From Dualism to Complementarity: A Systemic Concept for the Research Process

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ABSTRACT

In this paper, dualistic concepts are identified as limitations to scientific progress. A proposal is made for bridging a set of gaps between polar opposites in order to pave the way towards more interdisciplinarity and transdisciplinarity in science. In other words, a path is shown leading towards a more holistic, systemic research practice. The proposed approach is conceptual, not sociological or political.

Keywords: research process, complementarity, systems science

1. INTRODUCTION

As stated above,the purpose of this paper is to make a contribution to a more holistic research practice. Science seems to be going from strength to strength if we judge by the number of researchers, institutes, and the size of the funds available. But science is also in crisis, as can be seen from its fragmentation and incapacity to solve the intractable problems of our time (Husserl 1962; Luhmann, 1990; Chargaff, 1992). To put it differently, science is Society's organ of perception. It is the subsystem by which a society becomes aware of new, exceptional or challenging developments, so that it can respond to them. The crisis of modern society is or has been claimed to be - a crisis of perception, more than anything else (Capra, 1982). Perception has tended to evolve from an holistic mode, which accounted for interconnections, towards a fragmented mode.

The scientific community has not remained oblivious to these difficulties: The call for interdisciplinary and transdisciplinary research is persistent, and can hardly be ignored. Even so, research institutions find it hard to reorganize themselves along the lines of inter- or transdisciplinarity.

Interdisciplinary initiatives exist, but they are rare[1]. To an even greater extent than institutional bureaucratic hindrances it is the volitional barriers which are proving to be almost insurmountable. Scientists and science managers are for the most part reluctant to link up with researchers in other fields, either because they find it difficult or because they simply do not see any need for it.

Much of this situation is due to how the "craft" of modern science is understood by researchers. This understanding is characterised by dualistic concepts, which establish mutually exclusive polar opposites.

In this paper, a set of such dichotomies will be identified. Thereupon, a proposal will be elaborated on how to overcome them. A path towards a more holistic research practice should thus be opened up.

The argument propounded here relates essentially to the social sciences, not to science in general. It must be said in advance that the categories used in this article are broad. They are much debated in the literature, and generally there is no consensus on pertinent concepts. Distinctions are not always as clear-cut as they might appear in this text, owing to necessary abstractions. We shall at least avoid dogmatic positions and concentrate on tendencies or propensities.

2. FROM DUALISM TO COMPLEMENTARITY

Here, only three examples of these dualistic concepts will be outlined, with reference mainly to social science, in order to remain concrete:

1.) The dualism of explanation and understanding

Contrasting definitions of *explain* and *understand* stem from philosophy (cf. Lenk 1972, Apel 2001); this contrast is generally used in the theory of social science.

[1] For example, *Management Science*, one of the leading research journals, created a section on interdisciplinary studies a few years ago, which was closed soon afterwards for lack of interest by potential authors.

Explanation rests on the argumentative reference to known phenomena. Understanding denotes the comprehension of interdependencies between things, people and thoughts (Meyer 1979: 518). According to certain authors, the natural and the social sciences are fundamentally distinct from each other, and this difference is marked by the distinction between explanation and understanding (Moon 1977). However, in principle there is no dichotomy between the two. Both explanation and understanding are needed in the social sciences (cf. von Wright 1971, Weber 1964: 88).

Depending on whether a researcher aims at explaining or understanding phenomena, he or she will have to resort to completely different research designs. In the first case, there will be a tendency to use objectivistic approaches, whereas in the second subjectivistic approaches will be preferred. Traditionally, the former have been associated with quantitative methods, surveys, sophisticated measurements and data analyses, the latter with qualitative techniques, e.g., ethnography, explorative interviews and hermeneutic methods. Explanation is - not only, but to a great extent - analytically oriented, while understanding calls for synthesis. Keeping them separate leads to an explanation which is sterile, and to an understanding which is shallow.

2.) The dualism of exploration and hypothesis testing

In seminars on research methods, one of the first things taught to students is usually that a researcher must decide early on whether he or she will take up explorative research or hypothesis testing. The former option then tends to be linked to qualitative research by means of examples, case studies, grounded theory building, and the like. The latter will usually require relatively large scale quantitative research and statistical analysis.

Separating the two entails exploratory studies which remain inconclusive, and leads to hypotheses which are narrow.

3.) The dualism of discovery and design

This dualism is very much visible in the distinction between basic and applied research. The former is considered disinterested in its efforts and value-free in its choice of subjects, being dedicated exclusively to the generation of pure knowledge for its own sake. The latter is conceived of as a value-laden activity which transforms the pure knowledge derived from basic research into technical products or other tangible benefits (such as recommendations to agents in organization and society).

The dualistic approach has been most prolific in the natural sciences and technology. At least in the social sciences, discovery remains pointless if it is detached from the purpose of design. And design becomes enfeebled if it is not constantly nourished by discovery.

Dichotomies such as those outlined are limitations on research, which ultimately obstruct scientific progress.
In the following, a conceptual proposal will be made which shows how the yawning gap between the polar opposites can be spanned. This proposal is conceptual in the sense that it concentrates on the logical relationships between the concepts and the way they are linked in the research process. The first step is to recognize that the relationship between each pair of concepts is not one of opposition but of complementarity. We herewith refocus our perspective on the research process. We recognize that researchers should strive for the integration of all these aspects, at least in their “wildest dreams” .

- explain and understand
- explore and test
- discover and design.

3. A CONCRETE PROPOSAL

How can one draw up an holistic concept for research if one faces three (or more) kinds of dualism, as outlined above?

One could - as is often the case- take all six terms and draw a circle around them, signifying: "All of this must be taken into consideration", with the addendum "… in an holistic way."

To make progress here, i.e., to make a proposal which has implications for concrete research designs or projects, a more operational approach must be adopted. In this section, it will be shown, firstly, that the different terms introduced above with the different polarities, do indeed relate to each other. Based on a readjusted, complementarity-oriented view, the terms can now be associated with specific levels of description and synthesized as components of one and the same picture. Secondly, a process-oriented view will be taken, which helps one to sort out the essential relationships among the six components.

The six terms - explanation, understanding, exploration, testing, discovery and design - cover a broad range of aspects of the research process. The following attempt to synthesize these partial aspects goes beyond the transformation of pairs of concepts from opposites

into complements. It puts all three pairs of concepts into a larger, more comprehensive perspective.

To begin with, the six concepts are associated with different levels of description:

1. *Discovery* and *design* are terms strongly related to the *ontological level,* because they classify objects. Also, discovery deals with the realm transcending sensory perception, and design concerns creating new realities. Ontology (from Greek *ontos* - being, and *logos* - word, reason) is about the nature of the reality investigated or constructed by a researcher.

2. *Explanation* and *understanding*[2] are concepts which essentially belong to the *epistemological level*. Epistemology (from Greek *episteme* - knowledge, science) is about the relationship between the researcher and the object of his or her inquiry.

3. *Exploration* and *testing* are the concepts mainly associated with the *methodological level*. Methodology (from Greek *meta* - towards and *hodos* - path) concerns itself with the repertory of techniques, procedures and instruments used in the research process.

Accordingly, three different aspects can be combined into one all-embracing picture (Figure 1).

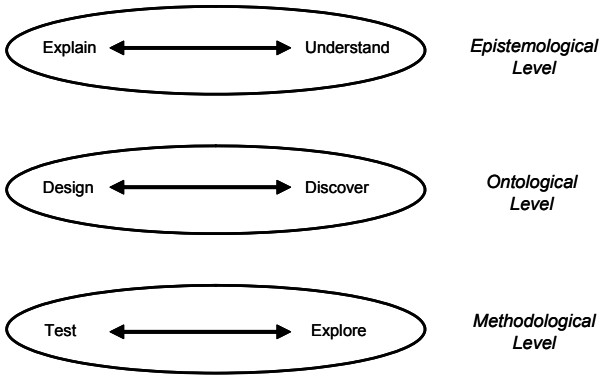

Figure 1: Levels of description of a research process

It would be facile to link everything with everything here, as is often done in schemes of this type. However, it is more desirable and rewarding to make an attempt at filtering out the essential relationships between the components. This has been tried, and the result is presented in Figure 2. To achieve this result, a combination of deduction and induction was used. Firstly, the concepts were defined and put in a logical order. Secondly, the relationships between the concepts were reduced from a fully connected graph to a limited set of relationships. The procedure was governed by the principle of exclusion, so that less important linkages were successively eliminated Importance here was defined in terms of likelihood of occurrence and significance. These were established as a function of rough estimates.

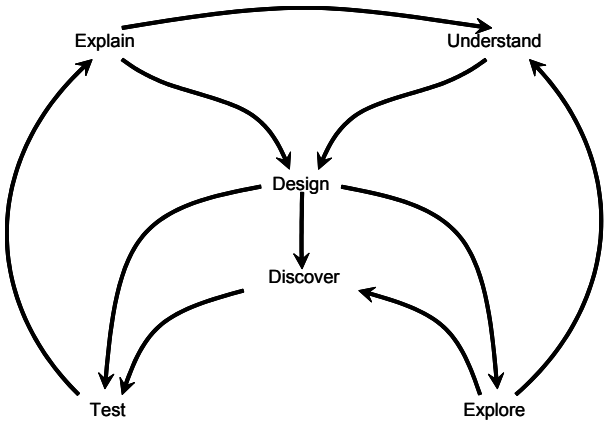

Figure 2: Components and relationships of a research process

It need not be especially emphasized that the relationships depicted here are by no means the only ones which may exist. They are merely considered to be

[2] We use the term *explanation* here with a positivistic connotation, while the term *understanding* is used with a hermeneutic, interpretative connotation, as in the sociological movement called *verstehende Soziologie* (cf. Weber 1982). Positivism is an epistemological position which makes *the positive*, i.e. the given, factual the principle of all scientific knowledge. Hermeneutics on the other hand is an epistemological position, the ideal and the methods of which are directed towards knowledge-generation by means of interpretation and understanding. For details, see: Seiffert/ Radnitzky 1994.

those essential for the maintenance of an holistic research process. We shall now proceed to elaborate on each of these relationships. For this purpose, they have been numbered from 1 to 10. (Figure 3).

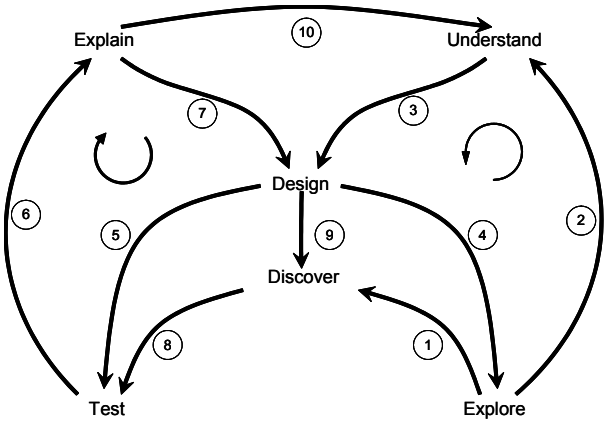

Figure 3: Sequence of the description

The starting point is exploration. We could also have chosen another component to start with, because the system is circular, made up of closed loops.

Explore**:** Exploration is a penetration of an unknown domain, impelled by the desire to know, - perhaps the most enduring of all the characteristics that distinguish *homo sapiens* from other species (Durant/ Dooling 1991). The purpose of exploration is discovery. The term carries a connotation of adventurous or entrepreneurial activity. If the purpose of exploration is discovery, then so, though not invariably, is the result (arrow 1).

Exploratory research is traditionally linked to the purpose of understanding the phenomena under study. Normally, the exploratory approach is chosen when little or nothing is known about the subject matter. However, exploration has an aspect of application, which fosters understanding (arrow 2).

Discover: To discover is to obtain a sight or a knowledge of something for the first time. The term evokes the sensation of the removal of a veil from something that is already there, whether actually or virtually. Breakthroughs in science and technology stem from discoveries. These may be the product of momentary inspiration or of a longer incubation or maturation period (cf. Nickles 2000). Discovery is a result of exploration (arrow 1), but discoveries may also emanate from design activities (Schwaninger, 2005) as arrow 9 indicates.

Understand: To understand is more than just to know. It also includes a comprehension of the nature or meaning of the phenomena of interest. From the hermeneutical viewpoint, it entails recognizing something "internal" resulting from "external" sensory inputs (Dilthey 1957: 318). Understanding, therefore, implies sense-making, interpretation, insight into the intentions of an actor or the signification of, e.g., a symbol, a social institution or a rite (von Wright 1971). Therewith, the act of understanding transcends the objectively ascertainable. At the most elementary level, one can understand a linguistic or non-linguistic action by describing it as the actualization of a scheme, as the compliance with a rule, or the pursuit of a goal or an intention. At a deeper level, however, the task of understanding involves the comprehension of whole interrelations or textures (Meyer 1979: 518). In this way, the general meaning of single actions, objects or incidents can be construed.

Design, or at least *good* design, must be nourished by deep understanding, i.e., insight into the nature of the object dealt with and the context in which it is embedded (arrow 3).

Design: By design we understand the act of working out the form of something. A design, then, is "a plan or scheme conceived in the mind and intended for subsequent execution; the preliminary conception of an idea that is to be carried into effect by action" (Oxford English Dictionary, Vol. 5:9).

If the purpose of research is to contribute to the progress of Society and the human condition in general, then it must abide by what could be called the design imperative: to assume the responsibility of making proposals for improved approaches, rules, products, etc. In Figure 3 design is shown as having two further links, one to exploration, the other to testing. The link to Explore (arrow 4) closes the loop formed by arrows 2, 3 and 4. This is the representation of the design process, by which a design is applied and therewith submitted to (further) exploration. Exploration in the application context gradually enhances understanding, which is fed back into the design itself, leading to adaptation and improvement.

The link to Test (arrow 5), on the other hand, closes the loop formed by the arrows 6, 7, 5, which will be commented upon shortly.

Test: Testing is about examining something by means of a set of criteria. A test is a trial by which something's existence, quality or authenticity is deter-

mined. In science, testing involves the examination of the validity of hypotheses by means of parametric or non-parametric tests. These tests are of crucial importance for the examination of any outcome of the research process. Additionally, however, they are at the core of validation, i.e., the quest for ever better models of reality (cf. Barlas & Carpenter 1990). On the other hand, submitting products of any kind - tangible or intangible - to testing procedures is a routine to ensure the quality or fitness-to-purpose of the products.

There are two different links leading to Test. The arrow emanating from Design (arrow 5) represents the process by which design outcomes are submitted to tests. The arrow emerging from Discover (arrow 8) symbolizes a process by which discoveries are examined critically as to their truth or existence. This is a kind of triangulation to determine whether what is perceived matches what is claimed to have been discovered.

Explain: Explanation is the counterpart of understanding in the pair of concepts used at the outset. In today's science industry, the bulk of the resources is dedicated to explaining phenomena. Explanation can be causal (by causes)[3] or teleological respectively intentional (by goals, i.e., intentions)[4]. To explain is derived from the Latin verb *explanare* - to describe clearly (metaphorically derived from the meaning of to flatten - from *planus* - flat). Accordingly, to explain means to unfold a matter, to give details of a matter, or to make it intelligible (Oxford English Dictionary, Vol. 5:569).

Explaining, therefore, is essentially a detail-oriented, sequential, analytical task, as opposed to understanding, which is synthetic, holistic, simultaneous. Also, in explanation the rational element dominates, while understanding is strongly reliant upon intuition. If explanation does not remain strictly analytical but opens itself to synthesis, then understanding is enhanced (arrow 10). Pragmatically speaking, "a good explanation increases our understanding of the world." (Newton-Smith 2000:130).

[3] From a rigorous stance, statistical explanations can never "prove" causality definitely, but only answer "why"-questions.

[4] For a differentiated view of causality, see Aristotle's (1978: 87) four kinds of causality, material cause (*causa materialis*), formal cause (*causa formalis*), moving cause (*causa efficiens*) and the final cause (*causa finalis*). There, teleological explanation is subsumed under causal explanation. See also the discussion of causal versus non-causal explanation in Ruben (1990).

The link from Test to Explain (arrow 6) represents the process by which hypothesis testing gradually enables explanation. This is a process of building up confidence. Usually, it also leads to more detailed knowledge. It rarely leads directly to new discoveries What *can* lead to discoveries, besides the process symbolized by arrow 1, originating from Explore, are serendipitous effects resulting from design activities (arrow 9).

The counterpart of arrow 6 is arrow 7, closing the loop 5-6-7 from Explain to Design. It signifies the improvement of Design through gradual accumulation of (detailed) knowledge. This can be achieved through a sequence of changes in design, tests and the interpretation of test results leading to explanation.

As mentioned earlier, the diagram (Figures 2, 3) is a simplification. In addition to the relationships represented by the arrows, other links are possible. For example:

- Understand → Explain: Understanding has been declared to be a "method" with the help of which human behaviour can be explained (Abel 1948).
  - Discover → Explore: Whenever a new "territory" is discovered, the discoverers move in to explore it and make new discoveries. This is a recursive process.
- Test → Discover: Testing a hypothesis may lead to the discovery of a new phenomenon (For examples concerning experimental tests leading to discoveries, see Popper 2002:73).
- Design → Understand: The practice of design tends to enhance the understanding of the designer.

Closed loops: There are several closed loops in the diagram, e.g.,

- 7-4-1-8-6
- 3-5-6-10

Here, we shall discuss only two which are of especial interest: loops 2-3-4 and - already introduced - 5-6-7. Both relate to the question of how change can be brought about through research. To be precise, they refer to the question of how research can lead to improved design, to the ultimate benefit of Society and humanity as a whole.

In order to make a comparison of the two approaches to design improvement which figure in our diagram, two ideal types can be described in detail: The 2-3-4-

loop represents an approach to improvement which may be rather unsystematic, often playful, and riddled with uncertainty. The 5-6-7-loop, on the other hand, is more systematic, more linear, and not so fraught with uncertainty. Both, however, are subject to trial-and-error..

We call the first cycle *hermeneutic (*or *interpretative)*, the second one *positivistic*, in order to capture their characteristics in a condensed way. Also the terms *ratiocinative loop* versus *intuitive loop* would also be an acceptable, pragmatic approximation. The two cycles are self-reinforcing.

In the case of the *positivistic loop,* testing enables explanation, which supports design, which gives rise to new tests. This is the domain of "external rationality" (Husserl 1962) and empiricism in search of the "objective truth". The denomination of this loop derives from its focus, which is on the evidence-based capturing and analysis of real-world features and relationships. These are used to improve the object of design. Progress tends to be incremental, with little risk.

As far as the *hermeneutic loop* is concerned, exploration enhances understanding, which improves design, which triggers more exploration. This is the domain of "immanent reason", which is at a deeper level than external rationality (Husserl 1962) and breeds insight, thereby shaping reality. The denomination of the loop is due to its focus on a more holistic, exploration-based interpretation of the world. The approach is one of synthesis rather than analysis. Improvements in design tend to be based on intuitive insights. The potential is for high and sudden progress, but potential risk is also higher.

The two circles described are virtuous to the extent that they leverage the complementarities discussed in this paper, first and foremost the complementarity of explanation and understanding.[5] It is problematic to attempt to reconcile an interpretative with a positivistic view. A full integration - e.g., via compromises or dubious medleys of methods - is neither advocated here nor possible. What is proposed is an enhancement of the dialogue between the two perspectives for their mutual benefit. .

So much, then, for the links and activities, which make up the research process. The systemic features of this representation, among others, are that it is integrative, relational, dynamic and holistic. It is integrative in the sense that the components of different levels of description are synthesized. It is relational because these components are linked to one another. It is dynamic insofar as sequences and circular processes are identified and explained. Finally, it is holistic in the sense that the emphasis is on the research process as a whole, not on partial aspects.

One could, no doubt, expand the scheme outlined here by drawing a boundary between the process and its environment. One could also, on a higher level, visualise aspects such as worldview, values, ethics and aesthetics, all of which impinge on the research process. As elaborating on these would be beyond the scope of this paper, however, we refrain from simply adding another graph, preferring to limit ourselves to this *pro memoria*.

4. CONCLUSIONS

This paper is an attempt to conceptualize the research process systemically. It commenced with a set of dualistic concepts on which modern science operates. The essential proposal here is that the dualistic view should be abandoned in favour of a complementaristic approach. This means that partial aspects of the research process, e.g., explanation and understanding, hitherto regarded as mutually exclusive opposites, should rather be considered complementary, completing and perfecting each other.

In a step-by-step approach, the concept pairs making up different levels of description of the research process have been linked together, with an emphasis on essential relationships. This resulted in a fuller picture of a research process. In its idealized form, it shows a path towards a more systemic approach to research which is less reductionist as well as more open and conducive to inter- and transdisciplinary modes of operation.

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[5] Not only are processes of joint learning possible. The complementarity can be leveraged effectively by alternating phases in which hermeneutical methods and others in which positivistic approaches are applied.

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