

Epistemological Perspectives on IS-Development – A Consensus-Oriented Approach on Conceptual Modeling

Björn Niehaves, Karsten Klose, Ralf Knackstedt, and Jörg Becker

European Research Center for Information Systems (ERCIS),
University of Muenster, Leonardo Campus 3, 48149 Münster, Germany
{Bjoern.Niehaves, Karsten.Klose, Ralf.Knackstedt,
Becker}@ercis.de
<http://www.ercis.de>

Abstract. Within the information systems (IS) research discipline, conceptual modeling is widely discussed as a fundamental task for IS-development as it leads to shared domain knowledge between IS developers and business personnel. As well as IS-research modeling takes place within a multi-disciplinary and multi-cultural context. Thereby, the (mostly implicit) assumptions made by different researchers may vary fundamentally. As a result, it is important to expose epistemological assumptions which underlie the work of different participants. Thus, we provide a framework which questions help to analyze and systematize the epistemological assumptions underlying IS research. We demonstrate the application of the framework on a special concept (the consensus-orientated approach) of conceptual modeling.

Keywords: IS development, IS research, conceptual modeling, epistemological assumptions, epistemological framework, consensus-oriented approach.

1 Introduction

Information systems (IS) research today already takes places in an international and also multi-disciplinary context. But the (mostly implicit) epistemological assumptions which underlie different research approaches may vary deeply due to the disciplinary and national background of the researchers [34]. E. g., cross-continental comparison between European and North American IS journals shows that the European ones are more receptive to interpretive approaches while North American journals tend to be positivist [11]. Against the background of distinct hidden (epistemological) assumptions, working on the same research topic or studying the same phenomenon of interest [52] does not necessarily mean that mutual understanding prevails. “An important skill we need to develop as researchers is an ability to reflect on, to understand, to evaluate, and to see the interrelationships among the deep assumptions that underlie our work.” [53] In this respect, the discussion of epistemological assumptions of IS research is almost mandatory. Nevertheless, the lack of epistemological funding of IS research methods is apparent and discussed extensively

within the discipline [33]. The discussion of epistemological assumptions in IS research requires a high degree of systematization.

Within the IS research discipline, conceptual modeling is widely discussed by all epistemological doctrines which are most relevant in the IS field, such as positivism and interpretivism [11]. Conceptual models are regarded as design artifacts which are result of a design science research process [21]. Design artefacts are supposed to deliver value by being applied to a problem situation. Conceptual modeling is a commonly accepted approach to overcome the communicational problem between information system designers and business personnel [51]. Sharing the (modeling) language will lead to shared domain knowledge because interdisciplinary organizational members have the means to communicate. A shared domain knowledge between business personnel and information system designers, positively influences the alignment of business and IT objectives and therefore enhances the quality of IT design artefacts [37]. Hence, in a business situation in practice, conceptual modeling gives a significant value to the quality and usability of information systems.

The aim of this article is to provide a framework which can be used to analyze and systematize the epistemological assumptions underlying IS research (section 2). The framework consists of five epistemological questions and the debate of selected possible answers to each question. We use the framework to explicit the basic epistemological assumptions of a consensus-oriented interpretivist approach to conceptual modeling (also referred to as consensus-oriented approach). The consensus-oriented approach is standing in the tradition of the so-called critical linguistic approach [24], [25], which is also referenced from other related approaches to conception modeling [32], [35], [54]. In section 4, we will draw conclusions and suggest possible future research.

2 Epistemological Framework

The discussion of epistemological questions must, at least presently, be considered as an open issue. For this reason, no theory based on a philosophy of science can be considered as binding for researchers. The individual selection, however, necessitates the extensive publication of the epistemological assumptions made by (individual) researchers. Here, basic epistemological questions can be differentiated from one another. Therefore, in a first step, we discuss what epistemology means, what the main relevant epistemological aspects in the field of MIS (management information systems) development are supposed to be, and how different epistemological schools approach these aspects. In this section we thus will present an epistemological framework that consists of five questions each addressing one core epistemological aspect.

Epistemology can be understood as the science of analyzing the way human beings (researchers in this case) grasp knowledge about what is (perceived to be) existing [8]. It addresses the question of how a person can come to true cognition. Hence, epistemology comprises assorted aspects (cp. Figure 1) which will be addressed ensuingly in detail.

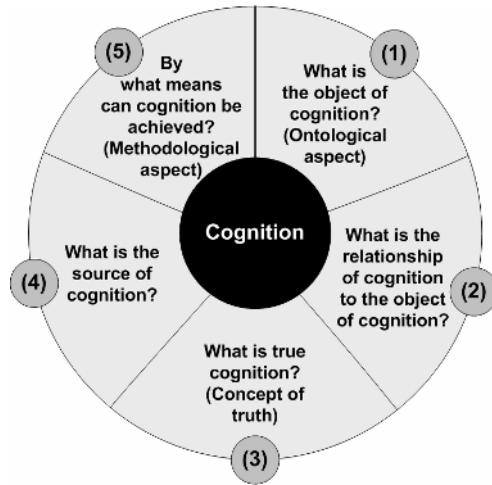


Fig. 1. Epistemological Framework

1) What Is the Object of Cognition? (Ontological Aspect)

Ontology is the science, the theory or the analysis or investigation of ‘what is’ and ‘how it is’ [49]. In the context of this epistemological analysis, ontology reveals its relevance in that objects are analyzed, to which the process of cognition refers. The process deals with the question of the way reality exists beyond the realms of pure imagination of the subject [7], [55], [70].

- a. If the researcher assumes a real world in his investigation, a world that exists independently of cognition, i. e. independent of thought and speech processes, he thus assumes the position of (*ontological*) *realism*.
- b. If the researcher negates the existence of a real world independent of human thinking and speech, that is, if he perceives reality as a construct dependent on human consciousness, he thus assumes the position of (*ontological*) *idealism*.

2) What Is the Relationship Between Cognition and the Object of Cognition?

This epistemological question, which is often regarded as central, is about the relationship of cognition obtained by the subject to the object of cognition. The point is whether things beyond human thoughts and speech can at least in principle be recognized as objective. Two possible answers to this question can be differentiated according to their basic notions:

- a. In *epistemological realism*, the objective cognition of an independent reality is possible. It claims the possibility of eliminating subject-dependent distortions of the cognition of reality, as soon as suitable measures for the removal of appropriate intervening variables are found [30].
- b. The understanding of cognition in *constructivism* is subjective, i. e. „private“ [16], [17]. The relationship of cognition and the object of cognition is thus determined clearly by the identifiable subject [31], [56].

3) What is True Cognition? (Concept of Truth)

A central topic of epistemology is the question as to how humans can achieve “true” cognition. Expressed more intuitively, that means how far “correct” knowledge can be obtained and how the “correctness” of knowledge has to be verified. Approaches, which yield high relevance in the context of IS research, are:

- a. *Theory of correspondence of truth.* According to the theory of correspondence, truth causes a *correspondence* in terms of an *analogy* or *equivalence* between two relata. The first relatum of a two-digit relation are *statements*. The capacity for truth determines the characteristic of statements. By correlating statements and facts, the former can be classified as true or false. Facts thus represent the second relatum in the context of the correspondence view and act as *truth inducers* for statements, because of their assumed status as objective [3].

In the context of this construct, mainly the terms correspondence and fact, pose problems [27], [40]. If the term correspondence is understood as *analogy* or *equivalence* in terms of a *correct reproduction*, this is ultimately nothing other than rephrasing of truth, the explanation of which should have been object of the investigation. The solution to this problem can be found in the operationalization of the term correspondence from Wittgenstein, designated as *image theory* (cp. [55]; a reconstruction in [44]; a related theory in [39]). Image theory links the correspondence to two conditions:

- i. The elements of a statement represent appropriate, corresponding, elements of a fact (*semantic condition*).
- ii. The elements of a statement are arranged between each other as the elements of a fact (*condition of structural consistency*).

This deconstruction of the correspondence term, presents another problem: the likewise unclear term *structural identity*, cannot be perfectly and accurately defined. Thus, image theory creates the dilemma, that it either requires the term *truth* to be clarified or that it is substituted with the less clear term *structural identity* [3].

- b. *Consensus theory of truth.* The consensus theory of truth is a social variant of the epistemic truth concept. In its elemental form, truth results from the consensus of everyone [2], [3], [19]:

- i. *A statement is true if, and only if, it is rationally acceptable for everyone under ideal and optimal conditions.*

A variant of this thought can be, for example, that the range of truth is reduced. No longer is everyone then required for the consensus on the truth or falseness of a statement, only a group of a certain size. With this understanding, statements about truth are thus always to be understood relative to a group. The reference to rationality could also be dropped. To what extent the group now accepts the statements and what the sources of cognition are (from which the acceptance of the statement arises) remains intentionally open. A concept of the consensus theory of truth, altered to this effect, might be:

- ii. *A statement is true (for a group), if and only if, it is acceptable under ideal and optimal conditions for the group.*

This concept of truth implies that nothing exists or proves to be relevant in the context of a test of truth, which would not be apparent to the community/group doing the perceiving. Within the search for consensus and truth, the existence of facts and things which are independent from thought and speech of the subject striving for cognition, are not necessary conditions.

- c. *Tarski's concept of truth.* Tarski's so-called *semantic theory of truth* suggests an alternative comprehension of truth and is greatly discussed in the literature. This theory achieves clarity and precision of argumentation by using the compact instrument of modern semantics. Regarding the following remarks on the semantic theory of truth, see [46], [47], [48] as well as [3], [18], [27], [41]. The attempt to enlarge Tarski's concept of truth beyond formalised languages can be found in [13].

Tarski's vision of truth is based to a large degree on linguistics. Thus, truth (T) is determined in terms of Tarski's semantic concept as follows. It applies to: s, L and p:

- (T) „s“ is a true sentence of the object language L, if it applies: p
 s: The statement of the object language, whose validity has to be proven
 L: object language, which expresses the statement, whose validity has to be proven
 p: translation of the object language based statement “s” into the meta language M
 M: meta language, which contains predicates of truth regarding object language based statements

Thus, the differentiation between object language and meta language is significant. Basically, the object language and meta language must be different from one another. In fact, a language can contain predicates of truth, their application area, though, has to be limited to other languages. Further it becomes clear that truth always refers to a language, the object language, and thus can only be understood as relative linguistic truth.

Tarski does not define the term truth. With his semantic theory of truth he rather expresses a condition for appropriateness, which represents the necessary requirement of a definition of the term truth [3]. He transfers the predicate of truth to the meta language and thus relocates the problem of comprehension of truth into the linguistic area. This limits the scope of application of the theory considerably on the one hand, but on the other hand, the problem of reference to facts or other objects outside the language, does not apply.

4) Where Does Cognition Derive from? (Source of the Cognition Capability)

The question as to the origins of cognition, relates to positions regarding the fundamental capability to perceive. In the context of IS research the relevance of this question becomes clear if formulated as: where does our knowledge derive from?

- a. Experience is regarded as one source of knowledge (impressions of senses). Experience-based knowledge is called *a posteriori* or *empirical knowledge* [1]. The assumption of this source of cognition is often oriented towards natural science

theory and practical experience and is represented by the school of *empirism* [5], [9], [10], [23], [29], [36].

- b. Intellect can also be assumed as a source of cognition. An object can become a matter of cognition through the conceptual efforts of the subject, in turn through the use of a differentiation system. Non-experience-based knowledge is referred to as a priori knowledge. The assumption of intellect as source of cognition is represented by supporters of rationalism, often also known as apriorism [6], [12], [14], [20], [28], [43].
- c. Conciliating positions recognise both experience and intellect as sources of cognition. According to Kant, none of these features has to be preferred to another. Without a sensory element, no object would be given, and without intellect, no one perceived. Thoughts are meaningless without content, cognitions are blind without being linked to terms. Thus it is also necessary as well, to make ones terms sensory [26].

5) By What Means Can Cognition Be Achieved? (Methodological Aspect)

The methodological aspect of epistemology deals with the question as to how humans perceive. This question addresses the modes which are considered to be valid for acquiring knowledge within an IS research process.

- a. Cognition can be obtained *inductively* on the one hand. Induction is understood as the extension from individual cases to universal phrases [42], the generalisation. An inductive conclusion means the transfer from statements via (observed, empirical) individual cases to a universal law a statement on the basis of an assumption of homogeneity on nature [38]. It is an a posteriori method which is often applied in the natural sciences.
- b. On the other hand, cognition can be acquired through a *deductive* method. Deduction is seen as the derivation of a statement (thesis A) from other statements (hypothesis A₁, ..., A_n) with the help of logical conclusions [15]. It is the derivation of the individual from the universal and is applied, for example, in mathematical axiom systems.

The presented set of questions forms the basis for an epistemological discussion of research approaches (especially in the field of conceptual modeling and MIS development) and offers the chance to support a comprehensive comparison of particular assumptions made. Where appropriate, this list of questions should be extended to additional issues (e. g., linguistic aspects).¹ Furthermore, we only addressed selected epistemological schools. In certain cases, it surely is useful to address more or different ones (e. g., coherence theory of truth, hermeneutics, or phenomenology). The selection here is based on a comprehensive literature review – especially in the information systems field and in general philosophy.

¹ The answers to the questions comprised by the epistemological framework are very much interdependent. E. g., the assumption of the possibility of objective cognition (epistemological realism; question 2, a) is necessarily linked with the assumption of the existence of an objective world that is independent of human consciousness (question 1, a) [11], [22].

3 The Consensus-Oriented Approach to Conceptual Modeling

Here, our concept of conceptual modeling is based on the consensus-oriented approach coined from the work of Kamlah and Lorenzen [25]. Figure 2 provides an overview of its most important elements and their dependencies. At first, the approach aims to create a linguistic community. Against the background of IS-development, this community facilitates information system designers and business personnel to overcome communicational problems [51].

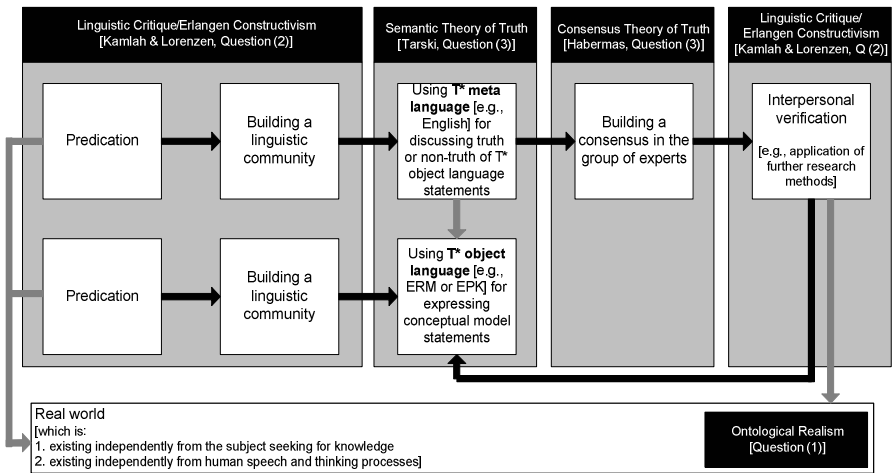


Fig. 2. Elements of the consensus-oriented approach and their dependencies

Linguistic communities can be created through the (re)construction of an ortho-language. First parts of the language can be formed by the alignment of individual (real world) objects to nominators. In the context of IS-development important nominators are terms such as ‘customer Meier’, ‘product 4711’ etc. Based on nominators, predicators (in our context e. g. ‘customer’ and ‘product’) are introduced in order to expose and communicate similarities of individual objects.

Following Tarski the creation of the linguistic community takes place on two levels. On the first level (here named *T* object language*) conceptual model statements are expressed. E. g. using Entity Relationship Models (ERM) members of the linguistic community have to agree upon the term ‘entity type’; in the case of Event Driven Process Chains (EPC) they have to agree upon the term ‘event’. Moreover, a distinction between a) the language of model instances and b) the language of the modeling method and technique has to be made. On the second level (here named *T* meta language*)² members of the community have to agree on a language which facilitates them to debate about the truth and nontruth of the statements represented in a model

² We use the term *T* meta language* in order to distinguish them from linguistic-based meta languages that are documented in linguistic-based meta models [45], which describe the language that underlies a modeling technique or method.

(e. g. German or English). In the next step, the meta language T^* is used to discuss the modeling system which is formulated on the first level using the T^* object language until a consensus of a group of experts is achieved. Afterwards, the results can be evaluated within the scope of the interpersonal verification [25]. Here, research methods such as field experiments, surveys, case studies or action research can be applied. Based on these results a revision of the conceptual model may be required.

From the perspective of the framework presented in Section 2 this approach results in the following epistemological positions:

1. *What is the object of cognition? (Ontological aspect).* The existence of a (real) world is assumed, which is independent of human thoughts and speech and for this reason exists even beyond human consciousness. Conceptual models therefore are supposed to refer to a real world issue describing elements which are part of this real world. The assumption of the existence of an objective real world implies the denial of the radical constructivism.
2. *What is the relationship between cognition and the object of cognition?* In the context of consensus-oriented approach, specific importance is attached to the influence of subjects in the process of cognition: each cognition is seen as subject related. In this sense, the consensus-oriented approach follows the tradition of interpretivism, which becomes particularly obvious in relation to the studies of Kamlah and Lorenzen (1973). Here, the subjectivity of cognition, but also the existence of a real world, which exists independent of human consciousness, is accepted. Against this background, a conceptual model can be understood mainly as a linguistic (re)construction of a real world issue.
3. *What is true cognition? (Concept of Truth).* With respect to conceptual modeling, the understanding of truth is relevant mainly with respect to the validity, reliability and “quality” of conceptual model statements.

With the *semantic theory of truth*, Tarski develops a concept of truth, which is always relative to a language (object language). Simultaneously, the existence of a meta language is assumed, which contains the predicates of truth about statements of the object language. In this context, both languages ultimately emerge in linguistic communities.

On the other hand, the consensus theory of truth confirms that a statement is true if and only if it's rationally acceptable to everyone under ideal and optimal conditions. In a modified version, this means that (for a group), a statement is true if and only if it's acceptable to the group. It becomes apparent that, both in the context of the semantic theory of truth and in the context of the consensus theory, that truth is regarded as relative. In the first case, truth is relative to the language in which the statement to be confirmed, is made. The languages which are to be applied for determining the truth, are ultimately the property of a *linguistic community* [25]. In the second case, truth is relative to the community in which consensus was obtained about the truth or non-truth of a statement. The foundation of this truth verification is ultimately the exchange of speech artifacts. Accordingly, finding a consensus within a group requires the existence of a *linguistic community* as well.

In the context of *consensus-oriented approach* to conceptual modeling it should be assumed that truth emerges through the consensus of a linguistic community. Truth is thus regarded as relative to a language (semantic theory of truth) and

relative towards a group (consensus theory of truth), in this case to a linguistic community. According to the consensus theory of truth [2], [3], [19], a statement is true if, and only if, it is acceptable for everyone. Focusing certain business problems and IS solutions suggests, that the reduction of “everyone” to a group of smaller size is permitted. In this context, the concept of the consensus theory of truth, altered to this effect, might be: A statement is true (for a group), if and only if, it is acceptable for the group. This implies that truth is relative to the group in which consensus was obtained about the truth or non-truth of a certain statement. In order to express the statements within conceptual models [50] several modeling languages can be used, e. g. ERM or eEPC. By this means, models can be used as a formalized way of stating the consensus. Here, the formalized modeling language functions as an object-language (L). Natural language, e. g. English, can be used to discuss whether the statements within a conceptual information model are “correct”. Hereby, it contains the predicates of truth regarding the object-language based statements and poses as a meta-language (M). Both languages are thus comprised by the linguistic community.

4. *Where does cognition derive from? (Source of the cognition capability).* Both empirical statements [25] and a priori statements can be made, which may form the basis of conceptual models. Conceptual modeling therefore derives its results via theoretical reflection of the model contents, as well as from the implementation of the model in information systems and through observation.
5. *How does cognition emerge? (Methodological aspect).* Conceptual models are one form of artefacts of a formalized language and can contain both empirical and a priori knowledge. Both inductive and deductive conclusions can be accessed firstly in the context of the model creation and secondly in the context of truth verification.

If in the context of *model creation*, single statements are generalized on the basis of a set of individual tests, for example in the context of reference modeling, the relevant process is that of induction [4]. Creating an information model can, however, can be achieved deductively as well, for example by attaching object-class-specific attributes to model elements on the basis of their linkage to certain object classes.

Truth verification is based on the procedure of interpersonal verification [24], [25]. The formalized linguistic statements contained in a conceptual model are logically decomposed (deduction) until they are accessible as elemental statements for purposes of truth verification. This takes place by means of a group of experts who obtain a consensus. The main instruments are observation, experiments, interviewing and the interpretation of texts [25]. The validity of statements in the model can be confirmed, for example, in the case of business specific models, with a single case. In case of a pattern or reference model, however, the generalized abstraction of different individual verifications (induction) is necessary. This means that in the context of the procedure of interpersonal verification, additional, mainly empirical research methods are used.

Thus, consensus-oriented approach is characterized by an interpretivist position, which is mainly coloured by the critical linguistic approach of [24]. The information models developed contain formalized linguistic statements to be tested for validity in combination with additional (empirical) research methods. This is done through

members of a linguistic community in order to obtain consensus. Therefore, elements of the semantic theory of truth and the consensus theory of truth are considered and used.

With the help of this instance, we demonstrated how the epistemological framework developed in section 3 can be applied for discussion the epistemological assumptions of certain research paradigms and research approaches. Especially regarding the discussion of the concept of truth (question 3), we analyzed the interdependencies in between specific answers to this question, namely the semantic theory of truth and the consensus theory of truth.

4 Conclusions and Future Research

IS research takes place in a multi-disciplinary and international context. As a consequence, the IS field can be described as a rich tapestry of different methodological approaches. Therefore, we developed an epistemological framework for systematically analyzing epistemological assumptions of different research approaches. The framework consists of five questions which are addressing different epistemological aspects appearing most relevant in the context of IS research. By offering a critical perspective on multi-disciplinary and international IS research, the chosen systematization tries to give new impulse to the theoretical discussion distinct research paradigms and approaches.

Furthermore, the epistemological framework was applied to the consensus-oriented interpretivist approach to conceptual modeling. Interdependencies between distinct epistemological theories, namely the semantic theory of truth and the consensus theory of truth, have been discussed intensively. For future research, the discussion of interdependencies between certain epistemological questions and answers has to be carried out in greater extend. Here, a differentiation of distinct types of relations / interdependences – such as *‘logically necessary’*, *‘product of the historical philosophical debate’* or *‘can be found in most dominant epistemological paradigms’* – can be very helpful.

Additionally, the analysis of the consequences of epistemological assumptions on research evaluation is of great magnitude. In the current IS literature, several approaches can be found which discuss guidelines for good IS research. But the discussion of epistemological aspects often runs too short. E. g., the assumption of the subject having great influence on the research process reveals great relevance for the validity of research results. In addition to the traditional validity criteria (coined by a positivist paradigm) – such as retrospective, prospective, and structural validity – the idea of an interpersonal validity ought to be debated. The discussion of research rigor is also very much affected by this issue.

References

1. Alavi, M.; Carlson, P.; Brooke, G.: The Ecology of MIS Research: A Twenty Year Status Review. 10th International Conference on Information Systems (ICIS), Boston, MA, (1989) 363-375
2. Apel, K.-O.: Towards a Transformation of Philosophy. Routledge Kegan & Paul, London (1979)
3. Baumann, P.: Erkenntnistheorie. Metzler, Stuttgart/Weimar (2002)

4. Becker, J.; Schütte, R.: *Handelsinformationssysteme*. Landsberg/Lech (1996)
5. Berkley, G.: *Philosophical Works*. London (1975)
6. Bonjour, L.: *In Defense of Pure Reason: A Rationalists Account of A Priori Justification*. Cambridge/MA (1998)
7. Bunge, M. A.: *Ontology I: The Furniture of the World. Treatise on Basic Philosophy*. Dordrecht, the Netherlands et al. (1977)
8. Burrell, G.; Morgan, G.: *Sociological Paradigms and Organizational Analysis*. London, UK (1979)
9. Carnap, R.: *The Logical Structure of the World and Pseudoproblems in Philosophy*. Open Court Publishing Company, Chicago (2003)
10. Carnap, R.; Hahn, H.; Neurath, O.: *Wissenschaftliche Weltauffassung: Der Wiener Kreis*. Vienna/New York (1929)
11. Chen, W.; Hirschheim, R.: A paradigmatic and methodological examination of information systems research from 1991 to 2001. *Information Systems Journal* 3 (2004) 197-235
12. Chomsky, N.: *Aspects of the Theory of Syntax*. Cambridge/MA (1965)
13. Davidson, J.: *Inquiries Into Truth and Interpretation*. Oxford (1984)
14. Descartes, R.: *Meditations on First Philosophy : With Selections from the Objections and Replies*. Cambridge University Press, Cambridge (1996)
15. Gethmann, C. F.: *Deduktion*. In: Mittelstraß, J. (ed.): *Enzyklopädie Philosophie und Wissenschaftstheorie*. Band 1. Stuttgart, Weimar (1995)
16. Glasersfeld, E.: Steps in the Construction of "Others" and "Reality": A Study in Self-Regulation. In: Trappl, R. (ed.): *Power, Autonomy, Utopia*. London, New York 1986 107–116
17. Glasersfeld, E.: *The Construction of Knowledge*. Seaside/CA (1987)
18. Haak, S.: *Philosophy of Logics*. Cambridge/MA (1978)
19. Habermas, J.: *Wahrheitstheorien*. In: Fahrenbach, H. (ed.): *Wirklichkeit und Reflexion. Walter Schulz zum 60. Geburtstag*. Pfullingen (1973) 211-265
20. Hanson, P.; Hunter, B.: *Return of the A Priori*. University of Calgary Press, Calgary/Alberta (1992)
21. Hevner, A. R. et al.: *Design Science in Information Systems Research*. *MIS Quarterly* 1 (2004) 75-105
22. Hirschheim, R.; Klein, H. K.: *Four Paradigms of Information Systems Development*. *Communications of the ACM* (1989) 1199-1216
23. Hume, D.: *A Treatise of Human Nature*. Oxford (1978)
24. Kamlah, W.; Lorenzen, P.: *Logical Propaedeutic*. Lanham/MD (1973)
25. Kamlah, W.; Lorenzen, P.: *Logische Propädeutik. Vorschule des vernünftigen Redens*. 3. edn. Stuttgart, Weimar (1996)
26. Kant, I.: *Critique of Pure Reason*. Cambridge University Press, Cambridge (1999)
27. Kirkham, R. L.: *Theories of Truth. A Critical Introduction*. Cambridge University Press, Cambridge/MA (1992)
28. Leibniz, G.-W.: *Nouveaux Essais sur l'Entendement Humain*. In: Leibniz, G.-W. (eds.): *Sämtliche Schriften*. Berlin (1962) 39-527
29. Locke, J.: *An Essay Concerning Human Understanding*. Oxford (1982)
30. Loose, J.: *A Historical Introduction to the Philosophy of Science*. Oxford University Press, New York (1972)
31. Lorenzen, P.: *Constructive Philosophy*. The University of Massachusetts Press, Amherst, MA, USA (1987)

32. Luft, A. L.: Software-Engineering und konstruktive Wissenschaftstheorie. Ein Beitrag zur Methodologie des Software Engineering. *Angewandte Informatik* 3 (1981) 93-99
33. Mingers, J.: Combining IS research methods: towards a pluralist methodology. *Information Systems Research* (2001) 240-259
34. Orlikowski, W. J.; Baroudi, J.: Studying information technology in organizations: research approaches and assumptions. *Information Systems Research* (1991) 1-28
35. Ortner, E.: *Methodenneutraler Fachentwurf*. Stuttgart, Leipzig (1997)
36. Quine, W. V. O.: Two Dogmas of Empiricism. In: Quine, W. V. O. (ed.): *From a Logical Point of View*. Cambridge University Press, Cambridge/MA 1961 20-46
37. Reich, B. H.; Benbasat, I.: Factors That Influence the Social Dimension of Alignment between Business and Information Technology Objectives. *MIS Quarterly* 1 (2000) 81-113
38. Rott, H.: Schluß, induktiver. In: Mittelstraß, J. (ed.): *Enzyklopädie Philosophie und Wissenschaftstheorie*. Band 3. Stuttgart, Weimar 1995 710-713
39. Russell, B.: The Philosophy of Logical Atomism. In: Russell, B. (ed.): *Logic and Knowledge. Essays 1901-1950*. London 1956 177-281
40. Schmitt, F. F.: *Socializing Epistemology. The Social Dimension of Knowledge*. Lanham/MD (1994)
41. Schmitt, F. F.: *Truth. A Primer*. Westview Press, Boulder/CO (1995)
42. Seiffert, H.: *Einführung in die Wissenschaftstheorie* 1. 12. edn. München (1996)
43. Spinoza, B.: *The Ethics ; Treatise on the Emendation of the Intellect ; Selected Letters*. Hackett Publishing Company, Indianapolis/IN (1992)
44. Stenius, E.: Wittgenstein's Tractatus: A Critical Exposition of its Main Lines of Thought. Oxford (1960)
45. Strahinger, S.: *Metamodellierung als Instrument des Methodenvergleichs – Eine Evaluierung am Beispiel objektorientierter Analysemethoden*. Aachen (1996)
46. Tarski, A.: The Semantic Concept of Truth and the foundation of semantics. *Philosophy and Phenomenological Research* (1944) 341-375
47. Tarski, A.: The Concept of Truth in Formalized Languages. In: Tarski, A. (eds.): *Logic, Semantics, Mathematics. Papers from 1923 to 1938*. Oxford (1956) 152-278
48. Tarski, A.: Truth and Proof. In: Hughes, R. I. G. (eds.): *A Philosophical Companion to First-Order-Logic*. Indianapolis/IN 1993 101-125
49. von Foerster, H.: *Wissen und Gewissen. Versuch einer Brücke*. 4. edn. Frankfurt a. M. (1996)
50. Wand, Y.; Weber, R.: Research Commentary: Information Systems and Conceptual Modeling – A Research Agenda. *Information Systems Research* 4 (2002) 363-376
51. Wand, Y.; Weber, R.: Research Commentary: Information Systems and Conceptual Modeling – A Research Agenda. *Journal of Information Systems* 2 (2002) 217-237
52. Weber, R.: Editor's Comment: Theoretically Speaking. *MIS Quarterly* 3 (2003) iii-xii
53. Weber, R.: The Reflexive Researcher. *MIS Quarterly* 4 (2003) v-xiv
54. Wedekind, H.: *Datenbanksysteme I, Eine konstruktive Einführung in die Datenverarbeitung in Wirtschaft und Verwaltung*. 2. edn. Mannheim et al. (1981)
55. Wittgenstein, L.: *Tractatus Logico Philosophicus*. Routledge, London (2001)
56. Wyssusek, B.; Schwartz, M.: Towards a Sociopragmatic-Constructivist Understanding of Information Systems. In: Gordon, S. R. (ed.): *Computing Information Technology: The Human Side*. Idea Group Publishing, Hershey et al. (2003) 267-297