Probing Concepts: Knowledge and Information as Boundary Objects in Interdisciplinary Discourse

Judith Simon

Department of Philosophy of Science, University of Vienna, Universitaetsstr. 7, A-1010 Vienna, Austria. judith.simon@univie.ac.at

Abstract

Contemporary science seems to be more and more affected and shaped by the need for as well as by the difficulties of interdisciplinary collaboration. Therefore, it will be of prime importance for science and the future of knowledge organisation to enable students and scientist to engage into truly interdisciplinary and not only multidisciplinary endeavours by implementing interdisciplinary practise into the curricula of undergraduate and graduate studies of each discipline. A lecture series on concepts of knowledge and information in different disciplines held at the University of Vienna revealed the utility but also the difficulties associated with such interdisciplinary endeavours. It became obvious that for interdisciplinarity to work, it is necessary to provide time and space for students to probe interdisciplinary discourses in a secure surrounding. Moreover it is essential to strengthen students' interdisciplinary skills, for instance by encouraging the reflection of their own methods and underlying research premises and by fostering an essential appreciation of other disciplines. To conclude, time and space as well as trust and self-–reflection seem to be some of the basic requirements for interdisciplinary endeavours and thus should be considered when developing curricula.

Keywords: Boundary objects, Information, Interdisciplinarity, Knowledge, Reflection, Thought styles.

Resumen

La ciencia contemporánea parece hallarse cada vez más afectada y modelada tanto por la necesidad como por las dificultades de la colaboración interdisciplinar. Por tanto, resulta primordial para la ciencia y para el futuro de la organización del conocimiento preparar a los estudiantes y a los científicos para un compromiso real con la interdisciplinariedad y no sólo con tentativas multidisciplinares, por medio de la implementación de la práctica interdisciplinar en los curricula de los estudios de cada disciplina. Una serie de estudios sobre los conceptos de conocimiento y de información en diferentes disciplinas, llevados a

cabo en la Universidad de Viena revelaron la utilidad pero también las dificultades asociadas con tales intentos interdisciplinares. Resultó obvio que para que la interdisciplinariedad funcione, es necesario proporcionar tiempo y espacio a los estudiantes para probar los discursos interdisciplinares en un entorno seguro. Es más, resulta esencial fortalecer las habilidades interdisciplinares de los estudiantes, por ejemplo animándoles a la reflexión sobre sus propios métodos, destacando las premisas investigadoras y promoviendo un esencial aprecio por otras disciplinas. Concluyendo, tiempo y espacio además de confianza y autorreflexión parecen ser algunos de los requisitos básicos para desarrollar tentativas interdisciplinares. Todos estos factores deben ser considerados en el desarrollo de los currícula.

Palabras clave: Conocimiento, Elementos transaccionales, Estilos de pensamiento, Información, Interdisciplinariedad, Reflexión.

1 Why Interdisciplinarity? Perspectives and Blind Spots

An abundance of academic literature has dealt with interdisciplinarity and its role in scientific knowledge at least from the 1960s onwards (cf. Weingart and Stehr 2000, Kocka 1987, Klein 2000, for a quantitative assessment please confer Braun and Schubert, 2003). So where does this massive interest into interdisciplinary cooperation stem from? Usually stressing the necessity for interdisciplinarity goes hand in hand with highlighting a certain area of conflict which is demarcated by two semantic fields: One around the term specialisation, the other around the term complexity. Given that specialisation and division of labor are frequently considered responsible for the accelerated progress of modern science, it is not self-evident how and why specialisation was rendered problematic, dangerous or at least ambivalent. At least two lines of argument could be followed. On the one hand, some theorists on interdisciplinarity (Klein 2000, Klein 2001, Weingart and Stehr 2000) focus on shifts in research questions and methods induced by worldly changes. These research-practical considerations are mostly related to the term complexity. For instance according to Klein (1994) the need for inter- and transdisciplinarity[1] "arise[s] from developments in knowledge and culture that are characterized by complexity, hybridity, non-linearity, and heterogeneity". Thus, in this case educational specialisation is contrasted with the need for rather holistic solutions to real-life-problems and trans- and interdisciplinarity are considered to be the remedies for curing the disease of proposed reductionist and myopic solutions. However, the hype of interdisciplinarity cannot be sufficiently accounted for by a rising demand for holism. According to Weingart and Stehr (2001) interdisciplinarity has become such a value-ladden term, also because it promised innovation and synergetic effects. How can this promise be explained?

I would argue that in Ludwik Flecks *Genesis and Development of a Scientific Fact* (1981), an explanation for this proclaimed virtue of interdisciplinarity as well as for the ambivalence towards specialisation can already be found. Fleck's investigation into the development of scientific facts in medicine from 1935 is now regarded as one of the first sociological accounts of scientific knowledge creation. He shows how academic education and scientific practise are thoroughly social processes instead of individual cognitive achievements. In order

[1] Please note that due to in the brevity of this paper I do not differentiate between transdisciplinarity and interdisciplinarity. For elaboration on the differences please consult HECKHAUSEN (1987), KLEIN [et al.] (2001).

to explain how knowledge is created in science and how not only this process, but also the resulting knowledge depends on these social interactions, he introduces the concepts of thought collectives ("Denkkollektive") and thought styles ("Denkstile"). According to Fleck "[t]he thought-style […] is the result of the theoretical and practical education of the given individual; in passing from teacher to pupil, it is a certain traditional value which is subjected to a specific historical development and specific sociological laws" (Fleck1986b, p.66). Two other quotes probably show more obviously how the notion of thought styles and though collectives are related to our fields of inquiry interdisciplinarity and specialisation. First of all, according to Fleck a certain thought style "[…] dictates what and how these members see" (Fleck 1986b, p.72). Thus, our thinking and the knowledge produced are highly influenced by our disciplinary education and, given the differences between education in different disciplines, this would also explain why "people exist who can communicate with each other, i.e., who think somehow similarly, belong, so to say, to the same thought-group, and people exist who are completely unable to understand each other and communicate with each other, as if they belong to different thought-groups. (Fleck 1986a, p. 81).

Moreover in his monograph, by employing visual metaphors adapted from Gestalt-psychology, Fleck (1981) also sheds some light on the ambivalence towards specialisation. First of all he differentiates undirected and directed vision as two kinds of seeing which are related to certain stages in scientific socialisation. In the beginning of academic education students' vision is characterised to be undirected, broad and unspecific. In academic education a shift occurs from undirected to directed vision which is focussed, i.e. sharper but also narrower allowing for many blind spots. These visual metaphors can help to understand, why on the one hand specialisation has been important for advances in science because it increases the depth of focus, but why it also necessarily leads to fragmented views. Thus in keeping with Flecks visual termini, I would argue that the key to the benefit of interdisciplinarity lies in the potential to become aware of one's own perspectivity through interdisciplinary communication and to light up the blind spots of each approach.

1.1 Enabling interdisciplinarity

After stating the necessity of interdisciplinarity practise while acknowledging the difficulties that go along with it, we should consider means of facilitating the communication between different disciplines without destroying the necessary degree of difference between them. More specifically, which means, methods or concepts could help to tap the potential of interdisciplinarity when planning and conducting interdisciplinary research and teaching? Combining some theoretical with more practical considerations I want to briefly introduce the function of boundary objects in interdisciplinary communication and finish this first section with some thoughts on the necessity of reserving time and space for interdisciplinary practice in undergraduate curricula.

1.1.1 Boundary objects as means of translating

One concept which is extremely helpful for understanding and promoting interdisciplinary communication while acknowledging and appreciating the existing differences between the disciplines as central for the success of interdisciplinary endeavours is the concept of boundary objects introduced by Susan Leigh Star and John Griesemer (1989). In a case study conducted at the Museum of Vertebrate Zoology in Berkeley, California, they analysed the cooperations between scientists, amateurs and professionals, administrative and scientific personnel in the early years of the institution. Star and Griesemer (1989) define boundary objects as "[…] an analytic concept of those scientific objects which

both inhabit several intersecting social worlds […] and satisfy the informal requirements of each of them. Boundary objects are objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual-site use. These objects may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation." (Star and Griesemer, 1989, S. 393). Thus in the case of interdisciplinary projects, boundary objects are objects, termini or procedures with which scientists from the different disciplines are familiar and which can function as means of translating between different perspectives, disciplines or thought styles. Consequently, when planning interdisciplinary projects, and especially interdisciplinary teaching, boundary objects should be considered a helpful concept for enabling and fostering communication between different disciplines. When planning our own lecture series, which will be presented in detail in the next section, and discussing possible topics for the lecture series, we also searched for boundary objects we all were dealing with in our research practice. What we found and selected were the terms *information and knowledge* as the possibly most prevalent and most compatible concepts within science.

1.1.2 Opening spaces for interdisciplinary practise as a mode of knowing

Many accounts on interdisciplinary practise convey the impression that interdisciplinarity does not become important before engaging in problem-based research (Weingart and Stehr 2000). Thus, it is not too surprising that even though there are more and more explicitly interdisciplinary curricula, such as the curricula for cognitive science or cultural studies at the University of Vienna, in more classical academic disciplines interdisciplinary lectures, seminars or projects are hard to find. It seems as if it was assumed that students should first of all learn the disciplinary armamentarium properly and only after they have finished their studies engage in interdisciplinary research practice. However, I would argue that interdisciplinarity should be conceptualized in a broader sense in order to include not only problem-based research cooperations, but also academic teaching and learning processes. Also inspired by Ludwik Fleck, the psychologist Rainer Bromme sketches "questions on the cognitive conditions and processes of interdisciplinary thought and action" (Bromme 2000, p. 115). Reflecting on the diversity of knowledge systems as the cognitive core of interdisciplinarity, he reminds us that the confrontation of different perspectives is a condition for any kind of cognitive development and not only central to interdisciplinary practice. I would therefore conclude that courses explicitly dedicated to interdisciplinary practice should be integrated into the curricula development of every scientific education. Time and space to probe interdisciplinarity in the course of their studies will support students and teachers to become aware of disciplinary blindspots as well as their own "thought styles" by exposing them to different research and thinking practises and challenging them to deal with these concussions of disciplinary (self-) conceptions. Thus interdisciplinary discourse should be considered as a reciprocal process of teaching and learning in itself. In return many occurring problems in interdisciplinary collaborations could be reduced if interdisciplinary education would have become an integral part of any academic education already. Just as much as triangulation of different methods is regarded an approach of approximation in socio-scientific research methodology, if not to obtain a truer, but rather a more complete picture of the problem of interest, interdisciplinary discourse could be conceptualized as triangulation of thought.

2 The Lecture Series: Knowledge and Information in the Disciplines

2.1 Origin & Goals

In cooperation with a physicist, I have planned and coordinated a lecture series on diverging conceptions of the terms *knowledge* and *information* in different disciplines. The lecture series was held on a weekly basis from October 2006 till January 2007 at the University of Vienna and was conceptualised as a seminar where students were invited to take active part in the discussions. The idea for this lecture series originated in a workshop for "Career Management for Women" offered by the Human Resources Development Department of the University of Vienna. The experience of the fruitfulness of the exchange of different perspectives in this setting has led to the wish to expand our cooperation beyond the scope of the career programme into our research and teaching practise. Accordingly, only after we decided to collaborate in organising and conducting an interdisciplinary lecture series together, we determined the topics "knowledge and information" as boundary objects and topics for the lecture series. Thus, in contrast to most lecture series, the basis for this one was not a pre-determined specific topic, but rather the will for an interdisciplinary experiment. The hopes, interests and goals for this didactic experiment were accordingly manifold. First of all from the side of the lecturers we all had an interest in delving into interdisciplinary discourses with disciplines we are not familiar with to obtain a clearer picture not only of others', but also of our own "thought styles" (Fleck 1981)[2] by contrasting them to others'. Secondly, several of us had a special thematic interest in the diverging notions of information and knowledge in the different disciplines. So more precisely we had a twofold interest for this lecture series. On a more theoretical level, we wanted to explore and contrast different explicit and implicit conceptions of information and knowledge[3]. The second just as important aspect was to practise interdisciplinarity as researchers ourselves and to create a space for practising interdisciplinarity for the students. Finally, since the lecture series originated in a workshop for "Career Management for Women", we also wanted to implement this lecture series as a mean for building up and strengthening women's networks at the University of Vienna.

2.2 Content: Information and Knowledge as scientific boundary objects par excellence

Besides our interest into the subject areas, we decided to use conceptions of knowledge and information as the topics for this lecture series for the simple reason, that almost by definition, every scientist operates with information and knowledge on their daily work basis. Judgements of what counts as valid information and what is considered knowledge are inherent in every scientific practise, irrespective of how conscious scientists are about the criteria for their judgements. More specifically, all academic disciplines must have at least implicit conceptions of knowledge, otherwise they would not be regarded to belong to the domain of science. This becomes even more obvious in the German translation of the term science – *Wissenschaft* - which explicitly denotes the production of knowledge. These implicit conceptions of valid information and knowledge are not necessarily made aware, but nonetheless - or maybe therefore - comprehensive and engrained into research methods, disciplinary methodologies and research assumptions.

---

[2] Besides physics and philosophy of science, speakers from the following disciplines took part: (Scandinavian) literature studies, mathematics, medicine, political science, psychology, science of sport, sociology and theology.

[3] In the course of the lecture series it became obvious that most lectures would concentrate on implicit conceptions of knowledge and that it might have been sufficient to focus on explicit and implicit knowledge concepts only.

However, scientists do not only deal with these implicit, but also to varying degrees with explicit concepts of information and knowledge. Certain branches of science such as epistemology and sociology of knowledge, but also certain areas within cognitive psychology, pedagogy, artificial intelligence, neuroscience and also library science, to name just a few, even primarily deal with explicit questions of knowledge. The same holds true for different conceptions of information. Some disciplines have their own specific concepts of information, i.e. the concept of information by Shannon in communications engineering (Shannon, 1948) or QBits in quantum physics. Moreover, there is an abundance of different information concepts in biology, computer science or philosophy, communication science and media or literature studies and many other disciplines.

If we accept that information and knowledge are on the one hand key elements of scientific practise and on the other that the meanings of information and knowledge differ extremely between different disciplines, it becomes obvious why these different notions of information and knowledge are central to the epistemological question on interdisciplinarity. Interdisciplinarity, as many social actions depends fundamentally on communication conceptualised as *mutual informing*. But how can communication or mutual informing between members of different disciplines function, if they talk about different things when using the same words? And why should this not only be possible but rather even promote the creation of new knowledge? The potential advantage as well as the frequent failure of interdisciplinary endeavours probably depends on the degree and success of reflecting, exchanging and probing these different denotations and connotations of the terms “information” and “knowledge”. Thus, knowledge and information appear to be ideal boundary objects for scientists from all disciplines, if their primary goal is to practise interdisciplinarity and also as the last boundary object if there is no other interface between their research interests.

2.3 Structure and Process of the Lecture Series

The smaller part of the lecture series dealt with explicit concepts of information. According to Janich (2006) two historical origins of the concepts of information can be found. One stems back to Latin words *informare* which means to form, shape and configure materials as well as in a more metaphorical way to instruct or form intellectually. The second line of origin can be traced back to Shannon’s (1948) mathematical theory of information, where information was defined and quantified for its application in communications engineering. In science, for instance in molecular biology, genetics and quantum physics the use of the term information is mostly related to this second origin (Lyre, 2002), whereas many students in the lecture series, especially from the humanities and the social sciences, preferably related the term information to the termini data or knowledge and considered information to be the interstage between data and knowledge. It became obvious in the lectures that even though the word information was used on a daily basis by the students, they were not aware of the different concepts behind the term information. So the first step of this lecture series was to clarify the different descents and origins of the term information such as the naturalistic and culturalistic notions (Janich, 2006) in order to show how different the connotations and denotations of a word as commonly used in the sciences can be. Our hope was that this experience would function as an eye-opener for the students to make them aware that communication even about key concepts is never as transparent or unproblematic as it might appear.

Explicit conceptions of knowledge were briefly introduced to the students in the introductory session, were main characteristics of knowledge in the fields of epistemology, sociology of knowledge and cognitive psychology were touched and contrasted. Moreover, one of the lecturers talked about sociology of knowledge and of science in her presentation so that the sociological perspective on knowledge was made clearer. Most of the lecturers however, did not present explicit concepts of information or knowledge, but rather decided to take a closer look at and reflect on the notions of knowledge inherent in their research practises, the methods and assumptions which often go unnoticed in the research routine. So the major part of the lecture series dealt with implicit conceptions information and especially of knowledge. The topics of the talks ranged from the epistemological and methodological presumptions inherent in the dispute on whether we live on the convex or the concave side of the globe connected to the hollow-earth theory, the differences between the notions of knowledge of a theologian and a mystic, the relationship and possible conflict between nomothetic and ideographic approaches in medical theory and practice as well as the impact of axiomatic definitions in mathematics and physics.

2.4 Some Reflections and Recommendations

Maybe because not only the lecturers, but also the students came from very different disciplinary backgrounds [4] in addition to these questions directly related to concepts of information and knowledge, the discussions did not only touch questions on the respective notions of information and knowledge, but did always also center around questions concerning interdisciplinary practise itself.

One question of principal and persisting interest was whether interdisciplinarity would or should lead rather towards a unification of science or towards an enhanced pluralism of research questions and methods and approaches. One related and frequent misunderstanding was that interdisciplinarity was considered as a means towards the unification of science associated with a streamlining of research agendas and the constriction of possible research questions and methods. Another was the belief that efforts to promote interdisciplinary skills would imply the credo that all projects should always be conducted interdisciplinarily irrespective of the specific questions and tasks at hand. Moreover the students differed a lot with regards to their scepticism or optimism towards interdisciplinarity, the perceived necessity and the basic appraisal of and respect for other disciplines. Even though the participation on the seminar was optional, differences between the openness towards other disciplines seemed to be not only subject to the disciplinary background of the students, but also related to the prestige of the specific discipline.[5]

From an organisational point of view it became obvious that for productively discussing topics from such a wide spectrum and for constructively comparing them, such a lecture series would need more time. Even though we tried to reduce the pure lecture time to 30 minutes, the remaining 60 minutes were not enough to enable deeper understanding, relating and contrasting of the disciplines involved. Thus it would probably be better to combine the lecture series with a reading and discussion course where preparatory texts could be read and

[4] The lecture series was open for students from all disciplinary backgrounds to obtain their elective course credits. For students in mathematics, physics, theology, philosophy and pedagogy it was even possibly to include the credits obtained in this lecture into their major curricula.

[5] For instance, the basic assumptions of theology were harshly criticized, whereas those of statistics were not even considered at first. Similarly, the respect for physics and mathematics appeared to be highest.

discussed. Moreover we figured that the spectrum of topics might have been too wide and that it would have been sufficient to concentrate on either explicit or implicit concepts of either knowledge or information.

2.5 Epistemological questions on interdisciplinarity

When recapitulating the lectures, the students' comments and the subsequent discussions, the return to certain key questions concerning knowledge and information in different disciplines could be noted. Thus I want to conclude this paper not with any answers or lessons learned about interdisciplinarity, but rather by asking questions which will hopefully trigger further research concerning the epistemological basis of interdisciplinarity. Thus, the following battery of questions is a subjectively structured summary of the central moot questions extracted from the discussion of the lecture series:

⇒ Input/Usage:
What forms of knowledge and information are used as input in the research process? E.g. how is literature used? Which are the major research methods, standards & practices?

⇒ Output/Production:
What kinds of knowledge and information are produced? Data, texts, test series?

⇒ Types of knowledge:
What kinds of knowledge are prevalent/ predominant in the respective discipline? Are the types of knowledge rather homogenous or heterogenous? Relation between practical and theoretical knowledge? Degree of procedural and declarative knowledge involved in the research process? Does the factual relation between different types of knowledge differ from the declared relation?

⇒ Axiomatic/Basic research assumptions:
What are the basis research premises? Are they mostly laid open or hidden?

⇒ Implicit philosophies of science and conceptions of truth:
What are the prevalent and dominant implicit philosophies of science (positivistic, hermeneutic, constructivistic approaches, etc.)? What are the prevalent and dominant implicit conceptions of truth (correspondence, coherence, etc.)?

Acknowledgements

I would like to thank Petra Kröpfl for conducting this experiment with me, the students for the lively discussions and especially the female scientist who agreed to break their daily routine and spend their precious time on reflecting on their very own research practises.

References

BRAUN, T.; SCHUBERT, A. A quantitative view on the coming of age of interdisciplinarity in the sciences 1980-1999. *Scientometrics*, 2003, vol. 58, n. 1, p. 183-189.

BROMME, R. Beyond one's own perspective: the psychology of cognitive interdisciplinarity. In: WEINGART, P.; STEHR, N. *Practising interdisciplinarity*. Toronto: University of Toronto Press, 2000. p. 115-133.

EINGART, P. Interdisciplinarity: the paradoxical discourse. In: WEINGART, P.; STEHR, N. *Practising Interdisciplinarity*. Toronto: University of Toronto Press, 2000. p. 25-42.

FLECK, L. *Genesis and development of a scientific fact*. Chicago: The University of Chicago Press, 1981. (First published 1935).

FLECK, L. Scientific observation and perception in general. In: COHEN, R.; SCHNELLE, T. (eds). *Cognition and fact: materials on Ludwik Fleck 59–78*. Boston: D. Reidel, 1986a. (First published 1935).

FLECK, L. The problem of epistemology. In: COHEN, R.; SCHNELLE, T. (eds.) *Cognition and fact: materials on Ludwik Fleck 79-112*. Boston: D. Reidel, 1986b. (First published 1936).

HECKHAUSEN, H. Interdisziplinäre Forschung zwischen Intra-, Multi- und Chimären-Disziplinarität. In: KOCKA, J. (ed.). *Interdisziplinarität: Praxis - Herausforderung - Ideologie*. Frankfurt: Suhrkamp, 1987. p. 129-145.

JANICH, P. *Was ist Information? Kritik einer Legende*. Frankfurt: Suhrkamp, 2006.

KLEIN, J. T. (ed.) *Transdisciplinarity: joint problem solving among science, technology, and society - an effective way for managing complexity*. Basel: Birkhäuser, 2001.

KLEIN J. T. Notes toward a social epistemology of transdisciplinarity [electronic resource]. In: *World Congress on Transdisciplinarity (1st: Arrábida, Portugal: 1994)*.<http://perso.club-internet.fr/nicol/ciret/bulletin/b12/b12c2.htm> [Consulted: 14.12.2006]

KLEIN, J. T. A conceptual vocabulary of interdisciplinary science. In: WEINGART, P.; STEHR, N. *Practising Interdisciplinarity*. Toronto: University of Toronto Press, 2000. p. 3-24.

KOCKA, J., (ed.). *Interdisziplinarität. Praxis-Herausforderung-Ideologie*. Frankfurt: Suhrkamp, 1987.

LYRE, H. *Informationstheorie. Eine philosophisch-naturwissenschaftliche Einführung*. München: Fink UTB, 2002.

SHANNON, C. E. A mathematical theory of communication. *Bell System Technical Journal*, 1948, n. 27, p. 379-423; 623-656.

STAR, S. L.; GRIESEMER, J. Institutional ecology, 'translations' and boundary objects: amateurs and professionals in Berkeley's Museum of Vertebrate Zoology. *Social Studies of Science*, 1989, vol. 19, p. 387-420.

WEINGART, P.; STEHR, N. (eds.) *Practising Interdisciplinarity*. Toronto: University of Toronto Press, 2000.