different "tribes and territories" (Becher and Trowler, 2001) or "epistemic cultures" (Knorr-Cetina, 1999), and therefore with different or even conflicting teaching perspectives. At every university, there are different academic traditions, or various categories of thought and behaviour with different socio-cultural characteristics – norms, values, patterns of interaction, lifestyles, as well as moral and pedagogical codes (Ylijoki, 2000).

Therefore, any understanding of the teaching process at the university must encompass knowledge regarding its academic culture, environment, or the social context in which teaching takes place, as well as the views of lecturers towards teaching, their educational objectives, values, philosophies, and accompanying teaching perspectives (Neumann, 2001). Insights from the anthropology of science and sociology of education, and their intersection, can offer valuable insights into overcoming the "hard–soft" distinction in sciences, and initiate a deeper examination of different academic cultures or epistemic "tribes" in terms of their teaching and worldviews.

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