Reflexions on Multidimensional Knowledge: Its Influence on the Foundation of Knowledge Organization

María López-Huertas

Universisad de Granada, Facultad de Comunicación y Documentación,
Colegio Máximo de Cartuja - 18071-Granada (Spain), <mjlopez@ugr.es>

Prof. María López-Huertas works at the Faculty of Communication and Documentation of the University of Granada. She teaches knowledge organization theory and methods and knowledge organization systems design, construction, and Implementation. Her research is focused on said topics, with special emphasis on inter- and transdisciplinarity. She is a former ISKO president.

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ABSTRACT: The theories that underlie multidimensional knowledge (multidisciplinarity, interdisciplinarity and transdisciplinarity) are revisited. The objective of this part is to analyze some proposals in order to arrive to the main features characterizing inter- and transdisciplinarity. A reflection on this thinking, with special reference to transdisciplinarity, follows, in the belief that this model can be of interest to the foundations of the organization of knowledge. Two aspects are approached: how concepts and categories in information science can be seen under this perspective and how this change might affect knowledge organization.

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1.0 Introduction

The modern view of knowledge had been strongly influenced by a discipline-based organization. For example, since Bacon's time, the paradigm of reference for classification of knowledge, including those developed in a library and information science context, had been encapsulated into the idea of the tree of knowledge, which divided knowledge by disciplines or a field of learning.

In the first half of the twentieth century, scientific paradigms went through a big change. Traditional science, characterized by specialization and dominated by positivism, was questioned, as well as the epistemology that supports it. A new way of looking at reality, science and research arose and made possible the development of new views that challenged, at the same time, what had been done until the present time. This move has to be also understood in the context of a society that started to change very much compared to that of the preceding century.

New theoretical models on which to base science and research were consolidated along the twentieth century until now. The predominating idea was that a high degree of specialization and reductionism, as a consequence of the strong influence of positivism in modern science, moved scientists away from reality. This thinking gave place to a new current that reacted by proposing that reality is a complex phenomenon to be solved with appropriate theories and methods not contemplated in disciplines. Morin (1992) with his complex thinking is a good example of a new movement that will embrace, with time, currents of thought that have been called postmodernism, postmodern science, multidimensional knowledge (interdisciplinarity and transdisciplinarity). Therefore, we are facing a big revolution that demands a new epistemology; that is, an epistemology based on premises according to the demands put forward by the current society, a new way of looking at research, new methodologies, new logics, etc. Multidimensional knowledge emphasizes a more reticular character of knowledge and the need to overcome its fragmentation and sectorialization which characterized the modern view of knowledge.

The next section will be devoted to analyzing the characteristics of multidimensional knowledge, with special emphasis on transdisciplinarity, and suggesting how transdisciplinarity and some other recent writings on epistemology of documentation can be a source to rethink the foundation of KO and KOS.

2.0 Multidimensional knowledge: multidisciplinarity, interdisciplinarity, and transdisciplinarity

In order to understand multidimensional knowledge, let us recall briefly some important facts. By 1970, interdisciplinarity was typified and the word transdisciplinarity was used for the first time at the Workshop on Interdisciplinarity held in France. In 1977, the bases for the cognitive model in Information Science were laid at the first Conference on Cognitive Sciences; The Chart of Transdisciplinarity was signed in 1985. In the nineties, the sociocognitive model in information science and the domain analysis approach were developed (Hjørland 2002).

The multidimensional knowledge movement (Sanz-Menéndez et al. 2001; López-Huertas 2007) is an expression that denominates all the varieties which have been identified with the production of multidisciplinary, interdisciplinary, and transdisciplinary knowledge. These denominations are widely accepted, but are far from being completely clear even in the minds of their first theorists. The debate about terminology and the conceptualization of this new knowledge is still open. Nicolescu (2010) talks about the war of definitions in a recent article. This is a controversial issue that has demanded for the scholars in this field to defend this new way of producing knowledge (Nissani 1997; Condee 2004; Rogger 2009), and that has originated quite a few reactions (Apostel 1972; Kockelmanns 1979; Klein 1990, 2000 and 2010; Salter and Hearn 1997; OECD 1998; Repko 2008; Huutoniemi et al. 2010; Alvargonzález 2011). This situation deserves a bit of thought on the positions of the specialists about multidisciplinarity, interdisciplinarity and transdisciplinarity.

2.1 Multidisciplinarity

It is also called pluridisciplinarity (Kockelmanns 1979) and polidisciplinarity (Morin 1992). The prefixes multi-, pluri-, and poli- refer to the fact that it affects several disciplines or that it involves several disciplines. Unfortunately, it is often taken as synonymous with interdisciplinarity, but there is a quite clear distinction between them. It is an approach that juxtaposes disciplines. Juxtaposition seeks wider knowledge, information, and methods. Nevertheless, disciplines remain separate, its elements keep their original identity and the disciplinary structure of knowledge is not criticized. As a result, the studied topic is enriched but it is still a disciplinary product, it transcends the discipline, but it is finally limited to the disciplinary framework. In the multidisciplinary approach, interaction does not take place, and this fact differentiates it from interdisciplinarity. In the multidisciplinarity process, the disciplinarian researcher perceives a complex task or topic, and he/she seeks to overcome this narrow view by looking for different disciplinary perspectives.

2.2 Interdisciplinarity (ID)

Contrary to what happens with multidisciplinarity, ID is considered as a really new approach to knowledge production. There are different conceptions about it although everybody agrees in that integration among disciplines must take place in order to finally get something organically new and different from the original concurrent disciplines. At the same time, most of the authors acknowledge that disciplines are necessary for ID because they are the starting point for it. The lack of agreement among experts is based on the observation of how researchers conduct their own ID projects together with the reflections made by the theorists in this field. According to Kockelmanns (1979, 128), ID is

> Scientific work done by one or more scientists who try to solve a set of problems whose solutions can be achieved only by integrating parts of existing disciplines into a new discipline …. This work does not imply that the original disciplines themselves become totally integrated, although this is not excluded either.

Other definitions can be found in Apostel (1972), Morin (1992), Gibbons et al. (1994), Nicolescu (1996; 2012), Klein (2000), Nowotny et al. (2001), McNicol (2003), and Repko (2008). To sum up, ID involves: a process mode of research, disciplines or bodies of specialized knowledge (disciplinary views) and an integration of disciplinary insights into new knowledge characterized by a cognitive advancement.

There are several kinds of ID, according to the consulted literature:

> 1) Instrumental Interdisciplinarity. This perspective is interested in developing ID as a pragmatic solution to unsolved problems that consists in borrowing methods and tools across disciplines in order to address the needs demanded by the specific problems at hand. Integration is required (Repko 2008). It does not look for an overall synthesis of concepts and/or analyses or a fusion of different perspectives toward the creation of new knowledge. It is inter-

ested in the integration of frameworks on specific problems on a temporary basis. Instrumental interdisciplinarity is related to operational research which seeks provisional information for specific purposes. It has a lack of concern with the transformation of disciplinarity and with the solving of epistemological issues. This perspective supports the belief that interdisciplinarity is one step in the creation of new realms of knowledge, or new disciplines or both (Salter and Hearn 1997).

2) Conceptual or Theoretical Interdisciplinarity. The theoretical ID "connotes a more comprehensive general view and epistemological form. The outcomes include conceptual frameworks for analyzing particular problems, integrating propositions across disciplines, and new syntheses based on continuities between models and analogies" (Klein 2010, 20). Salter and Hearn (1997) argue that a form of conceptual interdisciplinarity is dependent on disciplines that have both its foundation and its point of departure. There is not an overt critique to disciplinary epistemology. Others, however, think that the conceptual ID is in radical opposition to disciplinarity and it poses an open critique of its epistemology. It looks for a politicized transformative knowledge because disciplinarity has created units of knowledge that have no application to real social concerns or to the evolution of human thought. There is a disagreement about whether the conceptual ID searches for the unity of knowledge or not.

3) Critical Interdisciplinarity. Some authors consider theoretical and critical interdisciplinarity as belonging to two kinds of different clusters (Repko 2008; Klein 2010), but others claim that critical ID is one kind of conceptual interdisciplinarity (Salter and Hearn 1997). As in other instances, there are differences in terminology and in the conceptualization of what critical ID is about. This view criticizes the absolute, pragmatic perspectives of ID which only combine different methods, theories, etc., without seeking for transformation. It aims to transform and disband the established boundaries. Critical ID also implies a pragmatic approach, but the difference with other pragmatic driven interdisciplinarities is that critical ID goes much further by challenging established boundaries with the aim of transformation.

2.3 Transdisciplinarity (TD)

It is a concept that emerged in a Seminar on interdisciplinarity held in Niza in 1970 and it is attributed to Jean Piaget (Nicolescu 2008). Scholars use TD with different meanings (Motta 2002). In 1994, a transdisciplinary manifesto was signed at the Monastery of A Rabida, Portugal, which is considered de departure point for TD to consolidate (Nicolescu 1996). The signers of this letter react against a possible material and spiritual self-destruction and against techno-science which looks for the efficiency as an end, threatening life in earth. They are against the raising of differences among people and nations despite the growth of the knowledge and against the contemporary fracture between the knowledge and an inner being increasingly impoverished. Nevertheless, they agree on the possibility for the knowledge to change this situation.

Morin (1992) claims that transdisciplinarity is often dealing with cognitive schemas that can cross through disciplines. Nicolescu (2011) yields that TD's final aim is the understanding of today's world by the unity of knowledge. Its interest is the dynamic of action inscribed in the different levels of reality and it is based on the existence and perception of different levels of reality, in the raising of new logics and in the emergence of complexity. Wenzel (2001) claims that a complex system is today recognized as a topic for transdiciplinary research which aims to create an all-encompassing framework valid for all science.

Several classes of TD can be identified (Kockelmanns 1979; Klein 2009; Nicolescu 2011). However, two main views will be addressed: the theoretical TD and the contextualized (or phenomenological) TD.

2.3.1 Theoretical transdisciplinarity.

This perspective envisages TD as a global phenomenon that encompasses not only sciences but also any aspect of human social life and nature. Its goal is to transform science, the environment and social structures in a way which the world can be a better place to live in. This view represents a strong reaction towards scientific positions that understand reality as an objective entity ruled by objectives laws. Nicolescu is the main exponent of this conceptualization of TD. For him, the production of knowledge based on the classical physics view is the cause for the subject to become an object and as man-object it is taken to self-destruction. It is also the cause of the instauration of a paradigm of simplicity that is referred only to one level of reality (Nicolescu 2010). To move beyond the limits of classical physics, a new worldview inspired by quantum physics has to be assumed as a paradigm to explain the transition towards transdisciplinarity. For Nicolescu, reality has an ontological dimension and a trans-subjective dimension; the complex plurality and the open unity are two facets of the same reality. Reality is multidimensional, and it is articulated in levels. A level of reality is "a set of systems which are unaltered, under certain general laws" (Nicolescu

2012, 20), so we are in a different level each time that the applicable laws and the fundamental concepts are broken. For this reason, it can be said that there is discontinuity between levels. The levels of reality are unlimited. The transdisciplinary object is the set of levels plus the zones of non-resistance to our experiences, representations, etc. That is what cannot be known due to our limitations. At the same time, the levels of reality are accessible to humans because different levels of perception exist (levels of reality of the subject) that, together with the zone of non-resistance to perception, constitute the transdisciplinary subject. The different levels of reality and perception are articulated by the logic of the 'included third' which allows moving from one level to another. In order to ensure the coherent transmission of information and perceptions, these must interact in one point where the zones of non-resistance of the object and of the subject are identical. So interaction becomes the third term in transdisciplinary knowledge: "interaction term between the Subject and the Object cannot be reduced neither to the Object nor to the Subject" (Nicolescu 2008, 10).

The methodology of transdisciplinarity has been encapsulated by Nicolescu (2010, 24) into three basic axioms:

> 1) The ontological axiom: "There are, in Nature and society and in our knowledge of Nature and society, different levels of Reality of the Object and, correspondingly, different levels of Reality of the Subject";
>
> 2) The logical axiom: "The passage from one level of Reality to another is ensured by the logic of the included middle";
>
> 3) The complexity axiom: "The structure of the totality of levels of Reality or perception is a complex structure: every level is what it is because all the levels exist at the same time".

This view of TD will inspire several of my suggestions to improve the foundation of KO and KOS, as it will be seen later.

2.3.2 Contextualized transdisciplinarity

This is very much focused on society and contextual research. It aims at breaking with disciplinarity as the one and only way of producing knowledge. From this view, society has become more conscious of what could be expected from science and technology and of the possible side effects of both. It was not possible to understand this new knowledge divorced from its social context. Gibbons et al. (1994) and Nowotny et al. (2001) represent this perspective. For them, transdisciplinarity arises only when research is based on a common theoretical understanding and an interpenetration of disciplinary epistemologies. Transdisciplinary production of knowledge is contextual, and, for that reason, it is not inspired to restore the cognitive unity. On the contrary, it has a temporary configuration, and it is highly mutable. Contextualization is a continuous process where new ways of interaction and communication between scientists and those who speak to science take place. It is evident that this perspective is different from that of Nicolescu, especially in what deals with the unity of knowledge. Nicolescu (2008 and 2010) comments this trend and argues that he is against the idea of reducing TD to a "joint problem solving" (Nicolescu 2008, 12), and to producing better science.

3.0 Rethinking the actual foundation of knowledge organization

The changes mentioned above have given rise to a current of thought devoted to finding a theoretical model valid nowadays to face not only the science but also the societal demands and needs. There is no doubt that if the ways of producing knowledge and understanding the reality have changed that much, theoretical models in library and information science must also change. In the last two decades, several publications from authors of different backgrounds contributed with important ideas to the current of thought that was consolidating from the middle of the last century (postmodern thinking, inter-transdisciplinarity). This move identifies itself with an epistemological current named "after epistemology" (Harris 2009). In the LIS environment, a similar approach is followed by García Gutiérrez (2011a and b) who named it "post-epistemology." Both terms might seem vague but, in my view, they were chosen to differentiate it from what is called postmodern thinking in a strict sense. In fact, it is known that the term postmodernism is often used to embrace theories that react against modern science, without considering that there are many differences if compared, for instance, to the inter- and transdisciplinary thinking (Szostak 2007). Despite their differences and their origin in different theoretical backgrounds, post-epistemological approaches and (theoretical and contextual) trans-disciplinarity share a number of basic assumptions and common places: a) sensitivity to social demands and social welfare; b) the resurrection of the subject as a reaction to the classical ideas about it and about knowledge (a reification of the subject and knowledge); and, c) the criticism of the how nature and reality are conceptualized.

In the following sections, I analyze how by following these points a rethinking of the foundation of knowledge organization foundation could be envisioned, in relation to,

for example, key issues like the conception of concepts, categorization and strategies for KOS design. Whereas the traditional approach in knowledge organization is based on the notion of (tree-styled) logical hierarchy, more emphasis has to be given to transversal links and networked conceptual structures as it is evident from the multidimensional knowledge and post-epistemological thinking.

3.1 The sensitivity for social demands and social welfare

Post-epistemological approaches aim to improve the quality of life of individuals as a final objective. They yield that the chaotic situation that the human being is going through is a consequence of the reification of the subjects and knowledge. Harris (2009) defends that knowledge has undergone not only a process of reification but also a process of quantification on the market. So, a new epistemology should look for a scenario that allows you to change this situation. A change that seeks to avoid the potential for humans to self-destruction once that social and individual welfare promised by scientism has vanished indefinitely (Nicolescu 2011). The search for societal welfare is specially found in those who think that research cannot be taken as transdisciplinary without the active participation of society which is now considered a needed influence in knowledge production (Gibbons et al. 1994; Nowotny et al. 2001; Cooper et al. 2008). This idea is also shared by other authors who are not consciously much involved in TD, as it is the case of García Gutiérrez (2011a). For him, the actual epistemological foundations in library and information science, dominated by positivism, creates oppressive systems for the majority of the citizens, due to their concept of concepts and the construction of structures based on dualism. These foundations for instance, do not make it possible to create appropriate transcultural systems.

3.2 The resurrection of the subject

A direct consequence of the post-epistemological position is the resurrection of the subject while recognizing that her/his welfare and freedom must guide any methodological approach. Since the last decades of the 20th century, LIS approaches have been developed emphasizing the importance of the subject (the cognitive and the socio-cognitive perspectives), but the contribution of the post-epistemology goes far beyond. It considers the subject as the final end for any action undertaken by scholars studies, research and knowledge production. And we can go even further if we consider Nicolescu's theories. He argues that the subject is the most influential factor in the human view of reality, so the object has been pushed into the background. The limit of cognitive and sociocognitive theories in LIS is that the former disconnects the subject from the societal environment, and the latter considers the socio-labour medium as an object influencing the subject. On the contrary, the theoretical transdisciplinarity idea of reality considers the status of the subject as crucial (Nicolescu 2010). The TD subject refers to the levels of reality of the subject and the TD object applies to the study of the nature and the social (Nicolescu 2008). Knowledge is simultaneously interior and exterior, and they sustain one another. The communication between subject and object is coherently guaranteed by the means of the interaction term (later called the 'hidden third') which allows unification between the two (Nicolescu 2012). These ideas should be taken into account when designing KOS, for instance.

3.3 Criticism of how nature and reality are conceptualized and its impact on KO: the importance of transversal or networked systems

This third issue affects more deeply to what knowledge organization is about: concepts, referents, categories and organization of conceptual structures. In our specialised field, most theories about concepts and categories are influenced by the classical model inherited from the classical logic and the positivist view of the world. As a consequence, concepts as well as categories are considered closed entities. They have limits and generate exclusions. This leads to a binary understanding of concepts; that is, what belongs or not belongs to a given concept or category (mutual exclusivity). This dichotomous thinking has been predominantly used in KO, giving rise to rigid and strongly hierarchical systems. Logically-based hierarchies are, in fact, the main organizing feature of knowledge organization systems such as classification schemes, thesauri or ontologies.

This situation has been steadily changing due to contributions that highlight the fact that concepts and categories are influenced by the context (Hjørland 2002). Other approaches questioning the classical model are summarized by Iyer (1995). However, there is a need for going a step further in order to have a general model, away from the classical one, that could serve as a basis to revise the constituent elements of knowledge organization: concepts, categories and conceptual structures. For this task, I will borrow insights from García Gutiérrez (2011a) and Nicolescu (2008; 2011; 2012).

The first refers to a theory of concepts that represents a strong reaction against the usual way of considering and structuring them. Reality should be viewed neither as an object from which we get representations, nor as a subjective construction. Somehow, concepts (or categories) have been replacing the reality, although they fragment its com-

plex structure in order to handle or dominate it. Concepts are established in respect to a given context. This entails also that their definition or meaning depends on it. These ideas suggest that concepts should be considered porous; that is, they should be open to all necessary contexts when a system is being designed, and they should function as dynamic open systems in consideration of the fact that new contexts are continuously produced.

Similar ideas underline Nicolescu's theories. Reality is seen as an open system that cannot be constrained within the limits of dichotomous logic. By applying the logical axiom of the included middle in the LIS context, new ways of developing KOS could be gained. For conceptual structures to be more flexible and more suited to the needs of current communication demands they have, in fact, to incorporate a more flexible logic.

Another fundamental feature of Nicolescu's transdisciplinarity approach is its emphasis on transversality, in respect to how knowledge has to be produced and represented. Together with the idea of the porosity of concepts, the overcoming of the binary logic and the idea of transversality provide important insights that could contribute to revise the conceptual foundation of KO and the way of designing knowledge organization systems. In particular, the role of hierarchies in KOS has to be reconsidered. García Gutiérrez (2011a) talks about the need for a "declassification" and argues that the use of hierarchies is also a way of domination; that is, it goes against freedom. For him, this tendency toward declassification also requires a change in the metaphors to be used to portray conceptual structures in LIS. The traditional tree has to be replaced by the postmodern idea of the rhizome, as also proposed by Deleuze and Guattari (1987). García Gutiérrez (2011b, 8) explains this idea as follows:

> Deleuze and Guattari ... retrieved and rehabilitated the botanic metaphor by means of the rhizome, a set of anarchical, discontinuous, capricious and tangled roots, like those of the Southern mangroves, as a figure of epistemological dismantling. That is the nutrient from which sprouts the theory of declassification put forward in this article.

This contrast between the use of tree and rhizome models in LIS has also been explored recently by Robinson and Maguire (2010). The metaphor of the tree is used here to represent the traditional hierarchical approach in LIS, which is based on Aristotle's logic. Nevertheless, due also to the changes triggered by the Internet, a new way of conceiving systems is needed, by which non hierarchical (transversal) linkages and horizontal multiplicities are more valued, and crossing categories admitted. This new model can be portrayed by means of the idea of the rhizome.

For all the previously mentioned, KO should put more emphasis on transversal or networked systems. It does not mean that hierarchical relations should be forgotten, but that they should not be necessarily considered the main feature of those systems. Hierarchies are closed, context-driven entities so a conceptual structure based on them is also limited and hinders communication in today's transversal world needs. Following Sukovic (2008), Robinson and Maguire (2010) come to a similar conclusion. In information organization, there is the need to integrate non-hierarchical (rhizome-styled) items and models, which confers flexibility and associativeness, with hierarchical (tree-styled) ones, from which control and a more stable organization can be gained.

One might think that thesauri have paid attention to these by introducing associative relations in their structure, but they are few in number and in kinds compared to other more evolved models where transversality is the dominant feature (Figure 1).

What I would like to add is that following the transdisciplinary approach can help us in properly achieving this target. Other specialties, like psychology, are questioning now their foundations by adopting this model, as can be seen in an essay on "updating psychology" (Lumley 2011).

4.0 Conclusions

It is evident that a big change in knowledge production, culture, society, and epistemological positions has taken place in the last decades. This current gave place to general theoretical platforms known as multidimensional knowledge in general. This fact has led to some authors to go further and to generate theories that have given rise to what some call post-epistemology.

We have identified two main influences of this movement: Nicolescu's model of transdisciplinarity and Gutiérrez's theories. Based on this, alternative foundations for KO and KOS are suggested:

> 1) The need for an openness and porosity of concepts and categories to the needed contexts that, in turn, should also be opened to new possible contexts. Enlarging the content of concepts facilitates transversal structures because it enforces their potential for a high representativeness. This aspect is of great importance to move forward because it avoids exclusions in a great deal from the beginning, and it breaks with the Aristotelian model that leads to rigid tree-like structures.
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> 2) The need for the adoption of not dichotomous structures as much as possible to organize those categories and concepts. That is to say, that we

SOUND (Categories)	**Type of sound**	**Source of sound**	**Way of producing sound**	**Means of producing sound**	**Musical character**
(Key words) →	Instrument	Strings	Scraping	Bow	Singing instrument, Deep sound, Low records, Range of 3 octaves
RELATION WITH OTHER INSTRUMENTS (Categories)	**Origins**	**Family**	**Similarity with others**	**Competition with others**	
(Key words) →	Rabel, viola da bracio, viella	Violin	Viola da gamba	Viola da gamba	
MORPHOLOGICAL CHARACTERISTICS (Categories)	**Strings/ Number**	**Strings/Di-mensions**	**Instrument size**	**Neck**	**Neck/ Frets**
(Key words) →	4 strings	708 mm	Big	With neck	Without frets
PERSONS (Categories)	**Composers**	**Artisans**	**Theoreticians**	**Performers**	
(Key words) →	Haydn, Beethoven, Bach, Mozart, Vivaldi, Jacchini, Cirri, Dvorak Schumann, Debussy, R. Strauss, Britten	Stradivarius	Mich, de Cupis, Duport	Corelli, Duport, Cervetto, Tartini, Janson, Casals, Maréchal , Cassadó	
MUSICAL FUNCTIONS (Categories)	**Musical Genders**	**Musical Forms**	**Musical functions/ orchestras**	**Musical functions/ scores**	**Instrument's importance**
(Key words) →	Chamber music, instrumental music, dramatic music	Sonatas, concerts, ricercares	It is played with the orchestra	Solist instrument, Fa in fourth	Outstanding in instrumental music
TEACHING (Categories)	**Teaching Methods**				
(Key words) →	Methods of Mich, Corette, de Cupis and Duport				

Figure1. Proposed structure for the violoncello concept (López-Huertas 1999)

should move towards transversal or networked systems without forgetting the hierarchies, but including them as another element in the structure, since they hinder communication in transversal systems. To make this possible, our concept of concepts should also be changed, as suggested above.

3) The need for new logics beyond the Aristotelian tradition (e.g., the one used in the TD model) to articulate conceptual structures in a way that allows us moving away from the limits of dichotomy.

Finally, it is clear that KO should look for transversal or networked models nowadays, but, in my view, this is only the beginning of a process that can take us even beyond this idea. I think that the TD theoretical model can help in this task if deeply explored.

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