

# Information and Pragmatic Value-adding: Language Games and Information Science

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**Abstract:** This paper discusses terms which are of mutual importance to the fields of information science and computer science. Specifically we discuss the notions of "information" and "knowledge": their interrelationships as well as their differences, and the concept of value-adding. Concrete examples are used in the discussion.

**Key Words:** information science, theoretical foundation, pragmatics

## Language Games with Information

Most scientific disciplines either avoid generic concepts or use them without being able to provide appropriate definitions. This is not considered a particular disadvantage, at least in disciplines belonging to the sciences. Contemporary introduction to physics, for example, are not expected to define precisely basic concepts such as "power," "movement," or "energy." The same is true of "life" in biology. The situation may be somewhat different in social sciences and the liberal arts. Political scientists probably do need to agree on the concept of state and, similarly, sociologists often begin theoretical discussions with a definition of "society" as they understand it. On the other hand, psychologists, particularly when their research is highly experimental, tend to avoid a generic discussion of "mind." It may be that the more advanced the experimental status of a discipline, the lower the interest in nominalistic discussions.

Information science, at least with respect to the field of information retrieval, belongs without

doubt to the experimental sciences, and accordingly there is no need for a basic discussion of "information." Likewise very few contemporary computer scientists (who are called *Informatiker* in German) reflect on the basic concept of information — they simply construct information systems. Yet information science is not only an experimental science but also a science that claims to reflect upon the use of information in social environments. Perhaps it is this intermediary position between the technical and the social sciences which is responsible for the fact that in the last twenty years, at least in Germany and the English-speaking world, there has been intensive discussion about the relationship between computer science and information science and indeed about the right of each discipline to claim information as its fundamental concept. To the extent that this has been a "political" question of public recognition and status in the realm of academia, the battle has been won.

Computer science is a well-established and widespread academic discipline in most universities, in general as a department (*Fachbereich* or *Fakultät*) of its own or as part of a mathematics department. On the other hand information science, although it certainly is no longer struggling for existence — there are currently four information science departments at German universities (Berlin, Düsseldorf, Konstanz, Saarbrücken) and many more in the UK and the USA — is still unsure of its scientific status. Students of information science, and indeed professional information scientists are still confronted with the problem of how to explain to friends or colleagues from other academic disciplines the difference between com-

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puter science (*Informatik* in German) and information science (*Informationswissenschaft*), as well as how to motivate the need for an independent science of information.

Since this is still an ongoing discussion, it may be helpful to reconstruct the information-science understanding of information. This is the aim of the current paper. We do not aim to provide a scientific foundation for information science (sciences cannot be constituted by nominalistic discussions) nor to delimitate information science from computer science (the experimental work of information science can be done in computer science and/or artificial intelligence environments as well), but to make people sensitive to the fact that information is, above and beyond its technical or computational aspects, a social phenomenon and needs to be treated by a scientific discipline. Too technical an understanding of information, even a predominantly technical one, runs the risk of suppressing the social, or as we will call it, the pragmatic aspects of information. We would like to work out this pragmatic aspect of information science by playing some "language games" (in the Wittgensteinian sense) or telling "stories" (in the understanding of the phenomenologist Wilhelm Schapp) where information plays the central role. In taking this ordinary-language approach we, again, do not intend to provide a definition for information but to evoke the complexity of information and to encourage a multidisciplinary approach in the scientific treatment of information.

Language games are in general language-dependent. This article was originally written in German and certain nuances of meaning may obtain only for the German language. Therefore the language games which follow and from which we would like to derive some properties of information are also given in the original German version. Nevertheless we hope that the games will be interpretable in spite of the language barrier, in particular as concerns the difference between "information" and "knowledge."

(a) I have got a piece of information for you.

Ich habe eine Information für dich.

The speaker of (a) considers the chunk of knowledge s/he has to be pertinent to the receiver

and therefore calls it "information." It is quite unlikely that s/he would say: "I have some knowledge for you." The information is being explicitly related to a specific person ("for you") and this obviously depends on the speaker's knowledge of the addressee's situation and interests. The speaker has a certain model of the person to whom the information is being related; this is called a user-model. This leads us to the first property of information. Information is normally addressee-related, mostly directed to a single individual, and is not simply "broadcast" or distributed as is the case in mass communication. Anonymously distributed knowledge tends to be referred to as "news" in everyday language. Occasionally, mass communication channels are also used for direct transfer of information, for example, when a search message for some single individual is distributed via radio or television, but this usually has a slightly alienating effect. In this case the news will be interpreted as information too.

There is of course also information which is not transferred in a directed and addressee-related fashion but is simply picked up:

(b) I picked up this bit of information by accident.

Auf diese Information bin ich ganz zufällig gestoßen.

For the description of this phenomenon it is useful to distinguish between the notions of browsing and serendipity. Everybody knows that while searching for information, for example looking up the meaning of a word in a dictionary, one may incidentally pick up "side-effect information." This is called *browsing*. Sometimes one becomes so fascinated by this side information that the original goal is forgotten; this effect is then called *serendipity*. Both in the browsing and the serendipity case the borderline between creative and chaotic information input is fuzzy. But it may be characteristic of a good information environment that browsing and serendipity effects are possible. The lack of them is one of the drawbacks in contemporary electronic information culture, which is in the main directed and does not leave information-seeking to chance. One of the challenges for information science research is to

develop systems and/or methods which will preserve the creative side-effects of browsing and serendipity in the electronic age.

Not only must a bit of information be addressee-related or directed towards a certain person; in addition, the information must be accepted by that person. Information depends on actual reception by the addressee; and even this may not be enough. In fact, it may happen (as in c) that the speaker's user-model was not appropriate and therefore, although the information was directed, it was received but not interpreted as information.

(c) This is not information, I already know it.

Das ist keine Information, das weiß ich schon.

In this everyday formulation, the distinction we have in mind between knowledge and information comes to light. What is called knowledge here ("I already know it") is a fixed and accessible part of the intellectual resources of an individual whereas we expect information to be "new." Novelty is an important feature of information. And novelty, of course, depends upon the recipient's intellectual state. Information thus, as we know it, is recipient-dependent. This is one of the main drawbacks of current commercial (on-line) information systems; they have been designed for a more or less anonymous market. Information systems in general are neither provided with specific user-models nor do they have a component which could be called user-memory. The lack of user-models is responsible for inappropriate "information." The "information" delivered is not tailored to a special user's interests. This is one of the reasons why on-line databases originally designed for use in scientific and technical environments are not well received by other user groups, for example in management. Furthermore the lack of user-memories often makes people very very angry when they get the same information over and over again. In everyday conversation we simply take for granted that our interlocutor is keeping in mind what has already been said. Why not in "intelligent" information systems communication?

Current information systems have only very weak pragmatic components at their disposal.

They are extremely limited in their capacity to consider the consequences of their actions. The relevance of the system's output depends almost completely on the skill of the human end-user (or of the information transfer-specialist who is assisting the end-user). Therefore, based on our discussion so far, current commercial information systems do not deserve the name "information" because they are not able to reflect a user's needs; they do not have a pragmatic component. In the strict sense, they should be called data or knowledge administration systems. Of course we only wish to reflect on this problem here, and are not seriously advocating a change in current terminology. The term "information system" may be appropriate even for contemporary systems if we include the pragmatic capacity of the end-user in the general system design.

(d) This information confirms my present impression.

Diese Information bestätigt meinen bisherigen Eindruck.

The importance of newness or novelty has been emphasized for information. But a certain amount of redundancy is sometimes useful and, for the purpose of effective learning, even necessary. Example (d) makes it clear that it is sometimes helpful if an already existing opinion is confirmed by the same information (particularly when it stems from a different source). In social environments, where the truth value of a proposition cannot be proved but depends on experience or agreement, the repetition of a piece of information is necessary (and often not just sufficient) for the transformation of an opinion into knowledge. It is extremely difficult to manage the redundancy property of information in the design of information systems. For example, systems with poorly designed man-machine interfaces tend to repeat help-messages again and again, which is useful at the beginning but cumbersome for advanced users. Here again, the degree of redundancy depends on appropriate information about the status of the user.

(e) Without any further information I can do nothing.

Ohne weitere Information kann ich nichts machen.

Example (e) makes explicit what we have called the pragmatic aspect of information. A chunk of knowledge needs to be relevant for a specific action, be it physical or intellectual. Information must enable a person to do something. Information is active knowledge needed at this very moment. Knowledge which one "buys in stock," for example when one tries to memorize a vocabulary list as part of one's daily homework, is hardly called information, but looking up the French word *croissant* in a dictionary in order to explain one's wish in a bakery is seeking information. Lack of information, as can be seen from (e), may block further action. This often occurs in technical environments, where one simply needs to know in order to do. One cannot write a "record" in a given programming language if one does not know the syntax of the record-type. A handbook may provide the needed information. The corresponding chapter in the handbook cannot be called information per se, only the current recall of it makes it a piece of information.

- (f) This information is clearly interesting but is out of place.

Diese Information ist zwar ganz interessant, gehört aber nicht hierher.

- (g) This information does not suit my plans.

Diese Information paßt mir gar nicht ins Konzept.

- (h) This information turns everything upside down.

Durch diese Information wird alles Bisherige auf den Kopf gestellt.

In (f) a further feature of information, likewise emphasizing its relevance for action, is manifest. Information is not context-free but context-dependent. Context is often defined in terms of plans or goals. The condition of context-dependency is thus fulfilled if the information fits into specific plans or is appropriate to certain goals. Information is in general plan-dependent or goal-related. Normally information is supposed to promote

plans which already exist; diverging information, even if potentially relevant, will often be rejected or found troublesome if it does not fit into existing plans (cf. sentence (g)). Few people can deal with situations in which a sentence like (h) would be appropriate, because as human beings we tend to prefer informational stability. One good example of this propensity is the famous scene in Brecht's *Galilei Galileo* where the scholars in Florence refuse to look through Galileo's telescope because they are afraid that the new information they would gain in doing so will turn their world upside down. The willingness to be open to new knowledge, to accept it as potentially important information, is undoubtedly just as dependent on personal disposition as on cultural custom. Societies in which concepts like progress and curiosity are high on the scale of acceptance are more likely to be called information societies than societies in which these concepts do not carry such positive connotations. We mention this because of its obvious relevance to the problem of transferring models of information-related behaviour from one society to another.

- (i) I am not looking anything particular, I only want to inform myself.

Ich suche nichts Bestimmtes, ich informiere mich bloß.

Information is demanded in situations of uncertainty, where the wish is normally to be rid of the uncertainty as soon as possible. The question whether a piece of information fits into plans or is appropriate to certain goals is one of the most difficult in the theory of human information processing. Before discussing this problem, let us briefly interpret sentence (i), which at first glance appears to be in conflict with the goal-relatedness which has been derived from (f). Sentence (i) is often used as a means of getting rid of a questioner, perhaps a librarian who sees a user walking around and wants to be helpful ("What are you looking for?") but is more often than not merely bothersome. If one were to analyze this situation somewhat more carefully, it would probably turn out that the speaker of (i), despite claims to the contrary, really does have a problem but either does not know how to explain it, only has a vague

feeling as to what it might be, or does not want somebody else to participate in solving it. The first alternative — that the user does not know what s/he really wants — is typical of many information situations.

The starting point for seeking information or for being willing to receive information is very often a general and vague feeling of uncertainty. But neither the cause for this uncertainty (problem identification) nor how to get rid of it (concrete demands or information wishes) may be clear. The user is — as some information scientists have put it — in an anomalous state of knowledge. The conflict of (i) with the interpretation of sentence (f) can be resolved if the criterion of goal-relatedness is not applied too rigorously. We do not need to be fully aware of goals at the outset. Information is helpful in modifying existing goals, making them more precise or more concrete, and even formulating them from scratch.

This amounts to an important modification of our interpretation of information so far. Information need not be related only to articulated needs. Observations from cognitive psychology, e.g. that users tend to refuse information when it does not fit into their plans (the theory of cognitive dissonance), lead to the conclusion that information systems should be designed to strike a balance between helping the user satisfy articulated demands on the one hand and supplying information which is “objectively” necessary for the situation on the other — whatever “objectively” necessary information may mean. We would like to point out that powerful information systems should be supportive systems in the sense of being able to compensate for insufficient human information processing behaviour. This insufficiency may lie in slow processing, in limited memory, or in the propensity to ignore relevant information or commit oneself too early to an ostensibly appealing solution.

The difficulty in knowing what kind of information is needed and the human tendency to neglect relevant information or to shy away from seeking more information — even in critical situations — can be used as a means of justifying the need to advertise information. If one always knows what kind of information is needed, then advertising is unnecessary. Likewise, if there is no chance of

convincing people to open themselves to new information, then advertising makes no sense.

- (j) What was information yesterday is old hat today.

Die Information von heute ist der Schnee von gestern.

The message in sentence (j) is compatible with our interpretation so far. Information — or as we prefer to say: the transformation of knowledge into information — is context-dependent. Context encompasses, in addition to plans or goals, a temporal frame which is dependent on “now.” Tales of people voluntarily reading their newspapers with a delay of weeks or months give the impression of being caricatures. This is not only true for anonymously distributed mass communication news. Even today’s information will seem stale if it is what one urgently needed yesterday. The advantage of modern on-line bibliographic information systems, in comparison to traditional library catalogues, lies mainly in their speed. The ability to deliver information “in-time” is the main value-added effect of electronic systems and can thus be used as a justification for royalty claims. This brings us to sentence (k).

- (k) I am willing to pay \$500 for this information.

Diese Information ist mir 1000 DM wert.

- (l) In a competitive society only those who have access to the information they need for their professional, social or personal commitments will be successful. (Hans Matthöfer, former minister for research and technology, in his preface to the Federal Programme for the Promotion of Information and Documentation, 1974–1977)

Der Bürger wird sich in der modernen Leistungsgesellschaft dann erfolgreich behaupten können, wenn er über die Information verfügt, die er für die Erfüllung seiner beruflichen, persönlichen und sozialen Aufgaben benötigt.

Information, at least in modern western societies, has become a commercial article which is distributed on an international information mar-

ket. The merchandise character of information is considered by many economists to be the primary indicator of a so-called "information society." Sentence (l) suggests furthermore that access to and usage of information is the basic requirement for active participation by responsible citizens (*mündige Bürger*) in all public affairs. Therefore information must be regarded not only as merchandise but also as a public good.

In sum, information cannot be considered as a freely available, objectively definable piece of knowledge, but must be created or produced with regard to many contingencies including time, cost, social environment, cognitive ability and organizational goals. Information is without a doubt based on knowledge, but depends in addition on the specific situation in which it is used. Information is addressee-dependent, determined by the situation and the context of the user. It is judged by its novelty and needs to be relevant for a specific action. Information is in general goal-related or plan-oriented, whereby the user need not be fully aware of the goal. Information is sometimes also needed to shape plans or goals. Information cannot be absorbed in unlimited quantities. Over-information is just as harmful as under-information. While under-information creates a feeling of uncertainty, which a person will usually try to overcome by seeking additional information, over-information sometimes deceives a person into thinking s/he has more than enough information, although the "over" may not always mean the right information. In such a situation a piece of relevant information may not be recognized as pertinent and may be rejected. This can even happen in critical situations, where a person may prefer to stick to a first solution and try to avoid searching for more information. Information is mainly considered an economical factor in modern societies but must also be thought of as a political factor and as an important pre-requisite for responsible participation in public life.

#### **Transformation of Knowledge into Information**

In the preceding section we have tried to distinguish the concept of information from the concept of knowledge in such a way that information is the subset of knowledge which is needed by but not available to a specific person in a concrete situa-

tion in order to solve a problem. In our second section, we would like to clarify this still somewhat abstract formulation by again referring to everyday language. The following two sentences are both acceptable — at least in German — with a slight preference for the first:

- (m) To solve this problem I have some knowledge.  
Zur Lösung dieses Problemes verfüge ich über einiges Wissen.
- (n) To solve this problem I have some information.  
Zur Lösung dieses Problems verfüge ich über einige Informationen.

whereas of the two sentences

- (o) To solve this problem I need additional knowledge.  
Zur Lösung dieses Problems brauche ich noch weiteres Wissen.
- (p) To solve this problem I need additional information.  
Zur Lösung dieses Problems brauche ich noch weitere Informationen.

only (p) seems to be acceptable. A native speaker of German would probably refer "knowledge" in (m) and (o) to an internal mental state of the subject, whereas "information" in (p) would be considered to be outside or independent of the subject. To some (n) may be unacceptable for this reason.

"Knowledge," traditionally used to describe a mental state in a human being, is nowadays also increasingly being used as a description of the internal "mental" state of a computer. The knowledge of a computer is the internal set of semantic structures represented in an appropriate (formal) language in combination with procedures to process these structures. For the purpose of our discussion it is not necessary to distinguish between human and machine knowledge. The consequences are the same in both cases.

Knowledge can be accessed by memorizing (or in case of a machine by retrieval). Knowledge can be activated from a personal mental treasure independent of other people, whereas information

depends on interaction with someone or something outside the subject. Information is thus embedded in a communicative context, although from our argument so far it should be clear that this communicative context need not entail face-to-face communication but may be face-to-file: traditionally this has meant a person reading printed materials (files), but nowadays it increasingly applies to people accessing machine files.

Information, in contrast to knowledge, is not gathered by introspection. For systematic reasons we would like to exclude procedures such as memorizing, thinking or recalling from communicative situations. People who intend to inform themselves or to gather information do not listen to themselves but look for external resources.

#### *Knowledge*

Leaving the natural language games aside now, we propose the following convention: with "knowledge" we understand a fixed stock of models about objects and facts. These models are accessible by human beings or machines, useful for individuals, groups, organizations. Knowledge is the summation of individual, group-related, organization and/or cultural experiences and judgements, based on good reason and thus different from opinion. From a rationalistic point of view one might assume that information should also be based on reliable knowledge. It is even part of the professional ethic of information specialists that they deliver only information which is well founded. But there is no systematic way to delimitate "information from knowledge" on the one hand and "information from opinion" on the other. Sometimes an opinion is of high information value, for example, what x believes may be real information to y if x takes decisions which are relevant for y. Thus it should be pointed out that the pragmatic information concept (information being relevant to a person in a certain situation) threatens the distinction between truth and opinion which is fundamental to our western culture.

#### *Information*

If someone says they need information, they are in effect stating that they do not dispose of specific knowledge which they believe someone else has. What is needed in such a situation is a transfer

mechanism between the person who has the chunk of knowledge needed and the person who needs it as information. When we talk about the communicative context of information it is this transfer situation we have in mind.

The transformation of knowledge into information depends on at least two partners whereby one may be a file or a machine. Following this thought to its logical conclusion, it must be admitted that communication between two machines can also be described as a transformation of knowledge into information if one machine stores knowledge (knowledge structures) and the other machine needs some specific information to perform a task such as counselling or diagnosing. What is important for our transformation process is that the two partners are independent of one another. It is this independency which is responsible for the fact that the transformation only can take place if there is a communication channel which is accessible to both partners and if the message to be transmitted via these channels can be understood by both sides.

Knowledge, in order to become information, needs to be transmittable and codable. Knowledge in itself is determined by internal mental semantic structures; knowledge as a basis for information needs to be materialized, for example in the form of natural language, or in the case of machines, in the form of a knowledge-representation language (such as semantic networks, frame languages, predicate calculus, production rules). Knowledge which is materialized and syntactically defined is called data. Therefore it makes sense to call machine processes data processing and not knowledge processing. Machines do not process mental (knowledge) structures; they process data as materialized knowledge structures. The result of the processing needs to be reinterpreted in its semantic structure in order to become information which is relevant for an action.

The context of the situation determines the degree of specificity and the quality of information. Therefore information cannot be objectively defined but varies according to different requirements and contingency factors. What information is needed to be worked out according to these factors. Information cannot be processed context-free like data but grows out of concrete needs and

problem situations. Information — to put it in a nutshell — can be thought of as knowledge in action. We would like to call this postulate the pragmatic primacy of information work. Information work is primarily the transformation of knowledge into information.

In this pragmatic sense information is, literally speaking, a very volatile phenomenon. It is asked for only in very specific situations; afterwards it can be forgotten. This is why, for instance, one looks up the recipe for a delicious sauce in a cookbook repeatedly rather than memorizing it because one knows that the information can be always retrieved again. When one finally retains the information mentally, so that the cookbook does not need to be consulted the next time, then one has learned something, one has acquired some knowledge.

We do not learn information. If one learns something which so far has been the knowledge of someone else or has been generalized or derived from external experiences, then it becomes one's own knowledge. Therefore we can speak of a transformation process in a double sense: firstly, the transformation of knowledge into information, which we would like to call *Informationserarbeitung* (not information processing but information acquisition), and secondly, when that information is not forgotten but kept, the transformation of volatile information into lasting knowledge, which we would like to call *Informationsverwaltung* (administration of information).

Information — and this is an important property with respect to its merchandise character — is recyclable, reusable either by the same user in different context or by new users. The pragmatic value of information may get lost in usage, but the semantic reference still remains and can be activated in a different situation or by a different person and thus regain a new pragmatic value. This confirms the volatile character of information. Information transferred into a stable state is called knowledge.

#### *Value-adding*

We believe that the distinction between knowledge and information makes sense systematically and is analytically useful. If one assumes that an information system stores knowledge (more precisely:

reconstructed knowledge), then different persons with different interests can pose different questions to this system. If the result helps the user in a concrete problem situation, then the retrieved piece of knowledge is called information. One could of course argue that information is not different from the original subset of knowledge but is only a new perspective on existing knowledge. However, we prefer not to restrict information work to the selection of parts of knowledge from a certain point of view but would like to describe the process of the transformation of knowledge into information as a value-adding process. The transformation produces information added-value. Systematically, it is possible to distinguish between indirect value-adding processes and direct value-adding processes. Indirect processes have more of a support function, whereas direct processes produce added-value immediately. Examples of indirect value-adding taken from the domain of natural language processing are:

- natural language access to a database
- acoustic input facilities
- automatic translation support on different levels
  - word level*: multilingual thesauri in order to facilitate a multilingual query formulation for retrieval purposes
  - sentence level*: controlled syntax for writing multilingual abstracts
  - text level*: automatic translation of full texts
- graphically supported presentation of retrieval results

Examples of direct value-adding are:

- automatically produced flexible text condensates
- inference procedures from existing knowledge structures
- selection of knowledge according to given or automatically constructed user-models or situational analyzers respectively.

Of course the border between indirect and direct value-adding fluctuates. What is important for our discussion is that information work (the transforming process) often changes the structure of given knowledge and thus creates something new, information which again can be transformed



into knowledge. The acquisition of knowledge — this is our argument — occurs in the main via the “detour” of information.

**The “Informatization” of our World (*Lebenswelt*): A Determining Factor in the Production of Knowledge and the Use of Information**

Our contemporary understanding of knowledge and information is increasingly determined by a process of informatization. By “informatization” we mean the more or less complete penetration of all areas of life (*Lebenswelt*) by machine computation and machine communication. Processes of computerization are becoming as influential for the world we live in as industrialization was for production and, earlier, as the invention of the printing press was for our intellectual life. Informatization is also changing the conditions of physical, intellectual and social work. It is the main reason why knowledge is being materialized and represented in increasingly different ways by a wide variety of primarily electronic tools. We would like to call this the diversification of knowledge production and information services. In earlier centuries books, pamphlets and journals were the predominant, if not the sole ways of representing knowledge. But the contemporary range of knowledge and information products is much broader: not only can knowledge be administered electronically in many different ways, it can be distributed electronically in as many ways. In addition to the usual online databases (bibliographic retrieval systems with or without abstracts, full text systems or fact retrieval systems, which manage primarily numeric structures), we have new products such as electronically produced and distributed journals; image databanks, which process graphics and/or moving pictures; and, with the development of storage-intensive compact disk technology, multimedia encyclopedias, which process and supply textual, graphical and audio-visual material all at once. The next

development is already on the horizon: electronic storages which provide not only the referential products of knowledge (texts, abstracts, titles, etc.) but the knowledge structures themselves. These are already being used in domain-specific expert systems, but will become available on a large scale in new information products such as knowledge banks.

The broad variety of knowledge and information products — and this follows directly from the process of informatization — is made possible by an equally broad diversification of tools for knowledge/information production and distribution: no longer do we have only typewriters or printing machines but computers of all sizes, interrelated via telecommunication lines; optical storage techniques; all kinds of software systems for text processing, desktop-publishing, hypertext, electronic publishing, automatic translation; systems for the construction of data banks, shells for expert systems, knowledge acquisition support systems, etc. Knowledge will of course continue to be transferred in face-to-face situations via the printed media, but electronic media will be used more and more, particularly in professional environments where knowledge and information are considered economical factors.

Naturally the distinction between knowledge and information, which is fundamental for information science, is valid in a completely informatized society as well. Future knowledge-based systems, which are becoming more and more powerful in automatic knowledge acquisition, knowledge administration, inferencing and access techniques, will not solve the information problem automatically. Information, as we hope to have demonstrated, depends on social and cognitive circumstances. We must construct information systems which take the pragmatic primacy of information work seriously. This is the only way to add value to existing knowledge and transform it into active information.