Abstract
Classification and knowledge organization (KO) are increasingly ubiquitous in everyday life. We briefly examine two theories of KO development, the theory of scientific classification, and the theory of technological progress, and assess the subjective cultural aspects of classification. We find that the cultural dimensions significantly shape and permeate classification and KO activity, and we call for basic research investigation into the cultural dimensions of KO. Such investigations fall into three research fronts: rational, empirical and ethical. Finally, we call for a critical program that supports users efforts to understand the operations of KO systems.

"Knowledge organization (KO) system" and related terms (such as "classification," "taxonomy," "ontology" and "vocabulary") pick out members of a family of concepts whose referents share characteristics of several kinds. The referents vary from Internet search engines like Google, proposed systems like the Semantic Web, and international systems for bibliographic control, to systems like Facebook, which serve as platforms for personal interaction and as sources of shared reading, and which have similar functions. Such systems are increasingly characterized as "knowledge infrastructure" that mediates access to (by various formulations) information, knowledge, or documents. They comprise and are constituted by various standards, operating in multiple kinds of inter-institutional practice, from local practice to highly integrated global arrangements.

KO and classificatory activities take many forms: rankings, orderings, set definitions, descriptions, metadata, and the web of associations amongst terms, sets, and objects. Many of the conclusions from the field of critical algorithmic studies apply to our understanding of classificatory activities: they are ubiquitous, and closed; they incorporate and reiterate forms of social bias; and they can produce real social consequences for the people that interact with or are subject to them. Many of these items are discussed, for example, in Bowker and Star (2000), Pasquale (2015), and O'Neil (2017). KO is well-defined as "the field of scholarship concerned with the design, study, and critique of the processes of organizing and representing documents that societies see as worthy of preserving" (Tennis 2008, p. 103), but, because of the ubiquity of new media, we must view classificatory and KO activities as extending beyond information retrieval per se. KO systems such as Amazon's and Netflix's recommendation systems increasingly profile and classify users by a variety of markers, and adjust document retrieval sets accordingly. Tailoring online advertising to users can be conceptualized as an information retrieval problem, although it is not typically
considered to be a mainstream KO problem by the KO community. Typically considered to be even farther afield are the problems addressed by automated bank loan approval systems, college admissions systems, and parole approval systems based on estimations of recidivism. All are classificatory systems, operate similarly to automated KO systems, and provoke many of the same concerns with their use.

The last century of development of classifications, and of KO systems more generally, has proceeded with two major assumptions:

- KO systems should be modeled after scientific knowledge, using scientific processes that are attentive to expert consensus and evidentiary practices, to develop their conceptual content and structural arrangement. We call this the theory of scientific classification.

- Advances in KO system research are due to a functional experimental program that has relied upon technical advances. These techniques include the development and use of controlled languages, computer-based search and retrieval, and more recently increasingly sophisticated statistical approaches. We call this the theory of technological progress.

The field of KO system development is often conceptualized as a technological endeavor that has shifted, from a field where documents were represented by metadata gathered through manual processes and browsed in relatively simple manual systems, to a field where documents are represented by automatically generated metadata and searched in computational systems. Key to this transformation has been the implementation of the computational algorithm and increasingly sophisticated statistical approaches.

This technological change has occurred in a period of rapid social change. Globalization has further imperiled indigenous cultures and languages; increased social stratification; and digitization has not only multiplied documentary genres and formats but also enabled concentration of media ownership. These trends, along with increasingly onerous copyright and intellectual property regimes, have restricted fair and open access to knowledge resources. KO, once the exclusive purview of universities, libraries, archives, museums, and learned societies, with some commercial support, now is significantly shaped by major commercial players like Google, Thomson Reuters, and Reed Elsevier.

However, in a period of rapid technological and social change, key assumptions regarding the nature of the human mind, of sociocultural relations, of classificatory structures, and of linguistic phenomena remain relatively under-investigated. A lack of understanding of the social and cultural practices that underpin human interactions with information and with KO systems has led to undesired consequences in the design, development, and use of KO systems. KO systems, by failing to account for various kinds of social difference and variation, incorporate social bias, and reinforce it.

The theory of scientific classification had H. E. Bliss as one of its most significant
early advocates, particularly with his book of 1929, Organization of Knowledge and the System of the Sciences. However, later theorists have emphasized the lack of consensus in scientific exercise. Kuhn's The Structure of Scientific Revolutions (1970) is an example of the myth of consensus; Hull (1988) and Gould (1981) demonstrate the difficulties of, and mismatches between, human categorical modeling of the natural world and scientific taxonomy. The scientific approach is idealized, and cannot avoid the kinds of distinctions that are rooted in cultural systems.

There is a tradition of examining cultural bias present in classification. In the past, scholars like Hope Olson (2002) and Sanford Berman (1971) concentrated on problems of nomenclature, particularly around the names of kinds of people and cultural practices, with special attention to gender and sexuality. Work by Melissa Adler (2017) is a more recent addition to this topic. Elaine Svenonius (2004) examines theories of language and their connection to the validity of knowledge representations as a more basic examination of how those theories limit or enable our conceptualization of classifications. Automated classification systems have traditionally used term-frequency measures to determine the topicality of a document, on the assumption that terms that are relatively low-frequency across a collection, but relatively high-frequency within a given document, are good descriptors of that document. Clearly there are limits to this theory, similar to those "postulates of impotence" described by Swanson (1988), who states "word-occurrence statistics can neither represent meaning nor substitute for it. Such data, however, can be used, with occasional success, to signal or point out potentially fruitful areas of text..." (p. 95). Another potential direction of research would be to find out in which ways term frequencies fail, such as in the non-figurative or poetic language associated with lyric and poetry, and in fictional works. In such ways, we in the KO community might develop a greater sensitivity toward the limits of language in classificatory activities, even coming to an understanding that language itself is a cultural and social system; we might start to examine the ways in which language and our models of language limit, influence, and bias our KO systems, and the manner in which language does not present itself as a neutral field of scientific application.

KO systems are clearly incorporating a wider variety of data in their modeling of users and information. We are all familiar by now with Google's network-based centrality measures as a particular kind of citation practice, and the cultural (including science-as-culture) dimensions of citation behaviors as documented by Price (1963), Kaplan (1965), and Merton (1968). Other behaviors, such as shopping and viewing histories, location and search history are being incorporated in advanced retrieval systems. While these behaviors are strictly speaking non-linguistic, they are cultural signifiers, and hence semiotic. The assumptions enumerated above can even be usefully examined within the field
of biological classification, where rational and empirical approaches are generally
assumed to be part-and-parcel of taxonomic work. Scientific classification has been the
model *par excellence* for all of classification. One major operation has been to
determine the membership criteria by which a specimen could be assigned to a class or
taxon. Far from being an accurate reflection of a naïve natural reality, scientific
classifications again incorporate scientific and cultural expectations, which can act as
a set of biases on those classifications. For centuries, biodiversity work has involved
the production of taxa based on the possession of certain characters or organismal traits
(Queiroz and Gauthier 1992, p. 452). However, identification of the attributes and
features of an organism that are used to determine membership within a particular class
is, by definition, a subjective assessment. This is a fact not only accepted in the
biodiversity world, but also expected as part of the practice of building taxonomies in
general—taxonomies are hypotheses, always-already situated, to be rearticulated and
changed with the introduction of new scientific insights and methods. Scientists create
classes; classes do not exist as natural kinds. Alongside these practices, biodiversity
work has seen an increasing reliance on statistical and automated methodologies that
have begun to obfuscate the individual judgment required in any and all taxonomic
work.

In contemporary biodiversity practice, it is often the case that groups of organisms
are computationally clustered based on molecular similarities. These so-called
phylogenetic analyses rely on the examination of molecular traits that can be "measured
and scored" (Felsenstein 1983, p. 247) and statistically evaluated to produce
evolutionary trees of the most beautiful complexity. Genetic markers in the form of
DNA barcodes (such as the mitochondrial C01 gene sequence) have been increasingly
useful in constructing these schematics (Waterton, Ellis, and Wynne, 2013; Erickson
and Driskell, 2012). The outputs of such phylogenetic examinations are drawings that
depict the hypothesized relationship between various entities. One result of this
approach is a "proliferation of taxonomic categories" (Queiroz and Gauthier 1992, p.
457). Alongside these approaches we see an overall decline in the use of morphology
as the primary tool for assessment (Wheeler 2004, p. 571). The problem with this trend
is that human judgment is often overlooked as still being essential to taxonomic
practice. Individual intervention is still necessary to create classes and taxon groups.
Even with the assistance of computational analysis and clustering, we often
underestimate the cultural qualities of these classifications.

**Investigating the cultural elements of Knowledge Organization**

The age of the citations above indicates that investigations of KO as a kind of cultural
practice have been in existence for decades. Nor has the presence of such research
prevented technological development within the field. However, the presence of
cultural elements within classification raises two kinds of broad concerns: first, does
cultural variability in classification pose a limit to the development of KO systems; and secondly, does the presence of cultural perspective within a classification scheme amount to bias or other kind of ethical malpractice?

We thus see investigations of classification and KO as reflecting a basic and applied research paradigm that is common in scholarship and in science. Cultural investigations – both in how classifications are made of cultural presumptions and also in how classifications reinforce cultural presumptions – form a basic research paradigm for classification because of how they may limit or reshape classificatory practice. Technological advances may continue, albeit we hope with a better critical understanding of the nature of classification, and with the development of more sensitive, more robust, and more ethical KO systems.

Within the basic research paradigm, we also envision investigations of a series of assumptions regarding KO. We have organized these assumptions as rational, empirical, and ethical research fronts.

**Rational assumptions**

1. Platonism about concepts as abstract objects. Occurrences (e.g., utterances and inscriptions) of terms, keywords, concept labels, subject headings, topic statements, classmarks, etc., are concrete particulars instantiating abstract universals known as concepts; and these concepts exist in the real world.

2. Pluralism about instantiation. It is possible for a single term, subject heading, etc., simultaneously to have multiple meanings (i.e., instantiate multiple concepts) for different people and in different domains, disciplines, communities, cultures, worldviews, etc., and for the same term to have different meanings at different times.

3. Structuralism about semantic relationships. It is possible, at least in principle, to devise conceptual structures whose internal relationships are sufficiently coherent to form the basis for controlled vocabularies that, whether they exhibit polyhierarchy (many-to-many concept–concept relationships) or not, avoid circularity.

4. Intersubjectivism regarding the boundaries of KO and KO system concepts. The concept knowledge organization system is itself a social construct.

5. Skepticism about objectivity in KO system design. All KO systems necessarily reflect (to a greater or lesser extent) the worldviews of their curators. Indeed, all KO systems reproduce (to a greater or lesser extent) the power relations at work in their creation.

6. Relativism about the instrumental value of KO systems. Such systems are culturally-specific artifacts. Notwithstanding their generic similarity, individual systems have different uses, functions, purposes, etc., depending on the contexts in which they are produced and consumed. Likewise, it is possible for a single
KOS simultaneously to have value of multiple different kinds to different people; and different KOSs may well be incommensurable. "Universal" KO systems can never be truly universal. Empirical evaluation of all methods, approaches, schemes, systems, etc., is always necessary; yet the choices to be made among evaluation criteria, warrants, authorities, etc., are always more-or-less arbitrary (or, alternatively, "culturally situated").

7. Like culture itself, KO systems are historically situated. The linguistic, social and conceptual spaces that are modeled in KO system are subject to change.

**Empirical assumptions**

1. The universalist principle. Harmonization, standardization, interoperability, linked data, etc., are good; disconnectedness, localism, silos, etc., are bad.
2. The techno-optimist principle. Large-scale classifying, facet-decomposing, harmonizing, etc., can be done automatically, to at least as high standards as those reached by manual means.
3. The pragmatic principle. In the creation of vocabularies, a combination of top-down and bottom-up methods is always better than either one or the other.
4. The anti-enumerative principle. Organizing concepts by facet is always best.

**Ethical assumptions**

1. KO system designers should strive for neutrality and work to minimize the impact of personal biases.
2. KO systems should be inclusive: they should meet the requirements, respect the identities, and promote the interests of all of their potential users, not just the "typical" user, nor an elite, nor the "majority".
3. KO systems should distribute terms, classes, etc., equitably: *i.e.*, in ways that accurately and fairly reproduce the cumulative significance of the concepts represented for the whole user population.
4. Along with access, understanding, etc., transformation (particularly of power relations) and freedom from oppression are legitimate goals of KO.
5. Diversity is good; homogenization is bad.

Clearly, no single person could make all of these assumptions without facing several logical contradictions. We argue that it is just those contradictions that the KO community needs to address directly, and either eliminate or resolve, if it is to make substantive progress beyond the current state of the art.

**Developing a critical approach to the organization of knowledge**

Of increasing significance, then, is that KO itself must become the locus of critical reading and literacy. Users must not only develop an information literacy, defined as
"the ability to locate, evaluate, and use effectively the needed information" (American Library Association 1989), but develop a critical capacity for understanding how the various systems of knowledge organization permit, limit, or shape their means of access to information. Common conceptualizations of critical literacy serve as a point of departure for developing a notion of critical information literacy, especially as it pertains to KO. Critical literacy, as derived from Freire (1970), emphasizes the reader's ability to understand and analyze a text's ideological meanings and its role in various discursive formations, and that the reader and the text are both historically constructed. We seek a similar understanding not just of texts or of information, but of the methods of access to texts and information as well, and an understanding that the information seeker is an agent within a larger cultural milieu.

The consequence of enabling a more critical engagement with information systems entails exposing their functions, design assumptions, and biases to critical understanding. How to accomplish this task is also an open and relatively unexplored research question, but has received some attention, for example, in Drabinski (2013). Critical approaches will help us to establish more ethical approaches to the organization of knowledge, and to provide better articulations of their purpose and contributions to society.

References


