

# Heisenberg and the Structure of Concept - Content and Dimension

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## Abstract

*This paper aims to explore Interdisciplinarity and its necessary connection to the theory of Knowledge Organization. I am attempting to survey the problem of concept-building and extension, as well as the determination in different interdisciplinary aspects. My purpose is to find criteria for Interdisciplinarity and give some new approaches of the concept. I will survey controversies about Interdisciplinarity, concepts in their historical context, the representational theory of mind, conceptual representations; epistemological approximations etc., then sketch the structure of concept, make a comparison between content and the dimension of concept and semantic elements. I will draw up unknown possibility when I point new correlation between Heisenberg Uncertainty Principle and the components of the concept - studying content and the dimension of the concept is impossible same depth and accuracy in the same time-.*

**Keywords:** Concept-building, Heisenberg, Intention and extension, Interdisciplinarity, Knowledge organization, Structure of concept, Theory of information retrieval language.

## Resumen

*Esta comunicación se dirige a explorar la interdisciplinaria y su conexión necesaria con la teoría de la organización del conocimiento. Se intenta examinar el problema de la construcción del concepto y de su extensión, así como determinar su posición en diversos aspectos interdisciplinarios. Mi propósito es identificar los criterios de la interdisciplinaria y realizar algún nuevo acercamiento al concepto. Examinaré las controversias sobre la interdisciplinaria, los conceptos en su contexto histórico, la teoría representacional de la mente, representaciones conceptuales, aproximaciones epistemológicas, etc. A continuación se bosqueja la estructura del concepto, se hace una comparación entre el contenido, la dimensión del concepto y los elementos semánticos. Esbozaré nuevos planteamientos señalando la nueva correlación entre el Principio de Incertidumbre de Heisenberg y los componentes del concepto - estudiando el contenido y la dimensión del concepto es imposible la misma profundidad y exactitud en el mismo tiempo-.*

**Palabras clave:** Construcción de conceptos, Heisenberg, Intención y extensión, Interdisciplinariedad, Organización del conocimiento, Teoría del lenguaje de recuperación de la información.

## 1 Introduction

This paper examines some traditional approaches of the concept (Carnap, Church, Wittgenstein, Horwich, Dahlberg, etc.) and its circumstances on the basis of different sciences (Philosophy, Epistemology, Psychology, Physics, Semantics, etc.). We would conclude at the first step: one of the fundamental conceptions of Knowledge Organization, the concept itself is cross-science, a multidisciplinary and interdisciplinary phenomenon.

## 2 Interdisciplinarity

Why did I choose to study Interdisciplinarity then the concept which has already been examined since ancient times? One of the reasons is based on the Hungarian educational system. Teacher training was not organised in the frame of dual system therefore the students traditionally had to be majoring in two different subjects. Let us take, for example my qualifications: librarian and physics teacher for secondary education. Most of the students used to choose: Literature, History, Computer Sciences, Music, Languages... There is big flexibility between the different forms. In the beginning we recognised that librarianship would have to integrate much knowledge for the daily work, it is true even in the case of the theory of Librarian Science. My opinion is the following: this establishment is right especially in Knowledge Organization. Physical principles, axioms can describe many relationships of Information Retrieval Languages, like Entropy, Heisenberg Uncertainty Principle ... One of my university professors was György Marx, whose career was a symbol of cross-science and integrated the different elements of Culture and Science, Physics and Literature, Physics and Philosophy, Physics and Biology, Physics and Love, Experimental Physics and Life, etc. Some titles of his books: Freaks of Nature; The Voice of the Martians; Capable of Atoms etc. At this time I decided to find the most parallel identity that I can. This decision hasn't brought a lot of new solutions, but it means a special viewpoint to see scientific and daily life. One of the well known parallelisms between physics and LIS studies is Boltzman and Shannon Principle.

Why would Interdisciplinary signify difficulties for people? Generally students are/were trained by traditional disciplines that are built on the distinctions and differences among classical sciences. Later this approach would cause some problems, because no realistic occurrence could be classified to only one group.

I should agree with Hacking "I am not a good person to discuss interdisciplinary studies because they have never been a problem for me. My undergraduate education in philosophy was narrow [Sic!] than anyone today can imagine, and I loved it. Ever since then, I have dabbled in, and sometimes contributed to [Sic!], more fields of thought than most people can shake a stick at. Analytic philosophers are not expected to write a book about experimental physics and another about multiple personality (etc.) but for me it has been the most natural, if not the easiest thing in the world, partly because I do not think of myself as 'interdisciplinary' but as applying my discipline in different directions." (Hacking, 2006).

There are minimum two approaches of Interdisciplinarity in Knowledge Organization:

- Useful knowledge from different field in Information Retrieval Languages
- Classifying Interdisciplinary Knowledge

I am focusing only on the first viewpoint.

“Interdisciplinarity is the act of drawing from two or more academic disciplines and integrating their insights to work together in pursuit of a common goal. We use Interdisciplinarity to develop a greater understanding of a problem that is too complex to be dealt with using the knowledge and methodology of just one discipline.” (Wiki I, 2006).

Interdisciplinarity is a concept with many near-synonyms such as Cross-disciplinarity, Integrative studies, Superdisciplinarity and Transdisciplinarity. (Hjørland- Nicolaisen, 2006) They collected the definitions and literatures connected with Interdisciplinarity. Hjørland gathered interdisciplinary aspects of Knowledge Organization: Cognitive Science and Psychology; Computer Science; Philosophy; Educational Science; Linguistics; Library Science, “memory institutions” such as archives and museums; Documentation; Bibliometrics; Economics; Sociology and Economics; History of Science; History of Ideas; Critical Research (Hjørland, 2006).

“In the complex world of the late twentieth century, however, organizing information from an interdisciplinary perspective may be more useful and closer to the way things really are. Domains often cross boundaries, and to view knowledge as an organic whole rather than as disembodied individual specializations seems more genuine, than placing knowledge in unnatural or artificial divisions. Scholarly disciplines often consist of interdisciplinary ways of thinking.” (Mcinerney, 1997).

## 2.1 New examines and trends of Interdisciplinarity

The Institut Jean Nicod organized the virtual seminar about the “Rethinking Interdisciplinarity”. This institute is the one that describes itself as “an interdisciplinary lab at the interface between the humanities, the social sciences and the cognitive sciences”. If we study subjects in the electronic database of the Institut Jean Nicod we will get the meaning of Interdisciplinarity in Humanities:

- Linguistics

Origin and Evolution of Language, Phonology, Pragmatics, Psycholinguistics, Semantics, Sociolinguistics, Syntax

- Philosophy

Epistemology and Philosophy of Science, Aesthetics, Ethics, Logic, Metaphysics, Philosophy of Action, Philosophy of Mind, Philosophy of Perception, Philosophy of Law, Philosophy of Language

- Cognitive Sciences

Cognitive Dynamics, Ethology and Comparative Psychology, Artificial Intelligence, Cognitive Neuroscience, Cognitive Psychology, Evolutionary Psychology, Psychology of Emotions, Developmental Psychology, Psychology of Reasoning, Naïve Psychology and Simulation, Social Psychology

- Anthropology
- Law
- Economics
- Social and Cultural Evolution
- Political Sciences
- Sociology

The method of this virtual seminar is only a discussion, they fell across several discipline, and established collaboration among philosophers, psychologists, neuropsychologists, linguists, anthropologists, and others. They involved many scholars, students, and managers of scientific institutions. Scholars in interdisciplinary research end up having to either articulate the challenge or downplay it. The opening presentation was taken by Sperber. He outlined a historical summary, some viewpoints on the pros and cons and future of Interdisciplinarity. (Sperber, 2006). I am sketching only these experiences:.

- Cosmetic Interdisciplinarity

The committee established a grant to collect explicit criteria of Interdisciplinarity. Scholars made up a collection from several disciplines mostly, each recognised as powerful within his or her one discipline. Very few of them have been involved in intensive interdisciplinary work. The committee has to rank two proposals: a really good proposal the interdisciplinary character of which is superficial and ad hoc, and a merely decent, but genuinely interdisciplinary and innovative proposal. They recognised causes and put their questions, which would be ours, too: “What kind of a comedy is this, where we are pretending to fund novel, interdisciplinary research, while at the same time, there is very little funding available for interdisciplinary teaching and training in the first place? How likely is it that outstanding interdisciplinary proposal emerge in such conditions? And aren’t most of my colleagues on the committee quite content with this state of affairs, which allows disciplinary business to go on as usual at the cheap price of some interdisciplinary rhetoric? “

- Interdisciplinary disappointments

There were two research groups from eminent psychologists and anthropologists in the program. But they could not respect other experimental evidence and methods. This collaboration wasn’t fruitful and they could not take any discussion with each other. It was a very serious surprise and disappointment. “What is going wrong? The two communities, psychologists and anthropologists, have different vocabularies, presuppositions, priorities, criteria, references. In general different disciplines have different sub-cultures, and the difference is made worse, not attenuated, by the existence of superficial similarities, for instance identical words used with quite different meanings (“culture” and “mode of thought” in the present example).”

- A slow learning curve

There was the “Culture and Cognition” program at the University of Michigan and the participants could be able to understand each other and conceive of common goals, they still need not just good will for the end of training. “However, this makes serious involvement in interdisciplinary research a high investment endeavour.”

- A student's dilemma

“The inventiveness and creativity of younger scholars is discouraged from going into interdisciplinary work, slowing down this work, making it intellectually and practically less attractive, and so on.”

- The emergence of an interdisciplinary network

Since the 1980s “the cognitive sciences have become a new kind of (inter)disciplinary configuration, with less institutional unity than most established disciplines, but more dynamic interactions than recognised groups of disciplines such as the social sciences.”

- An interdisciplinary Web conference

Between October 2001 and March 2002, an interdisciplinary conference on the future of the text in the electronic age took place, appropriately, on the Web ([www.text-e.org](http://www.text-e.org)). The lecturers were historians, cognitive scientists, philosophers, librarians, and a publisher and a journalist. The people who participated in the discussions had even more diverse background. This web seminar gave participants greater opportunity to contribute to a discussion across disciplines and languages, without worrying about their status, affiliation, or fluency. Thus interdisciplinary interaction becomes easier via Internet, web conferences, discussing lists, and so does the recognition of interdisciplinary findings. The next step will come with the generalisation of teaching on the web: then may become a real possibility, boosting the development of interdisciplinary research in areas where it is genuinely fruitful.

- Conclusions, remarks

Sperber has research concept of interdisciplinary in Google. I have repeated this examination and there were 23.300.000 hits, as compared, for instance, to 259.000.000 for “scientific.” Results show the Interdisciplinarity is a huge part of scientific publications. The next step was restriction for Philosophy, Psychology, Biology, Linguistics, Physics, Cognition, Anthropology, Library Science, Knowledge Organization, and Epistemology.

Interdisciplinarity has become a hot topic in Economy, Philosophy and Psychology, and Interdisciplinary combined with Physics, Biology and Philosophy prominently. The first column represents theory a little bit more than the second one. The second pillar seems more empiric and applied. The role of Knowledge Organization is conspicuous in theoretical relationships of Interdisciplinarity.

Concept	Hits	%	Concept	Hits	%
<b>Interdisciplinarity</b>	751.000		<b>Interdisciplinary</b>	23.300.000	
...and Library Science (LIS)	10.700	1,42	... and Library Science (LIS)	309.000	1,33
...and Knowledge Organization (KO)	47.000	6,26	...and Knowledge Organization (KO)	44.300	0,19
...and Epistemology (EP)	62.800	8,36	... and Epistemology (EP)	564.000	2,42
... and Cognition (CO)	85.300	11,36	...and Cognition (CO)	899.000	3,86
...and Linguistics (LI)	103.000	13,72	... and Linguistics (LI)	945.000	4,06
...and Physics (PH)	139.000	18,51	...and Physics (PH)	11.700.000	50,21
...and Anthropology (AN)	144.000	19,17	...and Anthropology (AN)	1.270.000	5,45
...and Biology (BI)	151.000	20,11	...and Biology (BI)	10.900.000	46,78
...and Psychology (PS)	187.000	24,9	...and Psychology (PS)	6.120.000	26,27
...and Philosophy (PH)	251.000	33,42	...and Philosophy (PH)	7.760.000	33,3
...and Economy (EC)	367.000	48,87	...and Economy (EC)	2.630.000	11,29
<b>Total hits</b>	<b>1.547.800</b>			<b>43.141.300</b>	

Table 1. Hits of Interdisciplinarity and Interdisciplinary in Google

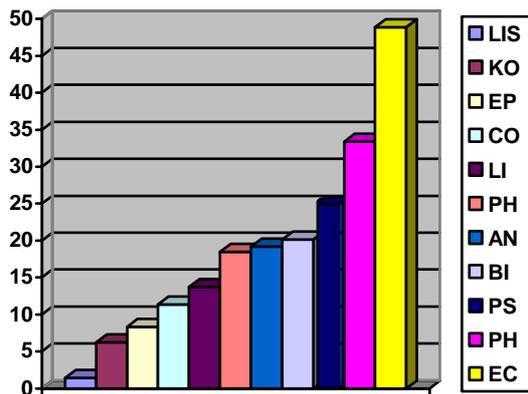


Fig. 1. Hits for Interdisciplinarity and sciences

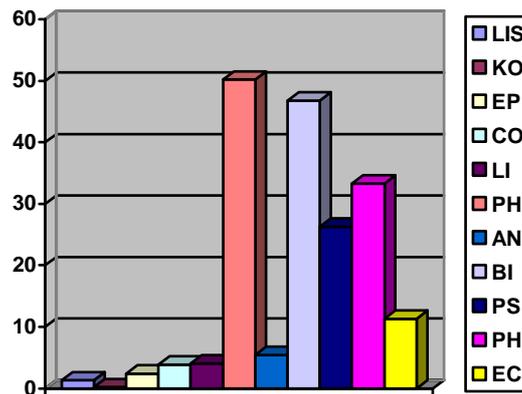


Fig 2. Hits for Interdisciplinary and sciences

## 2.2 Questions

Do isolated sciences exist at all? Do sciences have identifiable borders? Are there characteristics, elements of the concept and can we see them from the different viewpoints, research fields and study them with several methods?

## 3 The Concept

There are many philosophical, linguistic, psychological, epistemological approaches, definitions of what concept and concept-building are. "We might summarize the present situation with regard to candidates for "concepts" that have been discussed here as follows: there is the *token representation* in the mind or brain of an agent, *types* of which are shared by different agents. These representations could be *words, images, definitions, or "prototypes"* that play specific inferential roles in an agent's cognitive system and stand in certain *causal* and *covariant* relations to phenomena in the world." (Rey, 1995, p. 192).

Jerry Fodor, determined figure of Cognitive Science, places the theory of concepts to the heart of his science. He presents a strikingly original theory of the basic constituents of thought. Fodor argues compellingly for an atomistic theory of concepts, and maintains that future work on human cognition should build upon new foundations. He starts by demolishing the rival theories that have prevailed in recent years—that concepts are definitions, that they are prototypes or stereotypes, that they are abstractions from belief systems, etc. He argues that all such theories are radically unsatisfactory for two closely related reasons: they hold that the content of a concept is determined, at least in part, by its inferential role; and they hold that typical concepts are structurally complex. [...] Fodor then develops his alternative account, arguing that conceptual content is determined entirely by informational (mind—world) relations, and that typical concepts are atomic. The implications of this 'informational atomism' are considered in respect of issues in psychology, lexical semantics, and metaphysics, with particular attention to the relation between informational atomism and innateness." (Fodor review, 2006).

Dahlberg points up knowledge fields are interact and cross boundaries. In addition to Multidisciplinarity and Pluridisciplinarity, she describes a form of Cross-disciplinarity where experts from varying disciplines come together, use their talents, methodologies, and

knowledge to conduct research or develop a new product. The experts not only contribute; their collaboration actually produces something that reflects all the contributing disciplines in some way. (Dahlberg, 1994).

Frege's directive between sense and reference of a singular term, and the traditional distinction between the intension and the extension of a general term, apply also to concepts. Frege's criterion of distinctness for modes of presentation (in terms of potential informativeness of an identity statement) can be adapted for distinguishing general concepts that have the same extension. Sameness of topic (referent) is not sufficient for sameness of Fregean cognitive content. Frege showed that two singular terms with the same reference may have different senses, and we know that two general terms can have the same extension yet can differ in their intensions. Similarly with concepts: their contents must be sufficiently fine-grained so that thinkable differences correspond to distinct concepts. [<http://www.bris.ac.uk/philosophy/current/undergrad/unitdesc/yr3/0506/concepts.html#wk1>]

By simplifying the knowledge of concept we can see the structure of concept divided into two parts: content and dimension (intension and extension). They unify each other. The concept has intension, extension and their completeness. The content and dimension are in inverse ratio to one another. The relationship between these two elements is not only inverse, but *conjugate and complement*, too. Semantics of extension is intension, and if I want to describe intension we have to use elements of extensions, specified semantic elements. Intension is the meaning, picture in our mind. These senses appear to be personalized semantic elements from the dimension of individual person. They would be different for different people. The semantic elements are conventional.

Carnap introduced the concepts of Classificatory, Comparative, and Quantitative Concepts in *The Logical Structure of the World* (1928). Classificatory and Quantitative features are similar to intension and extension.

### 3.1 Heisenberg and Concept

If we continue thinking we would arrive at quantum mechanics and Heisenberg Uncertainty Principle. “The present paper seeks to establish a basis for theoretical quantum mechanics founded exclusively upon relationships between quantities which in principle are observable” – summarized *Heisenberg his first paper on quantum mechanics* (Heisenberg, 2006, p.7).

#### 3.1.1 Definitions of Uncertainty Principle or Indeterminacy Principle

“The more precisely the position is determined, the less precisely the momentum is known in this instant, and vice versa.” - Heisenberg, uncertainty paper, 1927 (Heisenberg, 2006, p.8).

In Wiki: “In quantum physics, the Heisenberg Uncertainty Principle or the *Heisenberg Indeterminacy Principle* — the latter name given to it by Niels Bohr — states that when measuring conjugate quantities, which are pairs of observables of a single elementary particle, increasing the accuracy of the measurement of one quantity increases the uncertainty of the simultaneous measurement of the other quantity. The most familiar of these pairs is the position and momentum.” (Wiki H, 2006).

The uncertainty relations may be expressed in words as it follows: The simultaneous measurement of two conjugate variables (such as the momentum and position or the energy and time for a moving particle) entails a limitation on the precision (standard deviation) of each measurement. Namely: the more precise the measurement of position, the more imprecise the measurement of momentum, and vice versa. In the most extreme case, absolute precision of one variable would entail absolute imprecision regarding the other. (Heisenberg, 2006, p.8a).

We often find Uncertainty Principle in adaptations that over-simplify this problem for choosing: where the electron is being or how it is moving; place or momentum, mass or motion, energy and time... Generally it is true, but we must not forget the quantitative edge and mix the results of the observer.

### 3.1.2 Uncertainty Principle and concept

The intension and extension are similarly conjugate concepts, therefore it is not surprising if we “study” intension and its pictures we measure the elements of extension with great difficulty or incorrectly. And if we measure and considerate each semantic element in extension we can visualize the concept with much difficulty or we cannot at all. *I am sure* that is the reason why we use specified semantic elements, favoured semantic characteristics for identifying concepts, thus thinking is in halfway or interposition when we know anything about the concept but this one is not correct, though can simplify the meaning, the pictures we want. The mind finds the best and easiest way for identifying concepts.

I have pointed new correlation between Heisenberg Uncertainty Principle and the components of the concept: *studying content – intension – and dimension – extension – of the concept is impossible in the same depth and with accuracy at the same time.*

My interpretation of Uncertainty Principle isn't far from Heisenberg's view of life, because he and his research colleagues, for example Niels Bohr, always study all life not only the abstract physical problems. The following known example illustrates difficulties of recognition and concept-building. Heisenberg described their conversation with Bohr: “Our washing up is just like our language. We have dirty water and dirty dishcloths, and yet we manage to get the plates and glasses clean. In language, too, we have to work with unclear concepts and a form of logic whose scope is restricted in an unknown way, and yet we use it to bring some clarity into our understanding of nature.” (Heisenberg, 1975, p.137).

### 3.2 Crises in Physics

There were two crises in Physics: the first at the discovering of the Relativity Theory; the second at the establishing of the Heisenberg Uncertainty Principle and Quantum Theory. The first one was short and very sharp. The second one took about thirty years and this date was the beginning of different explanations of the phenomena. There are two different solutions by Erwin Schrödinger and by Werner Heisenberg. Heisenberg expressed that the subjects of researches do not aim at Nature any longer, but questions by people about Nature. Thus people can meet themselves in their aspects and questions, too. This situation isn't easy for humanity, and mankind became vulnerable, sensitive and suffering. From this attitude people would bleed to death from the recognised truth. Byron wrote according to this realization:

“Sorrow is knowledge; they who know the most  
Must mourn the deepest o'er the fatal truth  
The tree of knowledge is not that of life.”

### 3.3 Individual concept-building and societal category

The concept-building of each person's entity is the variability. "We should find those favoured semantic characteristics which constitute the similar conceptual image in the mind of the librarians and of each user, too." (Hajdu Barát, 2003). Categories are the fundamental concept of the Knowledge Organization and epistemological approaches, too. Kuhn points Shearman's categories are considered genetic (naturalistic) or socially determined (depending on culture). These categories project taxonomic arrangement and classification to the World. (Kuhn, 1987, p.50). The opinion of Kuhn drafted about lexicons and their categories, but we can generalize these conceptions. There are similar explanations and social interpretation by Durkheim and Epistemology.

## 4 Conclusion

There are so many contact points and interactions that we have not considered in the research of Knowledge Organization yet. The physical viewpoint is only one of the various possibilities, but it can help to understand better at least a small part of Knowledge Organization Theory.

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