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The Reviews of Concepts in Knowledge Organization

The Purposefulness of Classification

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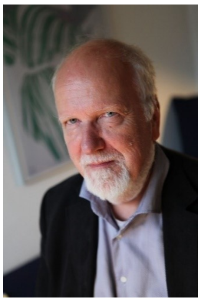

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Abstract

This article argues that all classifications serve some purposes better than others, and therefore that the idea of an all-purpose classification is untenable. This should not be confused with the view that any classification is as good as any other, either for a specific purpose or for a wider range of purposes. It follows that the aim of a theory of classification is to develop criteria for constructing a classification that best serves a particular aim, and that unclear purposes pose difficulties for this aim. The article discusses a recent paper by Claudio Gnoli that defends the view that an all-purpose classification is possible. The problem of the purpose-laden nature of classification is related to issues such as classificatory pluralism versus monism, realism versus idealism, objective versus subjective classification, and natural versus artificial classification. The article briefly connects such different dichotomies to the issue of the purpose-laden nature of classifications.

Keywords: classification; purposefulness; natural classification; classificatory pluralism

1. Introduction

In a recent paper, Gnoli (2025c) set forth the argument that it is possible to design an all-purpose classification — that is to say, a classification that serves all purposes equally well. In doing so, he explicitly argues against domain analysis[1], which, as he writes (p. 1), claims that "any classification reflects particular perspectives and purposes. This [domain analysis] implies that there are many alternative ways to identify real, natural kinds and to group them, none of which would be superior to the others". This is correct if it is understood in the way that no classification is superior to others *in all respects*. The present article examines Gnoli's arguments, and provides arguments that an all-purpose classification is impossible, while at the same time illuminating the distinction between artificial and natural classifications, where the last kind provides better *general* applications[2]. That an all-purpose classification is impossible is taken to mean that all classification serves some goals better than others, and therefore that a classification that claims to be neutral (serving all purposes equally well) in reality prioritizes some purposes at the expense of others. Classification is necessarily a purpose-driven activity, even when this is not recognized by the classifier[3]. The article also points out a range of associated theoretical and philosophical concepts in need of further exploration in knowledge organization (KO).

Section 2 presents five examples to set the stage and provide some initial views on the purposefulness of classifications: (2.1) An account of a lecture on classification provides a simple example intended to make the reader reflect on whether criteria for classification can be established without considering the purpose of the classification; (2.2) A quotation from the pragmatist philosopher John Dewey articulates the purpose-laden nature of classification and connects it with the tradition of pragmatism in philosophy; (2.3) A quotation from the writings of the philosopher John Stuart Mill challenges the pragmatist view somewhat by distinguishing between artificial and natural classifications; (2.4) A statement about the classification of living organisms presents an updated view from biological classification illustrating different purposes for the classification of organisms. Finally, (2.5) A brief observation by two philosophers of science about how members of a particular community of interest (*in casu*, carpenters) require a classification of wood that addresses their specific needs leads to a consideration of the issue of classificatory pluralism.

Section 3 presents a range of important philosophical concepts: (3.1) objectivism and objectivity, (3.2) pluralism, (3.3) realism, (3.4) essentialism, (3.5) theory-ladenness, (3.6) natural kind and natural classification, and (3.7) levels of reality. This section is motivated by two considerations: (1) by the fact that, in the course of his argumentation, Gnoli (2025c) uses these terms differently from the way that I do and (2) by the need to discuss the meaning of these terms within knowledge organization (KO) in order to improve the precision of theoretical arguments within this domain more generally.

Section 4 presents and discusses Gnoli's (2025c) arguments for the possibility of constructing an all-purpose classification, which implies a critique of domain analysis. Gnoli's arguments are most explicitly examined and discussed in this section, although this is also done in other sections. Gnoli's arguments are examined in three subsections: (4.1) Gnoli's presentation of domain analysis, (4.2) Farradane's principle of "unique definition", and (4.3) issues on interdisciplinarity.

Section 5 provides the overall conclusion of this article.

2. Some Examples Demonstrating the Purposefulness of Classification

2.1 A Lecture on Classification

In a lecture on classification for an international class of master's students (MA) students in information studies, the present author asked the class to perform a brainstorm suggesting criteria on how to classify the participants in the class. I wrote the students' different suggestions on the blackboard. Among the many ideas were:

- By sex/gender (men, women, …)	- By nationality
- By age	- By preferred food
- By size	- By background and former studies
- By hair color	- By interests
- By blood type	- Etc. etc.

After some time, new suggestions slowed down, and some uncertainty spread among the students. Then one of them said: But that depends on the purpose of doing the classification. Yes, I answered, it seems hopeless to continue this task without a given purpose, as there are infinitely many ways to classify any set of items. People can be classified in one way if the purpose is to dress them, in another way if it is about ordering meals for them, in a third way if it is about medical precautions, in a fourth way if it is to match students for group work in this class, or if the purpose is to adapt the teaching to the students' prerequisites, etc. While an infinite number of classifications are possible, the question is not primarily which of these are objective, but which are *relevant*[4]. This point is my most important one in this course.

This example is intended as a challenge for defenders of all-purpose classifications. How would such a classification look, given this example?

2.2 The Pragmatist Philosopher John Dewey

As regards classification, pragmatist philosophers generally emphasize practical consequences and usefulness over rigid, pre-defined categories. They also suggest that classifications should be evaluated based on their ability to help us achieve our goals and solve problems, rather than on inherent or essential properties of the objects being classified. The pragmatist philosopher Dewey (1948, pp. 151–154) wrote:

> No sensible person tries to do everything. He has certain main interests and leading aims by which he makes his behavior coherent and effective. To have an aim is to limit, select, concentrate, group. Thus a basis is furnished for selecting and organizing things according as their ways of acting are related to carrying forward pursuit. Cherry trees will be different grouped by woodworkers, orchardists, artists, scientists and merrymakers. To the execution of different purposes different ways of acting and re-acting on the part of trees are important. Each classification may be equally sound when the difference of ends is borne in mind.
>
> Nevertheless, there is a genuine objective standard for the goodness of special classifications. One will further the cabinetmaker in reaching his end while another will hamper him. One classification will assist the botanist in carrying on fruitfully his work of inquiry, and another will retard and confuse him. The teleological theory of classification does not therefore commit us to the notion that classes are purely verbal or purely mental. Organization is no more merely nominal or mental in any art, including the art of inquiry, than it is in a department store or railway system. The necessity of execution supplies objective criteria. Things have to be sorted out and arranged so that their grouping will promote successful action for ends.

While this quote clearly expresses the essential tenets of pragmatist philosophy, it ignores a problem formerly raised by, among others, John Suart Mill in 1872, to which we now turn.

2.3 Philosopher John Stuart Mill

For centuries, there has been a distinction between "artificial" and "natural" classification, which we shall consider further in Section 3.6. Here we shall briefly consider Mill's (1872, p. 498) distinction between on the one hand a natural or proper scientific and philosophical classification, and, on the other hand, an artificial or technical classification. The concept of natural classification (and natural kind) has been intensively researched in recent philosophy, and so we shall return to it in Section 3.6. Here we just present the concept of artificial classification, which Parry and Hacker (1991, p. 133) explained in accordance with Mill's understanding:

> For example, one may divide rocks—or even animals—into those weighing less than ten grams, those weighing at least ten but less than twenty grams, and so on; but this is likely to be of little use, except perhaps for knowing what it would cost to mail them.

Although Mill's intention was to show the general usefulness of natural classifications, this example clearly demonstrates that to perform certain practical tasks, such as mailing objects, some classifications are needed, although they may be of little use for most other purposes. It is hard to imagine an all-purpose classification, say of rocks, that would be optimal for both mailing them and for exploring their chemical properties and industrial potentials. Again, this example is intended as a challenge for those who want to argue about the possibility of constructing an all-purpose classification.

2.4 Classification of Living Organisms

Now we shall turn to classification in contemporary science. Transdisciplinary researcher and philosopher David Ludwig and professor of philosophy of science Stéphanie Ruphy wrote the following in the article "scientific pluralism" in *Stanford Encyclopedia of Philosophy* (2024, Section 4.1):

> [B]iologists discover many details about the structure of the biological world, including an ever-increasing amount of knowledge about the ecological, ethological, genetic, morphological, reproductive, and phylogenetic properties of organisms. However, this knowledge does not culminate into one uncontested and objective division of the biological world. Biologists do not have access to one objective "view from nowhere" but their taxonomies reflect diverging perspectives that are shaped by diverse (e.g., ecological, ethological, evolutionary) research interests and attention to heterogenous (e.g., bacteria, dinosaurs, mosses) organisms. Given this diversity of research questions and reference organisms, biologists pay attention to different properties of organisms and operationalize species in different ways. The reality of biological research practices does not seem to support the idea of convergence towards one absolute scientific conception of the biological world.

This quote expresses a pluralist point of view regarding biological classification: that there is a need for more than one classification of organisms. Pluralism versus monism will be further discussed in Section 3.2. We shall also see that the periodic table of the chemical elements seems to be the best candidate for a natural classification.

2.5 Carpenters' Need for Classification of Wood

The last example is very much like the one provided by Dewey (1948) but also addresses the question of scientific versus non-scientific classifications. Philosophers of science Vincent Cuypers and Thomas Reydon (2023, p. 5) wrote:

> A shipbuilder or carpenter is unlikely to be bothered by evolutionary or phylogenetic considerations, but rather by the properties and the quality of the wood in their hands. While these non-scientific classificatory programs might be seen as irrelevant by biologists, they should be acknowledged in philosophical analysis, because of the interaction between non-scientific and scientific classificatory programs.

This example underlines the different needs of, for example, biologists and carpenters, but rather than seeing the difference in these classifications as scientific *vs.* non-scientific, it is here suggested to characterize them as natural versus technical/artificial classifications, as presented in Sections 3.3 and 3.6, and thus downplay the difference scientific and non-scientific classifications: a general theory of classification should cover both.

These five examples support the view that an all-purpose classification is impossible, although there is no consensus regarding pluralism in scientific classification. Before considering Gnoli's arguments, some important concepts need to be presented, although these concepts need much more attention in KO than can be given in the present article.

3. Some Important Philosophical Concepts Related to Classification

Gnoli (2025c) used some philosophical concepts, which we — along with a few more — want to discuss in the present section. This Section is subdivided as follows: 3.1 objectivism and objectivity, 3.2 pluralism, 3.3 realism, 3.4 essentialism, 3.5 theory-ladenness, 3.6 natural kind and natural classification, and 3.7 levels of reality. These concepts are often used in a loose and overlapping way in the literature, including by Gnoli. Our goal here is to try contributing towards some consensus about their meanings.

3.1 Objectivism and Objectivity

The most important distinction in Gnoli's paper is between "objectivism" versus "multi-perspectivism"[5]. However, the word "objectivism" is in the philosophical literature often reserved to be about ethics and especially a philosophical system developed by Ayn Rand (cf., Badhwar and Long, 2025)[6]. It is also used in a way closer to the one used by Gnoli: about the view that various kinds of judgements are objective, i.e., pertain to objects, as opposed to subjectivism, that such judgements are subjective, i.e., pertain to the people who express these judgments[7]. Bryant (2000, pp. 20–28), and others use objectivism in a sense that seems identical to the way it is used by Gnoli (2025c), but her concept of objectivism seems to mix a set of other concepts, such as objectivity, realism, and monism, which are better considered separately[8].

The dichotomy that Gnoli emphases is therefore better labeled monism versus pluralism, and the term objectivism can be seen as a near-synonym for objectivity. If we return to example 2.1, the core question is not whether people can be classified objectively according to sex/gender, hair color, nationality, etc. (of course, this may also be a problem, consider, for example, the critique of the binary classification of sex/gender). However, the focus here is whether there is one correct way of classifying people (monism), or whether there are more ways (pluralism), which each are best to serve a specific purpose.

The term "objectivity" stands in contrast to subjectivity, where the last term means that a judgement is influenced by the opinions, beliefs, and feelings of conviction of an individual or a group of individuals (intersubjectivity). However, these two concepts are not necessarily opposites, as pointed out by Matheron (1989, pp. 26–27):

> We shall not dwell at such length on the notion of subjectivity, insofar as it refers to the opinions, beliefs, and feelings of conviction of this or that individual. Let us mainly note that this is not in any way the logical opposite of objectivity. People said to be "reasonable" or "sensible" will often give their (subjective) agreement to a well-corroborated (objective) statement such as "when an apple becomes detached from a tree, it falls down and does not fly towards the stars". In that sense, obviously, any probabilistic statement, insofar as some individual expresses his support for it, can always be said to be subjective. But this does not exclude a priori its objectivity. An objective law, such as the law of universal attraction, insofar as I believe it to be "true" can also be said to be subjective, since it does, in fact, represent my personal opinion.

Reiss and Sprenger (2020, Section 8) found that "it should come as no surprise that finding a positive characterization of what makes science objective is hard". Scientific methodology often contains specific procedures on how to avoid subjectivity in research, e.g., by prescribing double-blind experiments in which neither the researchers nor the test subjects know which subjects receive the actual drug to be tested and which subjects receive an inactive drug (a placebo). While such methodologies may limit certain forms of bias and subjectivity, they do not guarantee objectivity because data do not interpret themselves. Theories and models shape how scientists understand and explain results, which introduces conceptual perspectives that are not purely "objective". In the wake of Kuhn (1962), it is broadly accepted that scientific knowledge represents the theoretical view, tradition and paradigm of its originator. People may share the same subjective view, but this does not make the view objective, but public (as public knowledge should not be confused with objective knowledge).

A common belief is that positivism is an epistemology that seeks objective truths, whereas "soft" epistemologies like hermeneutics and feminist epistemology are subjective and have no ambition of being objective. However, objectivity should be an ideal for all epistemologies. Best (2000, p. 271) wrote in his review of Harding (1998):

> [Harding] seeks to replace the 'weak objectivity' of the male-dominated scientific world — a pseudo-objectivity riddled with value-laden theories, political biases, domineering interests, commodified research, and blinkered ethical vision — with the 'strong objectivity' that comes only from a 'robust reflexivity' attained through a rigorous self-scrutiny of one's socio-epistemological starting point. Harding notes that the very concept of 'value-free knowledge' is oxymoronic, because the goal of being disinterested is an interest in itself, and it allows science to separate fact from value and abrogate responsibility for its actions. Since 'value-free' theories are impossible, Harding argues, one might as well acknowledge the values that inform one's research, whether they include making money or improving the lives of the sick, and debate their comparative validity, and struggle to have science informed by progressive interests[9].

Best concludes (p. 275): "As Harding ably shows, the politicization and pluralization of knowledge is not necessarily a threat to (strong) objectivity, but one of its preconditions".

This quotation is important. It says that what are often regarded as soft, subjective methods may be a precondition for "strong objectivity". In the same way historian Haskell (1998) argues that "objectivity is not neutrality", meaning that while an important ideal in science is to strive for objectivity, it is not necessarily a problem that researchers are engaged or have interests in the object of their enquiry. (Of course, researchers must not engage in nepotism, have conflicts of interest, or let their interests lead them to ignore contradictory arguments.) For example, feminist scholars have provided important corrections and supplements to our historical knowledge about women.

We may conclude that objectivity may be considered an ideal for inquiry, and that researchers may often believe their findings are objective. However, after Kuhn any such claim of objectivity may turn out just to be an (inter)subjective belief, and further, as described by Axtell (2016, p. 90), norms of science, including the norm of objectivity, have a history themselves (Daston and Galison, 2007). Broad and deep knowledge is the best guard against premature belief in the objectivity of a given claim, but whereas it is often possible to trace subjective influences, it is impossible to fully guarantee the objectivity of a claim.

3.2 Pluralism

There exist many alternative classifications of everything (e.g., birds)[10], but as Cuypers and Reydon (2023, p. 38) write, it has been a long-standing scientific goal to produce a single all-purpose taxonomy of scientific phenomena[11]. Today, however, many philosophers and scientists have advocated forms of classificatory pluralism[12]. This entails that multiple classifications should be allowed to coexist, and that whichever classification is best, depends on context, interests and theoretical outlook. Cuypers and Reydon (2023, p. 4) wrote:

> The fundamental tenet of classificatory pluralism is that classifications can only be understood and assessed in connection with the specific aims and objectives for which they are produced. In the case of folk or practical taxonomies, that is not very controversial, but in the case of formal, scientific taxonomy it is, given its aspiration to construct context-independent all-purpose classifications. However, even if the sole aim of a classification is to map the biosphere, i.e., to accurately represent the diversity of life, it can be argued that the best way of doing so depends on the exact representational aims one has in mind and on which components of diversity one wants to prioritize, such as reproductive isolation, morphological or molecular differentiation or ecology. Advocates of classificatory pluralism tend to stress that classificatory disagreements can usually be understood by keeping in mind the fact that classifications are conceived from different perspectives, with different aims in mind. Different aims might obviously favor different classifications, which leads to conflict if it is a separate aim to set one classification as context-independent gold standard.

Pluralism is often associated with the philosophical concept "contingent" (i.e., subject to chance as opposed to being necessary), for example in the sense that scientific representations and models deliver partial, interest-dependent, hence contingent representations of the world. As Ludwig and Ruphy (2024, Section 2.2) wrote, pluralism is contrasted to monism[13]:

> This pluralist stance is contrasted with a monist view according to which science ultimately aims at establishing a single, complete, and comprehensive account of the world (Kellert, Longino, and Waters, 2006b: x). An analogy with maps (Winther, 2020) is often employed to explain that such a pluralist stance is compatible with some form of "minimal" (Longino, 2002) or "modest" realism (Kitcher, 2001). Which aspects of a part of the world are represented by a cartographer depends on the intended use of the map, hence the production of a plurality of maps, whose conformity with the real world can be assessed on pragmatic grounds through successful use. Similarly, science produces a plurality of partial representations of a given phenomenon, depending on various epistemic and practical interests, whose conformity to the real world can be assessed on empirical grounds.

The view that one kind of map of a given country may be the best to serve all purposes therefore represents the monist point of view, whereas the view that that, for example, road maps, topographic maps, tourist maps and geological maps each are optimal for a given purpose represents the pluralist point of view.

It is important to consider that pluralism may not be equally plausible in different domains. Stamos (2004, pp. 137–138) in his book review of Bryant (2000) wrote:

> A final problem with Bryant's argument for pluralism in science, is her implicit position that pluralism is or ought to be an either all or nothing affair. Logically, this is a false dichotomy, for one can be a pluralist in one area and a monist in another. Moreover there may even be strong reasons to support such a position. […] A strong argument for pluralism can be made in the case of the gene (which oddly Bryant ignores), a plausible argument can be made in the case of species taxa, but can a strong or even plausible argument be made in the case of chemical elements? Bryant thinks a strong argument can be made [but Stamos rejected Bryant's arguments concerning pluralism in relation to classification of chemical elements][14].
>
> Summing up, pluralism is the view that:
>
> • There is no single, uniquely correct way to classify the world.
>
> • Different domains, perspectives, and purposes may lead to equally legitimate yet incompatible classifications.
>
> • Classifications are often theory-laden, interest-relative, and context-sensitive.

Classificatory pluralism stands in contrast to classificatory monism, which holds that there is (or should be) one correct system of classification that reflects the true structure of the world—often associated with natural kind realism and essentialism.

3.3 Realism

The basic idea of realism is that a mind-independent reality exists, for example, that the Earth existed before humankind and that its existence does not depend on man's thinking and knowledge. The opposite view is termed idealism (all that exists are ideas in our minds). The idea that something exists independent of our mind is called metaphysical realism[15]. Metaphysical realism is different from claiming that a given text or theory reflects reality, or that a given scientific methodology provides a representation that mirrors the world, or the view that science approaches an objective representation of the world. The view that the world is as we see it, is called naïve realism, which is contradicted by knowledge of optical illusions and by the fact that scientists often see and describe phenomena differently from non-experts[16].

After Kuhn (1962), scientific knowledge is understood as formed by paradigms and scientists working in different paradigms see the world differently and describe it differently. Kuhn was therefore not a realist in the meaning that science provides an objective picture of the world. He found, however that the world provides "resistance" to our conceptualizations in the form of anomalies, i.e., situations in which it becomes clear that something is wrong with the structures given to the world by our concepts. This view represents metaphysical realism.

Different positions in the philosophy of science—such as positivism, pragmatism, critical realism, and hermeneutics—offer distinct views on how research should be conducted and how knowledge relates to reality[17]. (It is a common mistake to consider empiricism as a realist philosophy, but these are distinct philosophies, see Dilworth, 2007, chapter 1 and 9). While most researchers aim to produce knowledge about the world, they differ in their conceptions of "reality" and in what they regard as valid, objective, or realistic knowledge. This is the case even for those, who call themselves "anti-realists"[18]. Thus, the key issue is not whether they accept or reject metaphysical realism, but how they interpret reality considering epistemic values such as neutrality, detachment, replicability, historicity, reflexivity, and standpoint.

In relation to classifications, the realism-idealism distinction is different from the monism-pluralism distinction. The first is about what classifications reflect reality, the second is about what classifications are relevant (see again example 2.1). However, classifying reality is sometimes understood in opposition to classifying concepts (e.g., Oderberg , 2013)[19], a distinction that has been criticized by Hjørland (2021, + in press), because concepts represent reality in scientific taxonomy.

3.4 Essentialism

The most common understanding of essentialism is that some properties of an object are necessary for the object to be the kind of thing that it is, whereas other properties are dispensable. In addition, essentialism implies that a set of necessary and sufficient properties defines an object (see, e.g., Hull, 2007, p. 47). Aristotle made a distinction between the essential and accidental properties of a thing. He defined "man" as "rational animal", implying that possessing an intellect and sharing the characteristics of animals is central to humanity, whereas hair color is not, it is an accidental property (see further Charles, 2000). However, essentialism is a philosophical concept with a long and complex history, which has important implications for classification and knowledge organization. An important source for this history is the *Routledge Handbook of Essence in Philosophy* (Koslicki and Raven, 2024).

Gnoli (2025a, pp. 78–79) wrote:

> Essentialism assumes that good kinds can be defined precisely by a set of properties that need to be all present in order for an entity to be part of the kind. Squares are all and only the rectangles in which all four sides have the same length. This sounds very rational, but outside mathematics, it can only be applied in some cases where nature shows clear borders: for example, a chemical substance can be said to be gold if and only if it is made of atoms with 79 protons: either it is gold, or it is not.

Mathematics is a formal science, but in all empirical sciences the problem is whether nature ever shows clear borders. Gnoli mentions the number of protons (= atomic number) to be the clear border distinguishing chemical elements. Although this is probably the best example of natural kinds and essential properties, even this example is not unproblematic. Clearly, if nature sometimes shows clear borders which everybody agrees on, these will define natural kinds, and the concept would not be controversial. The problem is that different theories disagree on how to define a stuff like gold, and whether one theory is superior for all purposes[20]. Until the early 20th century atomic weight, not atomic number, were considered the defining characteristics of the elements, but Wray (2018, pp.118–124) argues that the discovery of atomic numbers, provides an example of a Kuhnian revolution in science. It was found at that time that while isotopes of the same element have different physical properties, their chemical properties were the same, thus defining chemical elements. Later it turned out, however, that chemical properties may also differ, although usually only slightly (see Needham, 2008)[21], and this also questioned the traditional distinction between physical and chemical properties. The issue therefore is still not settled, cf. van Brakel (2012) and Vandewall (2007), the latter of whom wrote (pp. 911–912):

> Where the essential/accidental distinction becomes less easy to draw, however, is with intrinsic qualities like the number of neutrons in a nucleus. Uranium-235 and uranium-238 are, in one sense, both 'essentially' uranium, as they share the same atomic number. But the extra neutrons give the atoms quite different properties—one is intensely radioactive and the other is stable. It is unclear in this case whether having a particular number of neutrons constitutes an accidental or an essential intrinsic property. This is a serious problem, not just for radioactive elements.

Essentialism is a disputed concept today. In relation to scientific classification, there has been an influential "essentialist story", claiming that essentialism as a philosophy has produced "two thousand years of stasis" in taxonomy (cf., Hull, 1965a; Hull, 1965b). This story claimed that all classifications before Darwin, including Aristotle's and Linnaeus's, were essentialists, but Darwin and followers overcame this philosophy. This historical view is now generally considered a misleading myth (cf., Richards, 2016, pp. 36–38; Winsor, 2006; Hull, 2007).

Essentialism has been considered one approach to classification conflicting with other approaches, but the nature of essentialism itself is interpreted differently in, for example, the analytic tradition, the phenomenological tradition and the pragmatic tradition in philosophy. Because Gnoli's article argue against the pragmatic view of the domain-analytic view, it should be said that according to Howat (2024, p. 53) "[i]t is a popular assumption that pragmatists are anti-essentialists;" but Howat rejected this view[22].

It seems reasonable to be critical of universalist versions of essentialism — that some properties are essential in all contexts – and rather to consider essential notions necessary for a given theoretical framework. Given a (scientific) theory, some core concepts are essential (e.g. "the unconscious" in psychoanalysis, but not in behaviorism and cognitivism), and as theories change or develop towards more mature theories, so do the essential concepts.

3.5 "Theory-ladenness"

Whereas traditional philosophies of science, such as empiricism and logical positivism, considered observations and empirical data the basis of research, on which to develop and evaluate theories, contemporary theory tends to consider observations and theories as intertwined. Boyd and Bogen (2025, Section 5) wrote:

> On an earlier way of thinking, observation was to serve as the unmediated foundation of science — direct access to the facts upon which the edifice of scientific knowledge could be built. When conflict arose between factions with different ideological commitments, observations could furnish the material for neutral arbitration and settle the matter objectively, in virtue of being independent of non-empirical commitments.

Further:

> This version of empiricism with respect to science does not accord well with the fact that observation per se plays a relatively small role in many actual scientific methodologies, and the fact that even the most 'raw' data is often already theoretically imbued. The strict contrast between theory and observation in science is more fruitfully supplanted by inquiry into the relationship between theorizing and empirical results. Contemporary philosophers of science tend to embrace the theory ladenness of empirical results.

The theory-ladenness of classifications means that the criteria of classification are derived from a theory (e.g., cladistic classifications are derived from Darwin's theory of evolution). The opposite position is that objects are classified in theory-neutral ways. For example, by their overall similarity, in which the description of the items is supposed to be objective, and the classification of items is made by neutral, statistical methods. In biology the best candidate for such non-theoretical classification is known as "phenetics" or "numeric taxonomy". Although all classifications are theory-laden (whether they acknowledge it or not) they recognize their theory-ladenness to different degrees: some foreground their dependence on the theories on which they are based (and in this sense valorize the "subjective" nature of the classification), while others deny, downplay, or even suppress their dependence on the theories on which they are based (and so typically valorize the "objective" nature of the classification).

The perspective of theory-ladenness influences many issues in this article, for example, objectivity and bias. However, here we will concentrate on the dichotomy between phenomenon-based versus discipline-based classification that has often been addressed in KO (e.g., Gnoli et al., 2024), and which is central to Gnoli's (2025c) views on classification. While both phenomenon-based and discipline-based classification may be theory-dependent (e.g., Gnoli's (2025c) phenomenon-based view depends on the theory of integrative levels). It will be argued below that the concept of theory-based classification has thus far not been recognized within the professional discourse on knowledge organization. First, however, some general issues are considered.

It is often assumed and stated by supporters of phenomenon-based classification that users, in particular interdisciplinary users, will benefit more from a phenomenon-based classification compared to a discipline-based classification. But how supported is this assumption? Mills and Broughton (1977, p. 37), defending discipline-based principles, wrote that a phenomenon-based classification

> [W]ould run counter to the way we usually study things and the way most information is marketed, which reflects the division of labor by discipline. There are relatively few persons, if any, specializing in a given phenomenon from all its aspects. Indeed, such a specialized study would require a training which is at present hard to envisage.

Mills and Broughton further noted "that the factual literature for children has always shown a strong tendency to concentrate on phenomena rather than disciplines — e.g., 'the big book of trains' which considers most aspects of the railway system". This example may reveal a certain naivety in the belief that phenomenon-based classifications will best serve professional users: These may be better suited for children or for people who want a superficial overview of all aspects of a phenomenon.

There is a more serious problem with phenomenon-based classifications, which has so far not been considered in the literature of KO: To identify the phenomena, one must consider discipline-based theories. For example, "The Basic Concepts Classification" (BCC) is a phenomenon-based classification developed by Szostak (2013) and further described in Szostak (2020). Szostak states: "We have in 2021 changed our F [Flora and Fauna] schedule to reflect advances in cladistics". By implication, BCC considers many well-known classes of animals, e.g., fishes, as "Hypothesized Species". The point here is that it is only possible to classify animals from one or another perspective, e.g., by "folk classification" (admitting fishes) or by a cladistic theory from contemporary biological systematics (not admitting fishes). Most works on integrative levels in KO, including Gnoli (2025c), fail to consider these more detailed levels (such as classification of animals), and fail to consider how the concepts in the classification relate to scientific theories in their respective domains.

Therefore, there is a third possibility beyond discipline-based and phenomena based classification: theory-based classification, and this third position seems to be the most important one, but it is totally unrecognized in KO. Although the theory-based classification tends to classify phenomena, it denies that these can just be identified and classified in absence of theoretical contexts, just as contemporary philosophy of science considers empirical data as theory-laden. This view leans towards the discipline-based approach because, as Bensaude-Vincent (2008) exemplifies in chemistry, (here cited from Labarca and Lombardi, 2009, p. 184) "the ontology of chemistry arises not only from cognition, but also from action driven by caution, utility and efficiency; therefore, the world of chemistry is the result of the very nature of the discipline—science and technology".

Gnoli (2025c, p. 8) wrote:

> [T]he connections between phenomena, those between phenomena and the theories studying them, and those between phenomena and the methods to investigate them, can be expressed and managed by analytico-synthetic techniques already developed in faceted classification (The León Manifesto, 2007).

Gnoli and the other signatories of the León Manifesto hereby consider phenomena and the theories that study phenomena as independent existing entities that can be classified separately. However, because phenomena and theories are intertwined, this is a problematic assumption. As Albert Einstein said: "It is the theory which decides what we can observe" (cited from, Heisenberg, 1989, p. 40), indicating that phenomena and the theories studying them cannot be separated the way suggested by the León Manifesto. While many phenomena, such as planets and birds, seems to be robust, they are still theory-dependent (for example Pluto is no longer classified as a planet, the concept "bird" has changed according to cladistic research, and the concept "the common blackbird (Turdus merula)" changed rather dramatically according to recent DNA-based studies (cf., Fjeldså, 2013, p. 141)[23].

3.6 Natural Kind and Natural Classification

The concept of natural kind has a long tradition in philosophy and in science[24]. Natural kinds and natural classification are here understood to be interdependent: belief in natural kinds often underpins natural classifications, and vice versa, and for classification this connection is important[25]. The dichotomy between natural and artificial classification was most influentially introduced by Carl Linnaeus, although the distinction has deeper historical roots. Linnaeus himself did realize that his own system was not natural, although he saw it as an ideal to be so[26]. Mill (1872, p. 498) also suggested that the Linnaean arrangement was not natural, and therefore not an adequate scientific classification:

> The Linnaean arrangement answers the purpose of making us think together of all those kinds of plants, which possess the same number of stamens and pistils; but to think of them in that manner is of little use, since we seldom have anything to affirm in common of the plants which have a given number of stamens and pistils.

Before we consider Mill's definition of a natural classification it should be mentioned that Adanson (1763) opposed Linnaeus's classification based on a few characteristics (in flowering plants, stamens (male reproductive parts) and pistils (female reproductive parts)). Instead, Adanson classified plants based on many anatomical features, an approach that he and his followers considered "natural classification". Adanson's approach is related to "phenetics" or "numerical taxonomy" developed in the 20th century (Sneath and Sokal, 1973). However, this phenetic approach to classification is also criticized for not being "natural" (see, e.g., Ereshefsky and Reydon, 2023, p. 247).

Mill (Ibid.) suggested the following definition of natural classification:

> The ends of scientific classification are best answered, when the objects are formed into groups respecting which a greater number of general propositions can be made, and those propositions more important, than could be made respecting any other groups into which the same things could be distributed.
>
> ...
>
> A classification thus formed is properly scientific or philosophical, and is commonly called a Natural, in contradistinction to a Technical or Artificial, classification or arrangement.

In the words of Parry and Hacker (1991, p. 139).

> [A classification] is fruitful to the extent that it suggests new hypotheses, explanations, and theories concerning its subject matter. For example, the periodic table — the classification of the elements — proved extremely fruitful, since it suggested the existence of hitherto unknown elements and even suggested what physical properties they would have. It should be noted that natural classifications, by definition, are more fruitful than artificial ones[27].

Mill's criterion for a scientific classification is therefore not pragmatic in a narrow sense (e.g., identification of entities or application for medical purposes), but in a broader sense for serving scientific advances. In biology, the theoretical background for natural classification understood in Mill's sense today is Darwin's evolutionary theory, which is the basis for the cladistic approach to classification[28]. This indicates that a natural classification is supported by domain-specific theory. Another example is that in chemistry, the periodic system[29] is considered the best representative of a natural classification which is based on chemical and physical theory[30]. As Magnus (2012, p. 8) wrote:

> [T]he account of natural kinds which I defend maintains that a category of things or phenomena is a natural kind for a domain if it is indispensable for successful science of that domain. Scientific success involves making sense of the things or phenomena — both accurately predicting what they will do and explaining their features. The account conflicts with the tradition that associates natural kinds with fundamental and precise essences[31].

Natural kinds are often considered to be caused by microstructuralism, which is the theory that membership of a natural kind is conferred by microstructural properties (e.g. Gold being a natural kind because its atoms have 97 protons; Water being a natural kind having the formula H_2O; animal species being defined by their DNA structure). Hendry (2006, p. 865) wrote:

> [B]iological microstructuralism seems implausible given the wide microstructural variation within biological species. Perhaps membership of biological kinds is conferred instead by historical or causal relations to particular populations of organisms. Or perhaps, as John Dupré argues (1993), different kind-membership conditions are appropriate to different classificatory interests and modes of biological explanation. Now these arguments — against microstructuralism and for pluralism — are local to biology. Chemistry, I argue, is different: the interests that govern its classifications are more unified, and in most cases membership of its kinds is conferred by microstructural properties.

Magnus' and Hendry's quotes thus limit natural kinds to specific domains of knowledge, and Hendry further indicates that pluralism has a stronger case in biology, but that even in chemistry, classification is still interest based, and that not even here are all cases of membership of kinds conferred by microstructural properties[32].

We finish this section by considering whether the periodic system is a natural classification. We have already encountered some problems such as Needham's (2008) demonstration that chemical properties among isotopes of the same element may vary, and that it turns out to be difficult to clearly distinguish essential and accidental properties[33]. Here we shall finish presenting two different views on this issue. Scerri (2009, p. 3) wrote:

> One final comment on this first paper is that I recommended the use of many tables and suggested that no one table was better than others. This is something that I no longer believe. According to a realistic interpretation, the periodic system is referring to some objective relationship among the elements that exists in nature and is not the result of mere human construction. I believe that it does therefore make perfect sense to be seeking an optimal periodic system in the sense of one that most closely reveals the precise periodic relationship between as many elements as possible.

Later Scerri, interviewed in Bradley (2011a), claimed that the periodic table [system] is not artificial, and that although the optimal[34] form is still to be found, this is an attainable goal[35]. However, Stewart (2011, comment in Bradley, 2011b) argued that we should "Leave the definitive table for Plato's Heaven!", showing that the debate about whether the periodic table is natural or artificial still seems to be open. There is broad consensus, however, that the periodic table is the best candidate for a natural classification, which, however, should not be confused with the view that it is the best classification of chemical elements for all purposes.

3.7 Levels of Reality

Foskett (1961, p. 139) expressed the idea of integrative levels as follows: "The theory of integrative levels is that the world of things evolves from the simple towards the complex by an accumulation of properties, and that, at a succession of levels, these aggregations reach new degrees of complexity and become new wholes, with individual and unique identities". Kleineberg (2017, pp. 349–350) continued:

> Accordingly, integrative levels can be defined as a developmental sequence in which entities at each new level integrate the essential properties and structures of the entities at the older levels, while they exhibit some emergent qualities and, therefore, more complexity than their predecessors. A typical example of such a hierarchical order is presented by the sequence atoms — molecules — cells — organisms (Feibleman, 1954, 62)[36].

The theory of integrative levels has a history in KO, especially in the British Classification Research Group (CRG) which was active in the 1960s, but continues to be influential, also in the works of Gnoli, who (2025c, p. 9) wrote:

> [T]he classes would be listed according to the series of integrative levels, a notion CRG members received from Needham (1943) and Feibleman (1954): these would include "energy, matter… mineral systems… land forms… plants, animals, man" (Classification Research Group, 1969) and every concept would have its place in only one of these levels.

This theory seems primarily to have been used as an organizing principle for bibliographical classifications at the overall level (main classes), such as, for example, the main structure of the Bliss Bibliographical Classification, BC2, which partly reflects the theory of integrative levels (cf. Gnoli, 2005). It seems seldom or never explicitly applied to more specific levels, such as classification of animals or other kinds of phenomena. The reason for this may be problems with applying this theory. As Kleineberg (2017, p. 253) wrote:

> [T]here seems to be no consensus on the idea of integrative levels, neither on the conceptual definition and theoretical foundation nor on the sequence and architecture of level models (Wheeler, 1928; Greenberg and Kenyon, 1987; Poli, 2001). As a matter of fact, its utilization as organizing principle often reveals inconsistencies or exceptions for practical reasons (Spiteri, 1995; Dousa, 2009).

One example of difficulties in the theory of integrative levels can be seen in Gnoli's quote above, where animals are at a higher level than plants, which probably reflects an obsolete view because evolution is not considered a ladder or a linear progression toward greater complexity or perfection. Evolution rather produces adaptations to particular environments. I will not exclude that certain developments in organisms can be considered to provide a more advanced level of properties, but it is difficult to see what integrative levels theory may contribute for classifying living organisms, compared to biological systematics based on genealogical classification[37].

The general conclusion is that the organic level probably represents a higher level of complexity, qualitative integration and emergence compared to the inorganic level. Life introduces properties (metabolism, self-replication, evolution) not found in inorganic matter. However, as Kleineberg wrote, there seems to be no consensus on the idea of integrative levels, neither on the conceptual definition and theoretical foundation nor on the sequence and architecture of level models. It is also important to examine its relation to classifications constructed by the sciences (e.g., the periodic system and biological systematics). As already mentioned, its contribution so far seems limited to the overall structure of general classifications.

4. Gnoli's Arguments for the Possibility of Constructing an All-purpose Classification

4.1 Gnoli's Presentation of Domain Analysis

As already said, Gnoli tries to provide an alternative to domain analysis which, as he wrote, is based on pragmatist views, according to which any classification reflects particular perspectives and purposes. In the terms of the present article, domain analysis represents pluralism in classification in contrast to monism. Gnoli (2025c, p. 3) cited the basic characteristics of domain analysis from Hjørland ([2017] 2019)[38]:

- Go to a given domain,
- Look at how it is classified according to contemporary knowledge (including different views),
- Discuss the basis, the epistemological assumptions and which interests are served by proposed classifications,
- Suggest a motivated classification.

Gnoli found, however, that although the domain analytic literature has provided some fruitful examples of the first three steps, he finds it lacks an example of a motivated classification as recommended in the last step. This is correct if one expects a comprehensive classification of a domain from the knowledge organization community, but domain specific classifications based on explicit epistemological views are probably common in the broader literature[39]. Here I want to argue that the lack of a motivated classification should not be given too much weight.

First it should be stressed that domain analysis implies involvement with dynamic developments in sciences and other knowledge fields. No other approach to knowledge organization provides theoretical and methodological suggestions for how to tackle this crucial issue. The Bliss Bibliographical Classification, 2nd edition (BC2), has an impressive methodological description for how to classify the different disciplines covered in each volume and it is to my knowledge the best motivated general classification constructed in library and information science (LIS). However, this methodology is somewhat deceptive as it omits the issue of selecting the sources used to identify the criteria for classification. For example, BC2's classifying of animals is inadequate and unmotivated[40], and it seems strange that a bibliographic classification about animals avoids considering the biological taxonomic literature. Similar problems apply to all scientific fields.

Next, we shall consider Gnoli's analysis of Ørom (2003) about classification in art studies as a model for domain analysis. Gnoli (2025c, p. 4) writes:

> This indeed reflects alternative approaches and theories of the arts, that may please different researchers. It is then a good example of domain analysis as a critical tool in the study of existing systems—the second and third points in Hjørland's summarization—although it does not explain how domain analysis could be applied in the development of new systems that are satisfactory for relevant communities of researchers.

I both agree and disagree with Gnoli that Ørom (2003) did not contribute about the construction of actual classification systems. Ørom's interests were primarily about "the materialistic paradigm" and "the "new" art history", and he shows how these views challenge the traditional classifications. However, he finishes the article by describing the *Art & Architecture Thesaurus*, which weakens the focus on the relation between paradigms and classification schemes (although he states, "there seems to be a kind of an 'additive' structural thinking in the thesaurus", which poses problems about the adequate representation of certain kinds of documents). Ørom could have used his own insight, that concepts such as "Early Renaissance" and "High Renaissance" do not have the same meanings in different paradigms of art studies. By implication, it is necessary to specify such concepts according to the different paradigms (e.g., by using parenthetical qualifiers), but to do this presumes classification of art studies from the different paradigms. Therefore, Ørom's basic work of specifying paradigms in art history and uncovering their importance for classification is absolutely necessary and represents a ground pillar in domain analysis.

Ørom's contribution to developing a new classification for art studies is that he pointed out that "new art history" is badly served by traditional library classifications, so an important goal must be to construct knowledge organization systems (KOSs) serving this perspective (classificationists should consider themselves as contributing to its development). The main difficulty here seems to be that new art history is not a coherent theoretical perspective, which may mean that before constructing a KOS, further studies and choices about this paradigm must be conducted. However, Ørom's article provides the basic analytic tools for producing such a KOS and thereby takes an important step on the road to overcoming outdated classifications in the domain of art studies.

There are some problems in Gnoli's (2025c) discussion of Ørom's article. He states (p. 16):

> As shown by Ørom (2003) in art studies, different classifications prioritize different characteristics of division, for example theme, style, or social context. These clearly are different facets of art (although Ørom does not discuss them in these terms; only in a final section does he consider the facets of the Art and Architecture Thesaurus, including physical attributes, agents, processes, materials and others, but finds that they have a "bricolage character")[41].

This quote reveals a discrepancy between Gnoli's view and domain analysis (and perhaps a lack of understanding of Ørom's article). For Gnoli, Ørom's paper is fine and relevant and can translated to different priorities of different characteristics of division. The problem is here the theory-laden nature of observations, concepts and classifications (cf., Section 3.5). Classification in relation to different paradigms is not just about classifying *the same concepts* according to different principles of division, although this is also important. The main thing is that the concepts vary with paradigms.

Gnoli (2025c, p. 16) further states:

> The differences among alternative classifications can then be analyzed in terms of different citation orders of facets: should art works be grouped, say, by style then theme, or the other way around? The choice may be justified with reference to different theories or arts. Again, the principle of unique definition may contribute a criterion, by considering what actually is a work of art, at which levels can it occur, and in what combinations with phenomena at other levels (art depicting bamboos; art as a therapy, etc.).

Gnoli claims that the principle of unique definition (to be introduced and discussed in Section 4.2) may provide the basis for a monist classification for art studies, which, in his opinion, will provide a better basis for classification in this domain. My answer to this suggestion is:

(1) What constitutes a work of art is not a question that the principle of unique definition by Gnoli even attempts to answer, and it cannot be answered without considering the knowledge accumulated over time in theories of art such as those presented by Ørom. Ørom demonstrates that this is a question that varies in different paradigms of art. If Gnoli suggests a definition or view of what constitutes a work of art, that definition would reveal its underlying paradigm or view of art (show me your classification, and I shall tell you which theory you subscribe to).

(2) Gnoli's claim that the principle of unique definition may reveal "at which levels can it [the concept of art] occur, and in what combinations with phenomena at other levels" is not central for the classification of art itself, but only for classifying art in a general classification (and even here, each paradigm of art will answer these questions differently).

4.2 Farradane's Principle of "Unique Definition"

This principle forms the primary basis of Gnoli's (2025c) argument for an all-purpose classification, as evident from the title of his article. Farradane's "unique definition" is just a small part of his classification theory, which cannot be reviewed here; suffice it to say (1) that his general inductive approach is problematic, as also mentioned by Coates (1973, p. 391), and (2) that his psychological approach to scientific classification seems dubious[42].

In the sources cited by Gnoli (2025c), three primary sources (Datta and Farradane, 1974; Farradane, 1961, 1966) are about "unique definition" and none of these contains a deeper analysis of this concept and its relation to theories of concepts and definitions.

Farradane (1966, p. 108) makes it clear that interest in the ideas on levels of integration (i.e., integrative levels theory) and unique definition arose when the Classification Research Group (CRG) became interested in problems concerning general classification schemes (and so moving from a previous focus on special classifications). This is important, because, as we shall see, it limits the relevance of these principles.

The connection between the theory of integrative levels and the idea of "unique definition" is clear in Gnoli (2025c) and as well as in Farradane (1961, p. 129):

> It is more useful to retrain every concept that has a viable individuality, and this can be achieved by importing the biological principle of integrative level, whereby we recognize when the whole is greater than the sum of its parts. Thus a thermometer is a heat measuring machine plus its individuality as a particular type of such machine and as a discrete object; on the other hand, the rabbit as a pest or the diamond as a jewel remains a rabbit or a diamond, respectively, even though, in the latter case, a diamond may usually be cut before some people regard it as a jewel. The selection of a concept for inclusion in

> the classification structure therefore also demands consideration of its definability at an unambiguous integrative level.

One of the secondary sources cited is Broughton (2024, Section 6.4) "that class which provides a given concept with its most fundamental defining characteristics, e.g., Zoology provides the place of unique definition for the concept Horse".

Gnoli discusses the example of diamonds in some detail, arguing that this object should be defined as a mineral rather than as, for example, a gem. Gnoli (2025c, p. 12) generalizes this argument as follows:

> In the definition of a concept, a set of properties is implied, as one can realize by looking at a term in a dictionary. What is seldom considered, however, is the priority order of such properties, and this is addressed by Farradane's principle. This reminds of the citation order of facets, but here properties are only considered in order to identify the appropriate place for a class, rather than combining some of them to express the subject of a document. To give a toy example, with no ambition of real scientificity or exhaustiveness, let us assume that diamond is defined as being made of carbon atoms (as opposed to, e.g., iron atoms), being a pure substance (as opposed to a chemical compound), being a good cutter (as opposed to a bad cutter), being beautiful (as opposed to ugly) and being a good thermal conductor (as opposed to insulator). These properties can be listed in different ways when defining diamond.

Gnoli expatiates further (p. 13):

> As diamonds are mineral entities, their most relevant property is to be a pure substance made of a single chemical element (carbon in this case), therefore they have to be listed together with other pure mineral substances, like pure iron, rather than together with other cutting, or beautiful, or conductor phenomena. A diamond is a pure substance, made of carbon which is also conductor, cutting, and beautiful.

What does Gnoli here argue for? Three levels of his claim may be distinguished:

(1) All concepts should be defined by their essential properties (based on Farradane's unique definition).
(2) In a general phenomenon-based classification (rather than a discipline-based one), the notation given to a phenomenon (e.g., diamonds), should be preserved (but supplemented with additional symbol for, e.g., its application in jewelry). (This corresponds to the analytic-synthetic, facet-analytic tradition).
(3) In a general phenomenon-based classification, diamonds should be classified under minerals, whether it is from one or another aspect (whereas in discipline organized classifications, phenomena are scattered by disciplines)[43].

The first claim is the most far-reaching. It is about defining concepts in general (not limited to classification). E.g., a diamond should be defined as a mineral, not as a precious stone. (Or, if more properties are included in the definition, these properties should be included according to a prioritized listing of properties, but as any object has an unlimited number of attributes, it is not possible to list them all). We saw in Section 3.4 that essentialism is a disputed concept today, and that concepts, meanings and definitions are theory-dependent, and even the quote by Gnoli himself (2025a, pp. 78–79) acknowledged that essentialism faces serious difficulties in the empirical sciences. Different disciplines may share the same concept (e.g., both chemistry and physics define gold as the element with atomic number 79), but different theories tend to define concepts differently (e.g., the species concept in biology). Therefore, Farradane's "unique definition" seems problematic as a general theory of concepts (and it has never been evaluated in the context of theories of concepts or definitions). It should also be remembered that Farradane developed his view because there was a need for it at the time when CRG turned their interests towards general classifications (cf. Farradane, 1966).

The second claim about assignment of a symbol of a phenomenon at the "unambiguous integrative level" and then reuse of this symbol in all other classes whether the phenomenon occurs (with additional symbols), can be understood as a version of the theory of semantic primitives and compositionality (which is discussed in a submitted paper, Hjørland, 2025b). For example, "diamond" is given its notation in the class of minerals (pure substances), and classes about, for example diamond mining and diamonds in jewelry, contains the same symbol + additional symbols. (A kind of formulaic language, reminiscent of chemical formulas). Such a language has been the dream of rationalist philosophers for centuries, but Eco (1995) considered this to be a utopian dream[44]. This does not provide a general rejection of facet analysis, but raises problems concerning its limitations (see Hjørland, 2025b).

The third claim, about general classifications, shall only be discussed briefly, as I am preparing a separate article on general versus special KOSs. The argument about the need for Farradane's "unique definition" for general classifications depends primarily on the value of phenomena as an organizing principle, which already was been discussed in Section 3.5. Here we shall just consider whether it is best to classify diamonds in one place or whether it is better (like the DDC) to classify diamonds according to different aspects. If some people primarily are interested in diamonds as jewelry, and if there is a special literature about jewelry is it then a good idea to scatter this literature under different kinds of materials? If jewelers form a special group of people, it may be expected that they are primarily interested in grouping the information and documents about jewelry together, thus classifying diamonds in relation to this domain rather than having all documents on diamonds classified in relation to minerals or pure substances. The basic differences in views seem to be the preference of a metaphysical order of the universe (the phenomena approach) versus an order that represents human interests and social organization and based on a kind of literary warrant.

The conclusion of this section is that there is no convincing argument that Farradane's "unique definition" can serve as a principle for the construction of all-purpose classifications.

4.3 Issues of Interdisciplinarity

Gnoli (2025c, pp. 5–6) considered the periodic table a pluralist classification, claiming that the traditional table reflects the interests of chemists, while the Stowe table reflects the interest of physicists, implying that the table as such is not a neutral, monist one. This is a bit strange, since, as we saw in the Stamos quote in Section 3, this classification is often considered the ultimate challenge for pluralism in classification. Furthermore, it is not right to claim that chemists and physicists have separate classifications, because both chemical and physical research have contributed strongly to the theoretical foundations for the different versions of the table. In addition, there is a strong overlap between different versions. However, it might be that some cases, such as the classification of Helium, tend to split chemists and physicists because chemists may prefer to see Helium as a noble gas (in the p-block), whereas physicists may prefer to classify it with the alkaline earths (in the s-block) according to its electron structure[45]. It is not clear from Gnoli (2025c) which principles he considers useful for producing an alternative to existent periodic tables, one that would better satisfy his aim of a monist classification of the sciences.

It seems clear that, as science grows, humans come to know regularities in nature, which often turn out to be fruitful for conceptualization and classification (but may be overstated, thereby suppressing the need for alternatives). This was also shown in Stamos' example, that atomic numbers best predict chemical and physical properties of chemical elements and therefore are better units for the periodic system compared to mass numbers. However, as we have seen, even for the periodic system, the debate still is open about how far chosen regularities reflect different interests.

Gnoli (2025c, p. 8) writes:

> Increasing interdisciplinarity is a well-known fact in the science of recent decades (Klein, 1996). Based on this, Szostak et al. (2016) urge KO scholars to develop KOSs that can serve the needs of interdisciplinarity better. Such a trend stands in opposition, or at least in some complementarity, to the approach of domain analysis, as KOSs designed to reflect the specific needs of one domain result in a hindrance to interdisciplinary research. What is needed is a system where the same concept can be identified and retrieved independently from any particular discipline and can be combined with any other concept: 'bamboo' may indeed be related to 'poaceae' or to 'fabric', or to 'building', or to 'pandas', or to 'Philippine mytology'.

However, classification of birds, for example, is based on both ornithology (living birds) and paleontology (extinct birds, mainly but not exclusively through the study of fossils), and draws on knowledge and technology of a wide range of sciences, including biogeography, genetics, and geology. Therefore, an ornithological classification of birds, such as that of Fjeldså (2013) already represents an interdisciplinary-based classification of birds (phenomena) and not disciplines. Perhaps Gnoli and others underestimate the interdisciplinary cooperation within the existing system of disciplines?

I have difficulty seeing that it should be possible (even in theory) to construct a phenomenon-based classification that can satisfy all interdisciplinary researchers. Mills and Broughton (1977, p. 37) wrote:

> Nevertheless, a growing number of documents do reflect a multi-disciplinary approach, although authorship of such works is usually, and not surprisingly, also multiple, as in the case of symposia. Such material poses a special problem for the older general classifications, which are sometimes called "aspect" classifications in that their basis of arrangement is by aspect or "discipline", not by phenomena. This does not, however, invalidate the general correctness of the decision they all reflect, which is to treat classification by discipline as being on the whole more helpful to users. It may be noted that the factual literature for children has always shown a strong tendency to concentrate on phenomena rather than discipline — e.g., "the big book of trains" which considers most aspects of the railway system.

Would some interdisciplinary researchers like to consider all aspects of, for example, the railway system? Or is the case that interdisciplinary researchers consider a new angle, previously scattered over more disciplines, and that they, as suggested by Tengström (1993), over time, may tend to form a new discipline[46]? Tengström's view implies that even interdisciplinary fields need a classification based on a certain perspective.

5. Conclusions

This article has defended the view that classification needs to be based on a purpose that makes it relevant to support some human activities. Although it has been argued that an all-purpose classification is unattainable, it is evident that natural classifications have important implications, which make them important to consider.

Biological systematics provides a useful illustration. The Linnaean hierarchy has been and still is considered very important, although neither Linnaeus himself, the philosopher John Stuart Mill, nor many contemporary philosophers and scientists (e.g., Ereshefsky, 2001) consider it a natural classification. Today, following Charles Darwin, the main goal for a natural biological classification is to reflect a strict evolutionary history/phylogenetic order. The main alternative to the Linnaean hierarchy today is based on cladistics, such as the PhyloCode[47]. Therefore, in biology we have two major approaches: (1) those based on cladism and a strict genealogical approach, best reflecting a natural classification, and (2) those related to the Linnaean hierarchy[48].

The interesting thing is that both approaches seem to prosper, probably because they fulfil different purposes. The Linnaean hierarchy seems to remain the standard framework for naming and cataloguing species in formal biological work (e.g., species descriptions, checklists, biodiversity databases, legislation, conservation, museum collections). Therefore, a hypothesis is that while strictly cladistic systems provide the best reflection of natural relations between organisms, the Linnaean hierarchy provides the best approach for communication. The concept "fish" provides an interesting example. Yoon (2009, p. 252 ff.) presented the cladists' "killing of the fish". She wrote:

> Okay, the cladist would say, luring in the unsuspecting, what about the salmon and the lungfish and the cow? Which two do you think are most closely related and which of the three is most distantly related? […] Cladists were able to see the strange truth: that lungfish and cows are more closely related to one another, share a more recent common ancestor with another, than they do with the salmon. It gets weirder still in the hands of cladists. […] Not only would you have to include cows, but if you want to have this group called 'fish,' you would need to include any mammals, including even humans. Cows as fish, humans as fish? Or else no such thing as fish[49]?

The fish example demonstrates huge practical challenges for communication following the natural classification provided by (some) cladists. Fish is a concept that is extremely integrated in human cultures (think of fish as food, fish economics, fish farming, fish as pets, fishing boats, fishing industries etc., etc.). No wonder, classifications related to the Linnaean hierarchy still seem to dominate not just in the broader society, but also in scientific communication. In other words, in biology, there seems to be a real dilemma between classifications representing natural relations versus those that are optimal for communicative purposes.

Concerning library classifications such as the Dewey Decimal Classification (DDC) it seems that these are not seriously engaged in the issue of natural classification (or seriously consider their theoretical basis). Hjørland (2025a) showed that Dewey himself was strongly against providing a classification that reflected scientific knowledge (rather than considering narrow pragmatic aims and avoiding instability by changing classification notations). Although Dewey's view has not been upheld by all subsequent editors, the system still reflects obsolete knowledge in many fields. This state of affairs seems, however, not to be realized by the broader library community. Miksa (1998, p. 89), for example, suggested that a future function of the DDC might be "for teaching, learning, and memorizing knowledge categories, and for discovering relationships not previously imagined among diverse areas of categories and resources". However, such a function presupposed, as Hjørland (2025a, p. 41) argues, that the way DDC organizes knowledge reflects updated knowledge, and not just arbitrary relations constructed by the system itself. If the goal of a library classification is just as Dewey said "pigeonholes" for what Ranganathan called the "mark and park"[50] function, then quality of the classification is not critical. However, implicit in the field of knowledge organization is a view of classification as serving wider purposes for which questions of natural classification become important.

An implication of the purposefulness of classification is that the more unclear the aim of the classification is the more difficult it is to provide an optimal classification. To put it in a nutshell: If there is no clear aim, any classification may serve as well as any other. The need for quality classification is greatest when users have clear criteria for what is relevant, which again is associated with theoretical clarity.

Availability of Data and Materials

There is no data and material beyond what is mentioned in the article.

Author Contributions

The single author was responsible for the conception of ideas presented, writing, and the entire preparation of this manuscript.

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Conflict of Interest

Given the role as an Editorial Board Member, Birger Hjørland was not involved in the peer-review process and has no access to information regarding its peer-review. Full responsibility for the editorial process for this article was delegated to the Editor-in-Chief.

Endnotes

[1]Dousa (2009, p. 23) wrote the following in a section entitled "Universalism *vs.* Localism: Otlet's and Kaiser's Differing Views on Framework Scope": "In stark opposition to Otlet's insistence that an ideal KOS be impersonal and universal, Kaiser firmly held to the view that, ideally, KOSs should be constructed to meet the needs of the particular organizations for which they are being created". This quote indicates an early opposition between on the one hand the ideal of an all-purpose classification, and, on the other hand, the ideal of designing a classification for a specific purpose.

[2]A distinction between arbitrary and non-arbitrary classifications may be made, as arbitrary classifications only serve goals like those served by *Tables of Random Sampling Numbers* (Kendall and Smith, 1961), today performed by computational random number generators.

[3]An anonymous peer reviewer wrote: "The idea of 'purposefulness' is a modern redescription of the traditional concept of 'teleology', which has very ancient roots indeed: it is important to remember that, for Aristotle, the most important of the five causes for the existence of any object is its final cause — the purpose for which it has come to be. I suspect that the author would not wish to use "teleology" or to invoke Aristotle with regard to purposefulness because of the strongly metaphysically essentialist quality of Aristotle's philosophical stance, which runs athwart modern understandings of science to which the author seems to subscribe (see section 3.4)". My answer is that I do consider this important, and I certainly do not want to avoid a term such as 'teleology'. Indeed, I am collecting material to an article about "functional classification", which has a certain literature, for example in archival organization. But I simply had to leave this comprehensive discussion out of the present article, which focus on providing a response to Gnoli's view that an all-purpose classification is possible.

[4]The concept of relevance is discussed in Hjørland (2010) in which relevance is defined (p. 229): "Something (A) is relevant to a task (T) if it increases the likelihood of accomplishing the goal (G) which is implied by T". For example, a classification of diseases (A) is relevant for the task to heal patients (T), if it increases the likelihood of accomplishing the goal of healing patients (G) which is implied by T. (for example, classifying patients into groups for which the same medicine helps cure the patients.)

[5]Gnoli (2025c, p. 5) also contrasts objectivism with skepticism. It seems better, however, to contrast skepticism with certitude. A person may be skeptical about a claim whether that claim is true or false, or whether it is taken to expresses a subjective or an objective point of view. Magnus (2012, p. 25) also contrasted skepticism with fallibilism, which, according to Hetherington (n. d.) "is the epistemological thesis that no belief (theory, view, thesis, and so on) can ever be rationally supported or justified in a conclusive way. Always, there remains a possible doubt as to the truth of the belief".

[6]An anonymous reviewer wrote. "When "objectivism" is used to refer to Ayn Rand's philosophy, it is almost always capitalized as "Objectivism", because then it is, of course, being used as a proper noun".

[7]Douglas (2004, p. 453) argued: "The terms "objectivity" and "objective" are among the most used yet ill-defined terms in the philosophy of science and epistemology. Common to all the various usages is the rhetorical force of "I endorse this and you should too", or to put it more mildly, that one should trust the outcome of the objectivity-producing process".

[8]Bryant (2000, p. 20) wrote: "According to the objectivist worldview, there is one and only one correct description of reality—the one that mirrors the structure inherent in the world". (This is called monism in the present article). Further (p. 22): "Objectivism … assumes the plausibility of the universal, context-free God's Eye perspective".

[9]The German philosopher Jürgen Habermas in the book *Knowledge and Human Interests* (1987) (German original *Erkenntnis und Interesse*, 1968) argues that positivism can be understood as a lack of reflection. Habermas is associated with "critical theory", and this view seems to correspond well with Haraway's.

[10]Bruce (2003) provided a brief history of the classification of birds from the perspective of a natural history. Alternatives exist in "folk taxonomies", which refer to the ways people from different cultures classify birds based on their own understanding, which often involves identifying broader groups like "songbirds", or "waterfowls". In contrast to contemporary scientific classification based on DNA-analysis, folk taxonomy relies on observable characteristics.

[11]In the literature on the phenomenon- *vs.* discipline-based classification, the term "phenomenon" (plural: "phenomena") has the meaning "object" or "thing" (e.g., animals, musical processes, processes, etc.) It is thus one among more terms used to describe a category under which everything falls. In some other contexts phenomenon is distinguished from objects by referring to subjective appearances, but this is not how it is used here.

[12]Ludwig and Ruphy (2024) wrote: "Ontological pluralism implies the rejection of traditional formulations of kind realism that appeal to the idea of one fundamental and mind-independent representation of the world as it is in itself (Chakravartty, 2023). At the same time, scientific pluralists tend to accept wider realist claims in the sense that scientific concepts are understood to reflect empirically discovered structures of the natural world even if their conceptualization inevitably entails contingent interests and values".

[13]Although Ludwig and Ruphy (2024) wrote: "pluralist philosophy of science has become a broad platform for negotiating post-positivist philosophy of science in the light of epistemic and social diversity. The literature on scientific pluralism has therefore increasingly moved from a simple contrast between monism and pluralism to debates about

different ways of articulating pluralism". Further (Section 1): "Sometimes formulated in polemic opposition to earlier positivist phases of philosophy of science, pluralism has become an umbrella concept for philosophical engagement with conceptual, methodological, theoretical, and social diversity in science".

[14]Stamos (2004, pp. 138–139) wrote: "It follows from the principles of modern chemistry, then, built as they are upon an enormous empirical basis, that two atoms with different proton numbers but the same mass number (= Bryant's isotope number) are not going to have the same chemical or physical properties and behaviors. Therefore mass number is not going to be deemed by competent scientists a suitable candidate for defining chemical elements, on Twin Earth as on Earth. The fact is, modern scientists classify atoms into elements based on proton number rather than anything else because it alone is the causally privileged factor. Thus nature itself has supplied the causal monistic essentialism. Scientists in their turn have simply discovered and followed (where "simply" ≠ "easily"). All that thought experiments to the contrary prove is either a desire to mislead or plain wishful thinking." Comment: consider the quote by Vandewall in Section 3.4, pointing out that isotopes of the same element may not share all chemical and physical properties.

[15]Chakravartty (2017). "Metaphysically, realism is committed to the mind-independent existence of the world investigated by the sciences. This idea is best clarified in contrast with positions that deny it. For instance, it is denied by any position that falls under the traditional heading of "idealism", including some forms of phenomenology, according to which there is no world external to and thus independent of the mind. This sort of idealism, however, though historically important, is rarely encountered in contemporary philosophy of science. More common rejections of mind-independence stem from neo-Kantian views of the nature of scientific knowledge, which deny that the world of our experience is mind-independent, even if (in some cases) these positions accept that the world in itself does not depend on the existence of minds. The contention here is that the world investigated by the sciences—as distinct from "the world in itself" (assuming this to be a coherent distinction)—is in some sense dependent on the ideas one brings to scientific investigation, which may include, for example, theoretical assumptions and perceptual training".

[16]Michael Dummett (1978) introduced the term anti-realism about the position that the truth of a statement rests on its demonstrability through the internal mechanisms of logic.

[17]Miller (2024): "Non-realism can take many forms, depending on whether or not it is the existence or independence dimension of realism that is questioned or rejected. The forms of non-realism can vary dramatically from subject-matter to subject-matter, but error-theories, non-cognitivism, instrumentalism, nominalism, relativism, certain styles of reductionism, and eliminativism typically reject realism by rejecting the existence dimension, while idealism, subjectivism, and anti-realism typically concede the existence dimension but reject the independence dimension. Philosophers who subscribe to quietism deny that there can be such a thing as substantial metaphysical debate between realists and their non-realist opponents (because they either deny that there are substantial questions about existence or deny that there are substantial questions about independence)".

[18]Explicit anti-realists (in Dummett's sense) do not abandon the quest for knowledge of the world, but they frame knowledge in terms of what can be verified, justified, or asserted under ideal conditions — not as correspondence to a mind-independent reality that may transcend our grasp.

[19]Oderberg (2013, p. 3): "Recent years have seen a revival of metaphysical thinking that, for all the disagreements among its partisans, is clearly realist when it comes to categories and boundaries in reality. Whether inspired by Aristotle, by natural science pure and simple, or by the neo-essentialism of Kripke/Putnam semantics, these metaphysicians are generally committed to the existence of a mind-independent world that comes to us pre-packaged, so to speak, and awaiting classification through one or both of relatively a priori philosophical reflection and the a posteriori investigations of natural science". Comment: purely speculative or a priori reflections cannot provide classifications such as the periodic table, and when scientists produce such a classification this is by applying concepts and theories, not by an unmediated access to reality.

[20]Gnoli (2025c, pp. 5–6) himself seems to agree that physicists and chemists need not consider the same properties as essential: "While the Periodic Table of elements is often cited as an example of a satisfying scientific system, it is based on properties of elements that are mainly of interest to chemists, such as atomic numbers; prioritizing other properties that are of greater interest to physicists, such as quantum numbers, produces alternative, even more elegant organizations like the Stowe Table, also described as 'the Physicist's Periodic Table' (Channon, 2011)".

[21]Needham (2008, p. 74): wrote: "Isotopes differ even in what were traditionally regarded as chemical properties, connected with reactivity. In more recent years, greater accuracy of kinetic measurements shows that variation of isotopic composition of a compound does have an effect on its rate of reaction. Usually the effect is very small, although in the case of the water substances there can be a marked difference. Deuterium oxide partakes in the same chemical reactions, qualitatively speaking, as does protium oxide. But it reacts sufficiently more slowly than protium oxide in many of the biochemical reactions of animal bodies that replacement may lead to death. Deuterium oxide is therefore poisonous, whereas protium oxide is essential to life. A more striking chemical difference is harder to imagine".

[22]Howat (2024, p. 63) concluded: "Thus, while we can easily find various claims and arguments redolent of anti-essentialism in the Classical pragmatist tradition and it is reasonable to think these laid the groundwork for subsequent assaults on notions of essence/essentialism, it is likely that Peirce, James, Dewey and perhaps others simply took issue with a traditional metaphysically realist notion of essences/essentialism. The result of these objections might be something more like antirealism about essence/essentialism and arguments for developing a distinctively pragmatist version of that position".

[23]According to Fjeldså (2013, p. 141), the common blackbird (Turdus merula) consists of 16 kinds, which were considered different subspecies of the same species in, for example, Peters's (1931–1987) *Check-list of Birds of the World*. New research based on DNA analysis have revealed, however, that they are genetically very different and do not even belong near each other in the global phylogeny of Turdus thrushes. They do not represent the same species but are simply similar adaptations in which the male birds developed a black plumage contrasting the yellow bill as an effective means of demonstrating dominance within their territory.

[24]Umphrey (2016) outlined three steps in the search for natural kinds: (1) Through common sense, (2) through scientific theory and (3) through the philosophical tradition. (1) and (2) are covered by Umphrey (2016), while (3) is covered by Umphrey (2018).

[25]Ereshefsky and Reydon (2023) is an article which explicitly links natural kinds and natural classifications.

[26]Lefèvre (2023) found that due to the alignment with metaphysical principles concerning the order of natural things which form, according to these principles, a continuous chain of beings and a scala naturae, arranged according to degrees of their perfection, "no botanical or zoological classificatory system in the early modern period — from Cesalpino in the sixteenth century to Linnaeus and Jussieu in the eighteenth century, could establish anything but an artificial and unnatural order of plants and animals.

[27]Adamson (1901, 1:185) wrote: "The process of arranging the objects of some province of experience into kinds or groups, characterized by the possession of common marks. As ordinarily defined, it involves more than logical DIVISION (q.v.), the rules of which furnish the minimal conditions of the process. In addition, classification takes into account (1) either the specific purpose of the arrangement, or (2) the natural conjunctions of marks which are of most importance. In either case, the aim of classification is to render possible the greatest number of general propositions regarding the objects, and so to facilitate the complete and systematic survey of them. The ideal of a classification that is not determined by special, human ends, as e.g. in classification of occupations in a census return, is to copy in its systematic arrangement the real order of interdependence in the things themselves. What is called "artificial", as opposed to natural classification, differs in degree only, not in kind. Literature: MILL, Logic, Bk. IV. chaps. vii, viii; VENN, Empirical Logic, chap. xxx; JEVONS, Princ. of Sci., chap. xxx. (R.A.)".

[28]Bremer (2007) compared the Linnean classification with a contemporary classification of plants and wrote: "I have examined all genera published in Species plantarum (1753) [Linnaeus, 1753] and classified them according to order and major groups in the APG-system [APG, 2003]. All classes except one, number 15 Tetradynamia, comprises groups of unrelated plants. Not surprisingly, the sexual system does not display what we know today about plant relationships. As is evident from this analysis, there is little correspondence between the sexual system and the APG-system. This does not mean that the sexual system has been useless or misleading. When it was introduced, it formed the basis for much intensified research and increased knowledge of plants".

[29]The periodic law is the observed oscillation of some properties of chemical elements as a function of the atomic number (until the beginning of the 20th century a function of atomic weight). This law is the foundation for all periodic systems of chemical elements, which are the structures resulting from considering the order and similarity of chemical elements. Finally, a periodic table is a representation (e.g., graphical representation) of the periodic system, e.g., to a bi-dimensional or tridimensional space. Obviously, such a representation of the periodic system is more pluralistic, and different tables have been formed because they better match a book-page, even if they make the system harder to understand. (The INTERNET database of Periodic Tables has over 1300 entries as of May 2025 see https://www.meta-synthesis.com/webbook/35_pt/pt_database.php). Therefore, the question of pluralism or monism is principally about the periodic system, not the table, although periodic table is probably the most used term even in this debate.

[30]Chang (2016, pp. 42–43) wrote: "Again, my view of natural kinds is a naturalistic one; I think they can only be discerned in the process of inquiry in the natural sciences. Alexander Bird and Emma Tobin's succinct characterization of natural kinds is helpful here, as a foil: 'To say that a kind is *natural* is to say that it corresponds to a grouping or ordering that does not depend on humans' [Bird and Tobin, 2024]. My view is precisely the opposite, to the extent that scientific inquiry does depend on humans. And how could it be denied that scientific inquiry depends on humans? It is a mistake, as common as it is fundamental, to insist on a nature/human dichotomy here. Humans are part of nature. And even if one avoids a heavy dose of Kant or Kuhn, it cannot be denied that nature as a possible object of our knowledge is inevitably framed by human perceptual and mental categories".

[31]An anonymous reviewer asked: "Clarify the evaluation criteria for "natural classification": is it predictive power,

explanatory power, or domain consensus?" My answer to this is: I think we can omit domain consensus, as questions of natural classifications seem open, even in the case of the periodic table. Predictive power was certainly a criterion that contributed to make Dmitri Mendeleev's periodic table famous, just as this table has demonstrated great explanatory power in the history of chemistry and physics. My understanding of criteria for natural classification is it has had a mutual interaction with scientific theory, so that the theory has influenced the classification and the classification has influenced the theory. However, as both theory and classification develop over time, one cannot fixate a given classification as being "natural" (just more or less likely so). The present table is more natural than Mendeleev's and is still developing.

[32]Ruphy (2010) discussed stellar kinds and found that her conclusions will neither please the essentialist monist, nor the pluralist embracing promiscuous realism à la Dupré (1993).

[33] "On the face of it, the classification of chemical elements seems rather immune to interest dependency: nuclear charge does not have any serious competitor as a grouping criterion for chemical elements, which would respond to alternative epistemic interests. For all that, this consensus should not be interpreted as vindicating that the periodic table constitutes an interest-free classification of the chemical elements. It can be argued that it rather reflects the fact that, as Hendry aptly emphasizes when contrasting chemistry with biology, "the interests that govern its classifications are more unified" (2006, p. 865)".

[34]Scerri (interviewed in Bradley, 2011a) made the distinction between an artificial and an optimal classification. I find the term "natural" is better in this content, because the term "optimal" is connected to a given purpose, while "natural" means given by nature, not be humans, and not formed to satisfy certain human purposes.

[35]Bradley (2011a) referred to Scerri's view that the periodic system is not artificial, and that although the optimal form is still to be found, it is attainable: "Of increasing interest to Scerri is the notion of an "optimal" periodic table. "This very notion has met with resistance from some philosophers of science who argue that all classifications, even the periodic table, are artificial and therefore do not reflect the way the world actually is". Scerri is also surprised that a number of chemists also seem to subscribe to the view that there is no such thing as an optimal periodic table because, they claim, it depends on what particular feature about the elements one is trying to represent as to which version will be chosen. "If I am correct, there may be a sense in which we can claim the existence of a best table in terms of the most fundamental criteria instead of in terms of utility", Scerri adds. As such, although chemists are yet to find this elusive form of the periodic table, Scerri is searching for the new criterion that would provide us with a better classification than we currently have".

[36]Remark that there seems to be a significant conceptual connection between the theory of integrative levels and Comte's classification of the sciences, though the two frameworks arise from different historical and philosophical contexts. They both attempt to organize knowledge hierarchically—from simpler to more complex forms—and both reflect a progressivist ontology, where higher levels build upon lower ones.

[37]Gnoli (2025b) interprets levels of reality from the perspective of an "informational ontology", which is beyond the scope of this article to discuss.

[38]The cited steps in the domain analytic approach do not appear in the printed version of Hjørland (2017), as they were added to the conclusion of the *ISKO Encyclopedia of Knowledge Organization* in 2019.

[39] In Abrahamsen (2003), two Danish books about the history of music are presented. One (Hansen et al., 1990) is "traditional", emphasizing the stylistic developments and viewing the history as developed internal to the music domain. The other book, Brincker et al. (1982–1984) views the history of music as influenced by the broader society (church, military etc.). These books provide different classifications of musical periods through their chapter titles. Although not bibliographical classifications, they do provide classifications based on different epistemological views, which might be used as basis for bibliographic classifications. Only Brinker et al. explicitly consider epistemological criteria and therefore only their classification can be viewed as a classification according to domain-analytic principles.

[40]On the homepage of BC2, a draft version of class G/GY Zoology is shown. On p. 207, Rothschild (1965) is mentioned as a source of the classification of animals. In an informal communication, Vanda Broughton wrote (November 7, 2021): "It is a revision of BC1 Class G, but there are some reasons not to give it too much credence. It was primarily based on Rothschild's Classification of Living Animals [1965], which was the only comprehensive treatment of the animal kingdom at the time. However, there were, and are still, many classifications for smaller divisions. Looking at it in 2020, the then-recent developments influenced it in thinking about animal taxonomy, which 60 years later is seen as too extreme; many of the groupings proposed by Rothschild are now rejected. Trying to reconcile the differences (and make allowance for the fact that, bibliographically, there may be literature on these concepts) proved very taxing".

[41]Ørom's term "bricolage" means, to my understanding, classifications that are not consistent with their own theoretical frameworks (or that lack understanding of how theoretical frameworks co-produce concepts and so make use of incompatible concepts).

[42]Vickery (1953, pp. 53–54) wrote: "This is not the place to make a detailed analysis of Faradane's [sic!] work — it has been attempted elsewhere (ref. 14 [unpublished and

unobtainable]) — but one central criticism can be made. The operators are derived from a consideration of two psychical processes claimed to be basic to all our thinking: the acts of distinguishing one percept from another, and of relating it permanently or temporarily to others. The operators are therefore concerned with relations at the level of perception, the interpretation of bare sense-impressions. But Farradane uses these operators indiscriminately to relate any two concepts which can be represented by a substantive. For example, the subject 'scattering of protons by protons' is analysed as though there were three perceptual elements present—two sets of protons and a 'scattering'—though physical analysis immediately makes clear that there are only two such elements, and that the third substantive, 'scattering', is the name of the relationship into which they enter. This example not only suggests the confusion which Farradane's 'operational analysis' introduces, but it also indicates a further and most important point: that there are at least as many kinds of interaction between things, such as scattering between protons, as there are kinds of things. There are not just four or nine possible relations [as Farradane claimed], but an unpredictable number". See also Foskett (1982, pp. 88–90).

[43]The discipline organized Dewey Decimal Classification, DDC 2024, classify diamonds under economic geology 553.82, glyptics 736.23, jewelry 739.27, mineralogy 549.27, mining 622.382, synthetic 666.88 and industrial diamonds 553.65, industrial diamonds economic geology 553.65 and industrial diamonds mining 622.365.

[44]An anonymous reviewer wrote: "Eco was a famous semiotician, but one wonders whether his opinion as an authority outweighs that of the rationalist philosophers who have endorsed an analytic language based on semantic primitives. It seems to me, at least, that a major reason that past "analytic languages" (e.g., Wilkins' real character, Dalgarno's system, and so on) have failed is precisely that they wanted "all-purpose" languages that could be used to express any concept in the world. One wonders if a classification structured on an analysis of semantic primitives could work better within a tightly constrained domain: after all, chemical symbols can be said to constitute a communicative apparatus that begins to approach the status of such an analytic sublanguage. The question, of course, is whether chemistry, the chief aim of which is specifically to understand the structure and resultant reactive properties of natural substances is uniquely suited to such an analytical approach". This issue is considered in Hjørland (2025b).

[45]Marks and Marks (2021, p. 219): "At normal temperatures and pressures, few chemists would classify hydrogen with the alkali metals. Probably fewer still would classify helium with the alkaline earth metals. That many physicists do is entirely due to considerations of electronic structure. Yet chemists had applied the Periodic Table to chemistry for half a century before the discovery of electronic structure by Bohr and Sommerfeld".

[46]The dynamics of specialties and disciplines is addressed by Tengström (1993, p. 12), who emphases that cross-disciplinary research is a process, not a state or structure. He differentiates three levels of ambition regarding cross-disciplinary research:

1. The "Pluridisciplinarity" or "multidisciplinarity" level.
2. The genuine cross-disciplinary level: "interdisciplinarity".
3. The discipline-forming level "transdisciplinarity".

What is described here is a view of social fields as dynamic and changing. Library and information science, for example, was viewed by Tengström as a field that started as a multidisciplinary field based on literature, psychology, sociology, management, computer science, etc., which is developing towards a discipline in its own right.

[47]Cladistics is, however, a somewhat ambiguous term (cf. Brower, 2018).

[48]There are some differences in views about how different classifications designed according to the Linnaean and cladistic methods are. Bremer (2007) found large divergencies, while Fjeldså (2013, p. 81) wrote about the Linnaean way of classifying living organisms: "These groupings reflect to a large extent the evolutionary process, although Linnaeus saw it as God's System: his intent was to demonstrate the higher order of 'the creation"'.

[49]Williams and Ebach (2020, pp. 401–403) provided some skepticism in relation to the Salmon-Lungfish-Cow debate. See also Gardiner et al., (1979). Encyclopaedia Britannica [2024] wrote: "The term fish is applied to a variety of vertebrates of several evolutionary lines. It describes a life-form rather than a taxonomic group".

[50]One of the anonymous reviewers provided the following information: "Although Ranganathan used the term "mark and park", the phrase actually was coined by the British information scientist Robert Fairthorne: see, Robert Fairthorne, *Towards Information Retrieval*, London: Butterworth, 1961, pp. 85, 95".

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