

Chapter 3

Data, Information and Meaning

“Information Systems are data becoming information in consciousness; organizations are socially constructed through language, and our reasoning about both these processes takes place in dialogue.” [Boland, 1985]

3.1

Introduction

This is the second chapter which establishes the theoretical and philosophical basis for the thesis. Key concepts are examined. These concepts are "data", "information" and "meaning" and an associated concept, "learning". Various definitions of the concepts, obtained from various sources, are considered in the light of the three ontologies which were discussed in Chapter 2. Hence, objective, subjective and intersubjective aspects of each of them are noted in Section 3.3. An attempt is made to understand what other authors mean by "information" and to identify different types of information as it is necessary to clarify the types of information that can be communicated by information systems to people, and by people with each other, before considering the more complex issue of how this information is associated with meaning. Habermas' Theory of Communicative Action, which was discussed in Chapter 2, is referred to again in order to explain how, in the process of sharing information, people reconstruct meaning.

Learning is a specific case of sharing information and constructing meaning and this is discussed in Section 3.6. It is necessary to study existing learning theories in this context, all be it rather superficially. This discussion provides a useful foundation for Chapter 5 where specific teaching and learning activities and environments are discussed. In particular it provides an explanation of the particular model of learning underlying the team activities which are the basis of the research for this thesis.

The theoretical and philosophical discussion is continued in Chapter 4, where the relationship between information systems and modern society is discussed. The factors contributing to the richness of information, particularly when it is communicated electronically, forms the focus of Chapter 5, and hence the classification developed in this chapter is built on further there.

3.2

Relevance of the concepts

The concepts of "data", "information", "meaning" and "learning" are vitally important in a number of different contexts that are represented by well-established academic disciplines or fields, which are usually accepted as separate. Disciplines in which the concepts "information" and "meaning" play significant roles are Information Systems (Informatics), Information Science,

Communication Science, Sociology, Philosophy and Education, all of which are considered to be social sciences. Whereas “learning” has always been considered to be primarily the specialist area of education, it has now also been recognised as being of importance in all organisations with issues of improving learning within an organisation and of retaining and sharing knowledge now being seen as of importance in Information Systems. Hence, learning theories, as well as critical social theories, are relevant in this discussion. Initially, the concepts as used in each of these disciplines appear to be very similar but on closer study different emphases and implications become evident.

Convergence of technologies plays a role in the overlap of interests, particularly between Informatics, Information Science and Communication Science. Examples of different aspects of this are easily identified. Computer technologies are now essential in modern libraries and are used routinely. Computer *applications* relevant to libraries are common, such as those for accessing catalogues to find out where the printed copy is located. Compact, digital forms of *storage* are used increasingly and these electronic copies of publications can be accessed by telecommunication technologies. Thus, virtual libraries are just one example of a virtual organisation. *Telecommunication technologies*, such as transmission via a satellite, are used in television broadcasts and by organisations delivering reports to members of a committee. *Data types* previously used exclusively in one field, such as sound and video (often referred to as multimedia), are now used by them all. Hence, the kind of information that the different disciplines focus on, as well as its format and the technologies used to store, process and transmit it, are becoming similar.

The ubiquitous, ready-at-hand use of technology as a tool by “the man in the street” and in virtually all aspects of radically modern¹ life, even those that are not mentioned in the list of disciplines directly associated with information, has also contributed to the blurring of the lines between what is considered to be in one area of specialisation and another. Technology is often used in educational, medical, and legal settings in ways similar to those encountered in commercial organisations and issues concerning how it influences the effectiveness of the organisation and interpersonal relationships within it are relevant in all environments. Globalization, which is rapidly affecting every aspect of modern life, could never have occurred without the infrastructure provided by technology.

The links between the different disciplines are not solely dependent on the rapid advance of technology in the twentieth century. These have been recognised by erudite thinkers completely

¹Giddens refers to the social structures of the late 20th century as “radicalised modernity” [Giddens, 1990: 149 - 150] or post-modern (not to be confused with post-modernity as used by Lyotard [Giddens, 1990: 2 - 3]).

independent of any references to technology. For example, Habermas, a social philosopher, is very aware of the ideas expressed by Piaget, an educational psychologist, and those of Austin and Searle, who developed and extended Speech Act Theory. As pointed out in the previous chapter, Habermas' Theory of Communicative Action has been used by academics and developers of information systems.

This section of the thesis touches on a complex field of knowledge which has been deliberated on by deep thinkers since the earliest times and forms the basis of many philosophical theories, namely, how we can make our knowledge and experience explicit. Dahlbom and Matthiassen [1995 : 36] say that the Aristotelian way is to formalise knowledge by setting up rules and criteria that describe the concepts exactly. Plato on the other hand made use of illustrative examples and the new instance could be compared with the typical or standard example to see if the same concept was applicable.

The extent to which the topic is investigated here will be limited. An attempt will be made to identify some similarities and differences in the way these concepts are perceived in some of the contexts (excluding Information Science and Philosophy for the most part) and in so doing express exactly what is intended by the title of the dissertation. The way in which the terms are being redefined within Information Systems particularly, as technology develops, will also be discussed. Occasionally intriguing questions arising from the juxtapositioning of ideas and contexts will be raised but not answered.

In "Information, Systems and Information Systems: making sense of the field", Checkland and Holwell [1998] confirm the need to define these important basic concepts rigorously. Firstly, many definitions exist and they differ in ways that may be significant. Secondly, it is important to agree as to what the terms mean, not in order to impose terminology [Checkland and Holwell, 1998: 88] but in order to ensure that you *can* differentiate between the underlying concepts, share this common understanding and go on to explore the ideas further. This is an important justification for including detailed definitions of each term even though it is likely that these will continue to be used informally and loosely in practice.

The development of more advanced Management Information Systems, Strategic Decision Support Systems, and Knowledge Management Systems and entirely new forms of technological support for all levels of employees are discussed very briefly in Chapter 4 to illustrate why the definition of basic terms in Information Systems is undergoing subtle and frequently unacknowledged change.

In this chapter the basic terms are discussed in more detail than is customary. The different aspects which are identified are classified according to the various ontologies identified in the research framework in Chapter 2.

Some aspects of the complex definitions that are developed indicate an objective, realist, view of the world and imply that data, information and eventual meaning are based entirely on undisputed facts. The material being communicated is independent of the personal knowledge of the individual who receives them, and needs no interpretation. The implication is that all persons reading output produced by information systems will understand it in exactly the same way, make the same decisions based on it and will be in complete agreement.

Other aspects of the definitions emphasise the individuality of each person and support a subjective, nominalist, ontology. Here the belief is that no two people will understand a report in exactly the same way, as no two people have exactly the same background of experience and prior knowledge. Thus, the material being communicated is interpreted by the recipient according to his lifeworld, prior experience and knowledge. In addition, these aspects recognise that information systems do not need to be restricted to mechanistic, functionalist systems and hence will include material that is not purely factual.

Some aspects reflect a socially constructed reality in which we recognise that society is based fundamentally on the ability of people to communicate with one another. Hence, there are pre-existing, shared, meanings, or shared meanings can be reached by means of discourse. The material is communicated with the express intention of sharing meaning.

Each of these points of view is illustrated by means of definitions and quotations, obtained from texts in which computerised information systems are the main focus of discussion. Definitions are rarely examples of a single unadulterated view but include aspects of more than one.

3.3 Data, capta and information

Classically, in introductory texts on Information Systems, information is considered to be the output from an information system, with data (raw, unprocessed, collected “facts”) being input. This is a very simplistic view and is often qualified by saying that the information only becomes useful if it is in context and is meaningful.

3.3.1 Definitions of data

“Data: A representation of facts, concepts or instructions in a formalised manner suitable for communication, interpretation, or processing by humans or by automatic means.”
(Hicks [1993: 668] quoted by Checkland and Holwell [1998])

Three aspects of data can be identified. These correspond with the three ontologies, realism, nominalism and socially constructed reality and the corresponding beliefs about physical and social reality (objective, subjective or intersubjective). As a result they emphasis the different possible roles of data, namely, to:

- Record objective facts which will be understood in exactly the same way by everyone;
- Record absolutely any type of concept, with no guarantees as to its accuracy or validity, which will be interpreted in all sorts of different ways by individuals;
- Use agreed structures and conventions for representing information, recording it and transmitting it, all in order to communicate it.

The objective view tends to assume that all data processing will be automated. The subjective view is very different in that it emphasises that if data are processed using a computer, the output is still only more highly structured or reformatted data. The intersubjective view allows for the possibility that data may be processed either by computer or directly by a person.

3.3.1.1 The objective point of view of data

The objective view makes the following assumptions about data.

- They are factual, resulting from recording of measurable events, or objects.
- They record particular instances of reality.
- Introna [1992: 2.42] takes a purely objective view of data, proclaiming them to be *“Aperspectual, ahistorical, acontextual”*.
- They are explicit as they are in a fixed, recorded form.
- Hence, they can be communicated digitally.
- Modern society generates enormous amounts of data that record details of individual events and objects.
- This objective point of view accepts that the data are validated in the sense that they must be measured and recorded accurately. Certain logic checks as to the reasonableness of the data can be done to try to determine whether the data capturing instruments or processes have failed. Data can be shown to be true if they correspond to reality.

The definitions that follow are examples of those that refer only to the objective characteristics of data:

“Data represent unstructured facts.” (Avison and Fitzgerald [1995: 12] quoted by Checkland and Holwell [1998])

“Data: Facts collected from observations or recordings about events, objects or people.” (Clare and Loucopoulos [1987: 2] quoted by Checkland and Holwell [1998])

“Data: The raw material of organizational life; it consists of disconnected numbers, words, symbols and syllables relating to the events and processes of the business.” (Martin and Powell [1992: 10] quoted by Checkland and Holwell [1998])

3.3.1.2 The subjective point of view of data

On the other hand the subjective view makes the following assumptions about data.

- The data are not necessarily true or accurate as not all errors can be detected automatically and not everyone will necessarily agree that they are a true representation of a particular fact.
- Some data record subjective opinion, not facts. If data can represent opinions and concepts, they are not truly objective.
- Data represent information and are the only way we can make information explicit.
- Nothing but data can be communicated digitally or in any other way. Only data are transmitted, be it by means of a telecommunications medium, in printed form, or directly without using any technology.
- Data have absolutely no meaning. They acquire meaning only when appropriated by a human recipient.

The definitions that follow are examples of those that include subjective aspects. These definitions include characteristics which have been highlighted as being objective or intersubjective as well.

“Data: Natural language: facts given, from which others may be deduced, inferred. Info. Processing and computer science: signs or symbols, especially for transmission in communication systems and for processing in computer systems, usually but not always representing information, agreed facts or assumed knowledge; and represented using agreed characters, codes, syntax and structure.” (Maddison [1989: 168] quoted by Checkland and Holwell [1998])

“By themselves, data are meaningless; they must be changed into a usable form and placed in a context to have value. Data becomes information when they are transformed to communicate meaning or knowledge, ideas or conclusions.” (Senn [1982: 62] quoted by Introna [1992])

3.3.1.3 The intersubjective point of view

- The purpose of data is to permit communication.
- Information exists before data. Some version of that information can be retrieved from the data.
- Data must be recorded in a formalised structure and knowledge of this structure must be shared as prior shared meaning. They cannot be totally unstructured or no-one would ever be able to process them, but they can be reorganised into more complex structures during subsequent processing. The structure will result from language syntax and semantics if the data are in the form of text, or in the case of numeric or symbolic data, will depend on the predesigned layout of database records, forms or even the position of the data on a physical object. (We know something about what a number plate denotes from its position on a car even if the format is unfamiliar.)
- They are represented using agreed characters, codes, syntax and structure. A predetermined, agreed way of coding and decoding must be associated with this representation. A stream of bits is not data unless someone has the key by means of which it can be decoded.
- The fact that data are both recorded and have some structure makes them potentially useful - they are in a form suitable for subsequent interpretation and processing. Other information can be inferred and deduced from them and they can be associated with other data. They have potential meaning.
- They have an implied context and history. If the data have been captured or a procedure exists to capture them, a purpose has already been recognised.

Example definitions:

“Data: Facts, concepts or derivatives in a form that can be communicated and interpreted.” (Galland, [1982: 57] quoted by Checkland and Holwell [1998])

“Data are formalized representations of information, making it possible to process or communicate that information.” [Dahlbom & Mathiassen, 1995: 26]

3.3.2 Definition of *capta*

In Checkland and Holwell's terms [1998] the objective facts are data before they are captured but *capta* once they have been captured as part of an information system or even in interpersonal communication. Hence, what is generally considered to be data, the input to a computer program, is not data but *capta* as it has a specified format, has a purpose, is meaningful to the program and has context. The data are thus the vast numbers of objective facts that exist in the universe and that could be measured and be collected. The *capta* are those that have already been identified as worth collecting and for which a form of representation has been chosen. The process of selecting *capta* from the data is a mental one and may be done subconsciously. This process is generally simply a matter choosing to pay attention to particular facts. *Capta* are richer than data as they are recognised as relevant (which implies that they are in a context). The fact that context and potential or actual meaning adds to the richness of data is included in many of the definitions of information found in introductory texts for Information Systems students, for example, Lay, Eccles, Julyan and Boot - The principles of business computing Fourth edition [1993:535] and Avison and Fitzgerald [1995:12] quoted by Checkland and Holwell [1998].

Unstructured text such as is found in e-mail and newspapers may be closer to Checkland and Holwell's concept of data, as it is left to the processor (that is, the human reader or receiver) to decide what to use and how. Processing is not specified or automated.

Those data which an individual (or system) considers to be of interest and hence pays attention to are selected and become **capta**. However, Checkland and Holwell say that processing may be more complex and the data may be classified, that is, associated with other data [1998: 89]. There is, however, some ambiguity in this regard as this is subsequently described as meaning attribution and occurs when *capta* becomes **information**.

3.3.3 Definitions of information

Definitions of information depend on the way in which the term "data" is defined. The major point of difference is whether information can be produced by an automated process and how this information, which is also digital, recorded and can be transmitted, differs from data.

3.3.3.1 The objective point of view

- Information is output from a computer program.
- The systems analyst decides what output will be useful. This output remains useful and meaningful regardless who the recipient is.
- The processing which produces the information includes summarising in order to reduce the volume of data.
- Data may be associated with other data, which may be obtained from different sources, to produce the information.
- The processing (classifying, linking, summarising, sorting, presentation) adds value in the form of potential meaning. The less structured data are less useful and less meaningful than the more structured information.

In the definition that follows “a meaning” seems to imply that the meaning is fixed and not open to interpretation and, therefore, this definition refers only to the objective characteristics of information:

“Information has a meaning ... (it) comes from selecting data, summarizing it and presenting it in such a way that it is useful to the recipient.” (Avison and Fitzgerald [1995: 12] quoted by Checkland and Holwell [1998])

3.3.3.2 The subjective point of view

- Data become information only once they have been appropriated by the human recipient. Hence, the output from any computer program is still data.
- The added value of information (compared with data) results from the recipient appropriating the new data, interpreting them and placing them in context by combining them with existing personal information.
- Some authors consider data to be information only if they are used by the recipient in making a decision.
- Data become information only if they include something previously unknown to the recipient.
- Introna considers information to be historical, contextual and perspectual [Introna, 1992: 2.42]. It is moulded by the life experience (erlebnis) to provide understanding.

The definitions that follow are examples of those that include subjective aspects. These definitions also include some characteristics which are considered to be objective or intersubjective.

“Information usually implies data that is organized and meaningful to the person receiving it. Data is therefore raw material that is transformed into information by data processing. Information can be defined in terms of its surprise value. It tells the recipient something he did not know.” (Davis et al [1985: 30] quoted by Introna [1992])

“Information: (1) Data that has been transformed into a meaningful and useful form for specific human beings. (2) The meaning that a human assigns to data by means of the known conventions used in its representations.” [Lay et al, 1993: 535]

“Information is that which results when some human mental activity (observation, analysis) is successfully applied to data to reveal its meaning or significance.” (Galland [1982: 127] quoted by Checkland and Holwell [1998])

“Information is the particular instances of reality as experience, perceived or understood by an individual in a specific context.” [Introna, 1992:2.37]

“... information comes into being as the receiver appropriates the data and gives it meaning” [Introna, 1992: 2.39]

3.3.3.3 The intersubjective point of view

- Aspects of shared meaning and discourse (validity claims [Braaten, 1991: 14]) are characteristic of this point of view.
- The recipient has participated in the systems analysis and hence has influenced the process and has said what output was likely to be meaningful to him and others using the system.
- More advanced, database-oriented, systems allow the user to formulate queries and interact directly with the data in the database. Hence, there is a more dynamic process where the user’s judgement is combined with the power of the technology.
- Information “has meaning” which can be communicated versus “is meaning” in the objective point of view.
- Information must be put into some context “... in order to understand something, we already need a preliminary understanding of it” [Dahlbom & Mathiassen, 1995: 32]. This

preliminary understanding must be shared in order for a new shared understanding to result.

preconceptions plus information = interpretation => knowledge

“To produce information we have to interpret what we experience and make explicit what we know.” [Dahlbom & Mathiassen, 1995: 26]

3.4

Discussion

There are a number of levels of information which are used in different ways and carry different kinds of meaning. The fact that these are all commonly referred to as information can be confusing.

3.4.1 Information¹ - lean information

The first sort of information is data (or *capta*) which has been processed electronically (summarised, sorted, classified, analysed or simply collated and associated with other appropriate data), reformatted and made available to someone who is expected to find it meaningful and useful (and may act on it). The processing associated with the production of this type of information is mechanistic and procedural and can be described by an algorithm. The processing is done deliberately in order to add value. Since this processing was not done by a person, in Checkland and Holwell's terms [1998] this is still *capta*. In Habermas' terms this type of information is the manifestation of functional rationality (administrative systems).

The intention is, therefore, that:

- The information will be used to initiate action or decisions within a clearly delimited scope of function and time, or should be available when action and decisions are required. Its purpose is unambiguous.
- Hence, it generally has a short useful life.
- It has a limited readership for whom it is meaningful and who are authorised to access it. The person who creates the specification of the program that will produce this type of information, specifically intends to produce information that the reader will react to and has a relatively stringently defined target group in mind who is expected to be very familiar with the context and share the frame-of-reference.
- The information is necessary either because it is not already available or to reduce uncertainty by confirming facts.

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- Provided that the context is explained, this information is not ambiguous. For example, the trade deficit may be given in a recognised format, for a specified currency, for a specified country, on a certain date, calculated according to a procedure for which a description and explanation are available.
 - It is specific, not universal, and hence acontextual, ahistorical and not perspectual leading to local knowledge (functional rationality) rather than wisdom or universal knowledge (theoretical rationality).

3.4.2 Information² - rich information

What then is the type of information that is not the output from a computer process, such as information in newspapers and text books - text which is intended to inform? Is the difference between Information Systems and Information Science which of these two types of information the subject tries to make available or accessible? This 'information' has been carefully put in context (explained) and a human has done this processing but it is in artifact form (the information is printed on paper or displayed on a computer screen) and is a commodity. In Checkland and Holwell's terms this is still *capta*, as it is external to the human mind. In Habermas' terms, the intentional behaviour which produces this type of 'information' may be strategic or communicative action and the communicative rationality would be authentic self-expression referring to the aesthetic sphere. It might be instrumental if it consists largely of instructions such as a manual or recipe book.

This type of information, which will be called Information², has the following characteristics in comparison with Information¹.

- It is not as likely to initiate immediate actions or decisions as Information¹ but is intended to initiate thought and to influence the reader by altering his lifeworld.
- It is produced deliberately for a purpose but this purpose has less well-defined scope and the expected outcomes are less specific.
- It has a wider readership. (The newspaper is not prepared for one specific reader, it is prepared with the intention to inform.)
- It is relevant for a longer period.
- It is less structured than information produced by a computer and has more complete sentences and fewer tables.
- It handles more of the type of information which is "soft" and cannot easily be expressed in terms that are exact or precise. Hence, readers need to interpret the information to a greater extent than the first type. It is for this reason that it is likely to contain more redundant information and that the context is usually explained in greater detail - except where it is assumed that the context is already known, in which case the information may be very difficult for "an outsider" to understand.

- It handles more complex information, where more explanation is required. (Although this might not be considered to be discourse because it is not interactive or a dialogue, it can certainly present one or more sides of an argument and try, by force of the better argument, to convince the reader of a particular “truth”.)
- It is sometimes specific but may also attempt to explain universal “truths”.
- It is perspectival in the sense that most complex information, formulated by a person, includes that person’s perspective, slant, or bias.

The two types of information are related: Both are intended to present facts (and in the case of Information², may include opinions) in a form which will probably (hopefully) communicate meaning to the recipient. In Information¹ ambiguity is avoided. In Information² ambiguity may be inevitable and is sometimes courted. Information¹ is “lean”. Information² is “rich”. The more subtle and equivocal a text is, the richer it may be considered to be. It is easier to refer to both lean and rich information as information even before it is appropriated and hence, for the moment, neither Introna’s nor Checkland and Holwell’s terminology is used.

Both Information¹ and Information² are processed data in a sense. In the one case, a computer has done predetermined calculations and processing to produce the information. In the second case, a person has either intuitively or deliberately processed the information and combined it with his or her unique world view, possibly analysed, synthesised or evaluated it but definitely expressed it in an individual way. As with all aspects of technology, appropriate fit between the task and the technology is important although it is not the only factor involved in adopting a specific technology. Rich information corresponds largely with “thick information”.

“In fact in one area - so called thick information - management technology can be dangerously limiting. As defined by Henry Mintzberg of McGill University, thick information is irrational, subjective, intuitive knowledge that transcends what can be categorized on an MIS report.” [Davidow & Malone, 1992 : 170]

3.4.3 Information³ - appropriated information

When a human acquires information and mentally processes it, some form of learning occurs. The user or acquirer of information relates it to existing knowledge and information and a third type of information results. During this process meaning is attributed to the information. It is possible to assimilate isolated facts but it is easier to remember information that can be related to an existing mental landscape (or a world view, or mental model). Information³ is personal and mentally stored and has meaning. This is the richest information. It is impossible to express it exactly and completely. Hence Information³ cannot be transferred. It may change from day to day. It probably does not correspond entirely with anyone else’s version. How it is structured is unknown. The creation of Information³ is the process of learning. Further learning can occur

without further input of Information², as the learner restructures the information and associates it with other personal beliefs, values and knowledge. This is the 'true information' according to Checkland and Holwell [1998] and Introna [1992].

Introna [1992] explains the process of developing understanding in terms of the hermeneutic circle. Interpretations of text follow a cycle in which a new element is interpreted alone and then in terms of the larger text. This results in a re-interpretation of the meaning of the text as a whole. The new element may then be re-interpreted in terms of the new understanding of the complete text. Thus, the individual starts off with certain prior knowledge or prejudices in order to form an initial understanding of a text. This new information is then related to the larger context of the learner's lifeworld (traditions, economic and social situation) and he arrives at a new understanding of the lifeworld. New understanding now influences the more particular interpretation of the text and this will be modified. Once again the modified information will be related to the broader context, and once again this might be adjusted to reach a consistent view. This process will continue until the new information and the larger picture no longer have any inconsistencies.

3.4.4 Information⁴ - tacit information

Certain types of information are more difficult than others to put into words. Tacit information may be difficult to verbalise. In fact some skills, such as balancing while riding a bicycle, do not

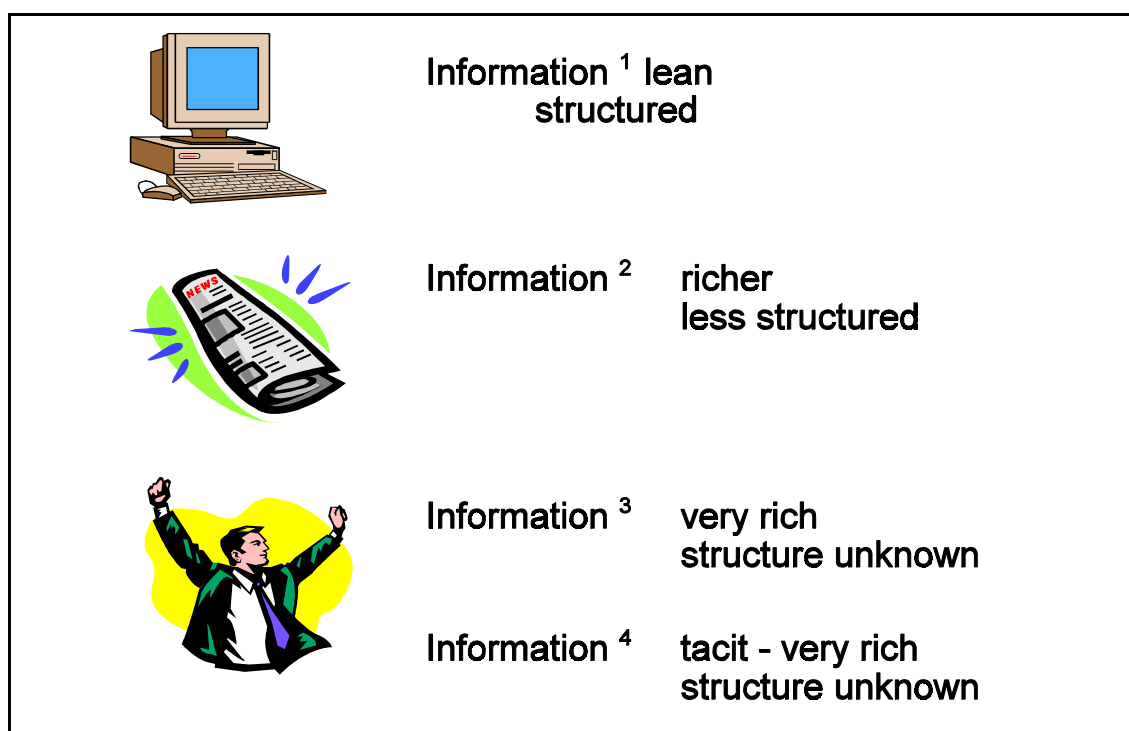


Figure 3.1: Taxonomy of types of information

seem to have words that describe them. Hence, this information is usually imparted by demonstrating it and by the recipient learning by trial and error or practising the skill.

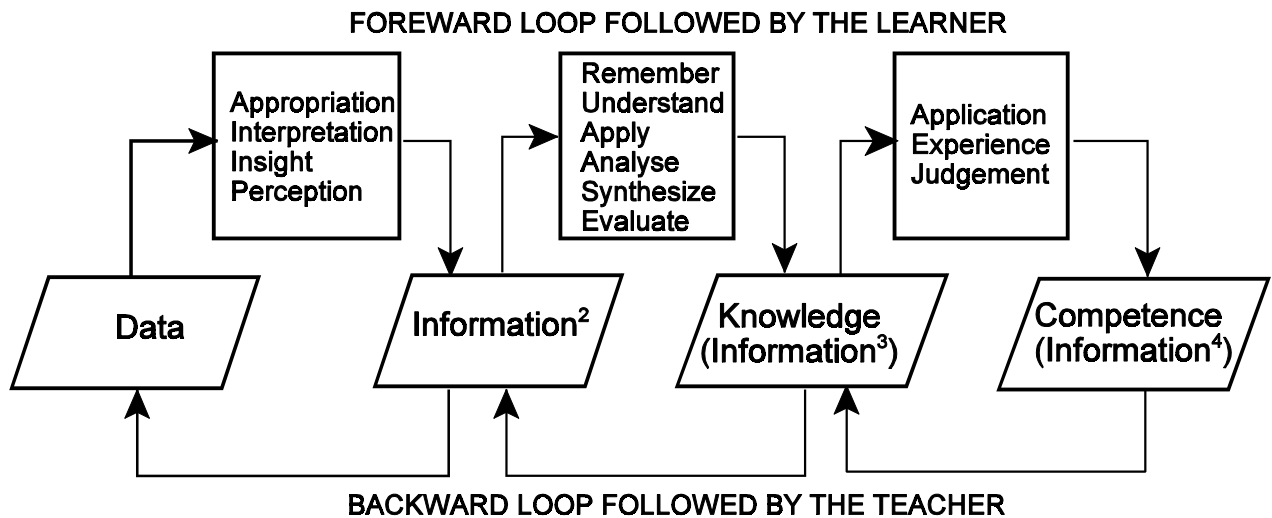


Figure 3.2: Adapted from De Villiers [1995: 83] Model of the teaching and learning process

Another type of interpersonal communication that it is difficult to achieve in formalised exchanges of information is “brain storming” , (problem solving where a small team or only two people exchange ideas). These may often be verbalised as fragments of conversation which do not seem to make a lot of sense when transcribed and where leaps of logic are particularly fruitful. The term “on the same wave length” seems to imply the idea that the participants have evoked already existing, matching, world views. Hence, they need fewer words to refer to a concept that they share and may naturally relate concepts that they both consider are appropriate. Eventually they will arrive at a conclusion or solution that they both find satisfactory.

This creative problem solving is not considered by this author to be tacit. It stems rather from having a compatible background and language of practice (a large degree of existing shared meaning) but is also stimulated by fast response and even interruption so that concepts are moulded before “they set”. Intron [1998] is concerned with the fact that cooperation needs this type of intimate and rich communication and that this will be impossible to achieve in technologically supported environments. This seems to point to Information⁴, which is tacit. Figure 3.1 illustrates the four types of information.

3.4.5 Making Information³ explicit

When a person expresses Information³ as words, music or anything else, it becomes Information². It loses part of its context, its meaning is once again only potential, it may not be

well expressed and hence be prone to misinterpretation. This is explained by Dahlbom and Mathiassen [1995: 33] and illustrated in Figure 3.2, based on a diagram in De Villiers [1995: 83]. Mingers [1995], using Dreske's terminology, refers to this as making analogue information digital. Codified information, that is, Information¹ is by definition already explicit and is, therefore, easy to copy and has little natural protection. Tacit information, because it is very difficult to capture and make explicit can be lost permanently when, for example, an experienced member of staff retires [Chesbrough & Teece, 1996].

3.5 Meaning and learning

3.5.1 Personal meaning

Meaning is closely related to learning and knowledge. It is the result of a personal process where an individual converts information to a form which is related to his own world view. Hence, it is a purely human aspect of information processing which occurs when an individual extracts meaning from Information¹ or ². He appropriates it, relates it to existing Information³ and converts it to Information³. Appropriation is the hermeneutic process during which new information is incorporated into the larger structures of existing, personal information. Mingers [1995] refers to a process of conversion of information from an analogue form, reflecting objective reality to a digital form. (Mingers acknowledges Dreske as the originator of this concept.) This is a not very accurate way of explaining the loss of information that occurs as a result of the filtering process that is an unavoidable part of appropriation. Not all aspects of the available information can be appropriated, whether the input is in the form of Information¹, Information² or the analogue form provided by our senses during direct observation of an event.

Interpretation is an essential activity in understanding and converting Information¹ and Information² into the personalised information which is part of one's world view and frame-of-reference. It is coloured by prejudice, as the existing Information³, which includes prejudice, is used in the process of understanding (interpreting) the new information.

What is information for some people would be meaningless to others. In this case it is not even *capta* as there is no way that the person (or procedure or computer) can use it. Just as a file whose data structure is unknown is useless or a telephone conversation between people who do not speak a common language cannot inform either of them, so information that does not get understood is of no value. Information which has not been appropriated by a user has no meaning, it only has potential meaning - as music not only needs to be played but also heard.

Mingers [1995] identifies different “levels of meaning” which are developed progressively during the reception phase in a meaning system. These are processes during which meaning is constructed or information is interpreted. The first is understanding, and corresponds largely with appropriation as described above.

“...in which the receiver comes to understand the primary meaning of a sign or linguistic message. ... This is the level of meaning that can be expected from all competent speakers of a language. that is, the digitalized information without the analogue message” [Mingers, 1995: 299].

The second is connotation, during which other meanings, beliefs and implications, which are associated with the new information are recognised. This includes nested consequences, that is, recognising predictable subsequent events. It seems that Mingers sees this as association of the new information with the subset of Information³ which can be considered to be objective, uncontested, factual information. The third level of interpretation is intention. Here the individual meaning and implications of that meaning for action are developed. Hidden meanings in text or messages that are deliberately equivocal, or where meaning is implied or hinted at rather than being stated unambiguously, are revealed here.

Each level of interpretation in fact adds “richness” and meaning to information which may originally have been quite scanty and “lean”, either because that was all that was available, or because of the filtering that took place during appropriation. The more Information³ that is available, the more efficient the appropriation process can be - the less new information has to be absorbed.

Mingers also identifies a second phase, the production phase, in which the information which has been interpreted during the reception phase is applied or generates action.

3.5.2 Shared meaning

The description of meaning given above indicates that meaning is unique in that no two individuals will possess the same version of Information³. What then is meant by “shared meaning”?

Habermas' concept of societal rationalisation has as its essence the idea that:

"... the social construction of social reality is part of the process of social change. Social reality is constructed through what Habermas calls communicatively rational action, or communication between participants attempting to reach a rational consensus. ... Communication, according to Habermas, is inherently oriented towards mutual understanding, and the standards that govern communication are therefore conditioned upon reaching mutual understanding and, ideally, rational consensus (CES, 3)." [Braaten, 1991: 13]

"This mutual commitment enables one to recognize one's own and the other's respective places in an intersubjective shared world;" [Braaten, 1991: 14]

Thus, the whole concept of society and the way in which it develops is, according to Habermas, based on members of society reaching consensus, that is, sharing meaning by means of rational discourse. This relies on the ideal of "ideal speech" which allows rational discourse by requiring all interested parties to be allowed to participate in the debate and to be heard and that the final consensus be based solely on the force of the better argument. The ideal strives, therefore, for a situation where everyone has the same Information³, at least as regards truth and norms. This is, however, an unattainable ideal. The best we can achieve is a narrowing of the gap between different lifeworlds and interpretations. A double hermeneutic process can be said to occur here in which I interpret (within my own lifeworld and coloured by my own prejudices) what you say. But what you said was an inexact (digitalised in Mingers' terms) version of your interpretation of reality. It is even possible that the recipient of a message will not only ideally reconstruct the meaning and hence understand exactly what she is told but might also understand **better** than the originator of the message because the existing knowledge which she possesses may be greater or more relevant than that of the originator.

The four types of social action named in Habermas' Theory of Communicative Action, namely instrumental, communicative, discursive and strategic provide a different way of classifying information according to the purpose for which it will be used. Hence, Mingers' process of interpreting the intention of information or a message is relevant as it will indicate which type of discourse is appropriate if it is necessary to challenge the information or even to seek further explanations.

- Instrumental action is where the actor considers the opponent to be an object or instrument. The message is likely to be in the form of giving instructions or orders. Reference to the context must be part of the message.

- Communicative action sees both the communicator and recipient as actors in the social context and has the purpose of achieving and maintaining mutual understanding. This implies a need for clarity, completeness, contextuality and truthfulness of the message. Validity claims are made in terms of the truth, rightness or sincerity (or truthfulness) of the argument. (Comprehensibility is also sometimes included but this seems to be related more to the concept of ideal speech whereas the validity claims are based more on the content of the argument.)
- Discursive action occurs when two actors do not agree and hence involves debating an issue. Since the arguments need to be understood by the opponent, clarity, completeness and context are important. In addition a rational outcome cannot be achieved unless all interested parties are allowed to contribute and their arguments are judged fairly.
- The last of the communicative actions is strategic, where the actor is trying to achieve an advantage by influencing others. There is some similarity between strategic action and instrumental action as in both the actor is not engaged in a dialogue. None of the validity tests need apply to strategic action.

Mingers has related his levels of meaning to Habermas' validity claims as shown in Table 3.1. Information¹ is most likely to be the basis for instrumental action (uncontested factual information leading to action). Communicative action requires rich text messages, that is, Information². Discursive action may require both types (1) and (2) to achieve clarity, completeness and context. Strategic action depends least on facts and most on how the message is formulated and hence is definitely Information².

Table 3.1: Mingers' levels of meaning related to Habermas' validity claims

Mingers' levels of meaning		Habermas' type of social action	Habermas' validity claims
reception	understanding	instrumental, communicative, discursive	comprehensibility
	connotation	communicative	truth rightness
	intention	strategic	sincerity
production	intention	instrumental communicative, strategic, sincerity	
	generation		truth rightness effectiveness
	action		

3.6

Learning

3.6.1 Introduction

Maturana, as quoted in Winograd and Flores [1987: 45] defines learning as follows:

“Learning is not a process of accumulation of representations of the environment, it is a continuous process of transformation of behaviour through continuous change in the capacity of the nervous system to synthesize it.”

“Learning is a change in behaviours as the result of experience” [McNally, 1977:14]

There is a definite relationship between the process of learning and the one of developing meaning. Meaning has to be developed during all human activity, be it while listening to the news on the radio or simply recognising that the cat is asking for food when it rubs itself against your legs as you are making coffee in the kitchen early in the morning. In order to learn one must develop meaning but not all construction of meaning is recognised as learning. Learning implies that there is influence from outside in the form of new information and a definite outcome. Generally someone learns to do some specific thing or learns about a specific topic. Hence, there is often a conscious goal to understand a particular topic or master a particular skill. Sometimes there is a teacher who is deliberately assisting the learner in the process. The intention of learning is to retain the new skills and knowledge developed.

Alternatively one could view learning as the more advanced levels of mental processing beyond simply trying to interpret fairly unambiguous messages. Meaning is constructed during all levels of learning but is also involved at a level that is considered to be more temporary or more superficial than learning.

3.6.2 Philosophies of knowledge acquisition

3.6.2.1 Introduction

There are a variety of theories associated with education. These include theories of the development of the child (for example, Piaget), ways of classifying activities associated with learning (Bloom's taxonomy) and theories that set out to explain how people learn.

Learning models can be classified as being behavioural or cognitive and can in turn be associated with the different beliefs about physical and social reality (that is, objective, subjective or intersubjective). An example of a behaviourist learning model is Objectivism. Constructivism and socioculturalism are both cognitive models but emphasise the subjective and intersubjective points of view.

3.6.2.2 Behaviourism

Behaviourist models of learning follow the ideas that originated with Pavlov and were continued by Skinner. The central idea is that learning occurs as a result of the learner recognising a stimulus and responding in a predictable way. The use of positive reinforcement (rewards or praise) when the required behaviour is exhibited encourages the learner to react in this way whenever the stimulus is encountered. This theory is built on the supposition that there is an objective world that everyone will perceive in the same way and that everyone can be taught to react in the same way. Hence, teaching and learning involve a transfer of knowledge which will result in the learner eventually obtaining an exact copy of the knowledge of the teacher. The teacher is in control of the process. This theory assumes that "... *the purpose of the mind is to act as a mirror of reality rather than as an interpreter of reality.*" [Leidner & Jarvenpaa, 1995]

Amongst these models are those referred to as Objectivist [Leidner and Jarvenpaa, 1995]. In the learning of Mathematics, Platonism and Logicism view reality as being objective [Matthee, 1998]. The objectivist approach is the one mostly used at tertiary level. Lectures are a good example of teaching according to such a philosophy. This approach assumes that students learn best in locations, such as classrooms, which are removed from outside distractions and that intensive study for relatively short periods is most effective, such as hour-long lecture periods. Leidner and Jarvenpaa [1995] suggest that this approach is most suitable for factual or procedural-based learning.

Variations of the basic Stimulus-Response theory exist. Thorndike proposed three primary laws which determine whether learning takes place [De Villiers, 1995]. Firstly, the learner must be ready (presumably this includes physical maturity as well as motivation). Secondly, the association must be built and strengthened as a result of practice and repetition. Finally, the outcome must be rewarding.

3.6.2.3 Constructivism

The Constructivist philosophy, as explained by Alavi [1994], says that learners must be actively involved in the learning process. The learners acquire, generate, analyse, manipulate and structure information in order to construct knowledge. Information forms an essential basis for learning. The new Information² must be interpreted, elaborated on and related to other Information³. Thus, a relatively subjective view of reality is adopted as each person's reality is different. This approach is learner-centred with students controlling the pace and formulating their own questions. Nevertheless, most constructivists acknowledge the existence of an objective world and believe that learning involves a hermeneutic process in which new information is interpreted by the learner. The interpretation is coloured by his existing prejudices but is then compared with the different interpretations offered by others (teachers, classmates or reference books). The learner will gradually or incrementally adjust his personal interpretation until, ideally, the subjective reality for this particular piece of knowledge is very close to the universal objective reality.

“Gadamer’s point would seem to be that anything new can only be understood in terms of what one already knows. The first step in understanding is based on what one already knows or the tradition within which one finds oneself. If the process of understanding stops after the first step then, yes, it is subjective. But if one continually opens oneself to the text and continually re-evaluates one’s understanding against the text, one will be able to complete the meaning through the process of understanding.” [Introna, 1992:2.23]

Piaget is considered to be primarily a supporter of constructivism as he emphasises the role of the learner in discovering knowledge and not the teacher.

Radical constructivists take a more extreme view as they believe that there is no shared understanding and that each individual discovers or constructs his own view of the world, building unique schemas. They sometimes go as far as to say that knowledge cannot be taught or learned from books [Thomas, 2000:87].

Even if radical constructivism is not accepted, constructivists recognise that different people have different learning styles and should be encouraged to consciously recognise this and hence improve their learning effectiveness and efficiency.

The following characteristics of constructive learning are derived from those given by Simons ([in Duffy et al, 1993] cited by De Villiers [1995:79]).

- The learner must be *actively* involved.
- The learner will interpret the new information in the *context* of existing information.
- The resulting knowledge will, therefore, extend existing knowledge as additional meaning is *constructed*.
- The learner must be aware of the *goals* towards which he is working.
- The learner must ensure that he is still on course and *progressing* towards the goal.
- The learner must be *conscious* of his way of learning.

There is no real reason why these requirements cannot be achieved in a lecture but it is the learner who must actively participate during the lecture. The lecturer cannot ensure that this learning occurs. However, this approach is well suited for topics where relationships can be determined, multiple representations compared and a real-world context explored. It is not suitable for acquiring a fixed set of preordained, factual knowledge [Leidner & Jarvenpaa, 1995].

3.6.2.4 The sociocognitive learning theory of Piaget

The sociocognitive model is an example of constructivism. Piaget's writings illustrate how children naturally acquire skills and knowledge without having to be taught them. Piaget believed that all humans develop cognitive abilities in a more or less fixed sequence and at predictable times in their lives. Piaget did not set out to develop a theory specifically relevant to education or teaching but his work concerning the stages of intellectual development, as well as his explanation as to what kinds of intellectual structures can be formed at the various stages and how these are developed, is extremely relevant in this context.

Piaget identified two functional invariants which apply to all stages of intellectual development, namely adaptation and organisation. These concepts are closely linked to one another. Organisation refers to the intellectual structures or schemas (or schemata) that the learner develops and makes use of as strategies for solving problems. These strategies are reasonably specific (for example, schemas for doing addition and schemas for reading maps). More complex schemas are created by combining existing schemas. Hence, arithmetic can be combined with map reading to find the shortest route between two places.

“Thus as intellectual development proceeds, the individual’s schemas become more complex, differentiated and capable of greater generalisation to situations yet always organised and integrated.” [McNally, 1977:7]

The second functional invariant, adaptation, involves two activities, namely assimilation and accommodation. During assimilation data are input from the environment and interpreted in terms of current cognitive structures. The new data may not fit the existing schema exactly and accommodation occurs in order to adapt the schema and in so doing reconcile the most recent experience and the previous experience to an acceptable degree. In this way equilibrium is reached but this is a temporary condition as the human mind is constantly assimilating new data and accommodating existing schemata. In fact, this intellectual curiosity and adaptation of intellectual structures is a fundamental characteristic of mankind. It is important to note the difference between the schemas and the facts or content that a person remembers. The same facts will be interpreted or even be recollected differently if the schema being applied has been revised. Schemas are not typically forgotten whereas facts may be. Schemas correspond to some extent with tacit knowledge and may be difficult for the learner to explicate.

A description of the stages of intellectual development is unnecessary in this context since, at tertiary education level, all students can be expected to have reached the final stage, that of formal operational functioning, in which the individual can handle abstract concepts. At this stage the learner can use hypothetic-deductive reasoning and has a uniform logical system which can be used systematically to isolate variables and hence determine relationships between them. The learner is capable of understanding assertions or propositions independently of concrete examples and can examine these critically. When new concrete facts are assimilated, the learner can be expected to look at the circumstances from a broad perspective and associate information from other sources and obtained at other times. Hence, the learner can identify logical relationships and can integrate concepts, seeing how various factors and their relationships interact.

Since the learner at this stage does not need to work from concrete examples in order to understand concepts, the use of language, either spoken or written is used more in reasoning and learning than prior to this phase. (The student is capable of interpreting explicit, lean Information² into rich Information³ or tacit Information⁴.) Nevertheless, active participation by the learner in the learning process is still required even though it is not necessary that the learner is given as much practice in manipulating the concrete examples.

Richmond [1970: 94] says, “ ... *learning at any age needs contact with concrete reality. Piaget expresses this as follows: ‘The subject must be active, must transform things, and find the structure of his own actions on the objects.’ Piaget Rediscovered, p. 4)*”

Richmond [1970:108] says specifically that, even in the period of formal operations, "... [t]he need for contact with the concrete remains in order that potential generalizations may be modified." McNally [1977: 74] confirms this, "... he is clearly in favour of true activity methods, ..."

Piaget makes the distinction between figurative and operative aspects of knowing. Figurative knowing is associated mostly with the perception or image of the object and hence is fairly passive. It is the more superficial knowledge of the static, material characteristics of objects. The operative aspect is closely associated with meaning and is significantly influenced by the existing intellectual structures (schemas) and will probably result in adaptation of these structures. This type of knowing is more active, in that the learner assimilates the new data. It is encouraged by providing the learner with opportunities to actively interact with the environment. The learner discovers concepts by means of this interaction followed by reflection, leading to the formal abstraction of relationships [McNally, 1977: 101]. Figurative knowing is, therefore, likely to involve memorising, while operative knowing involves understanding.

The social interaction of the individual is an essential part of learning. Richmond [1970: 95] quotes Piaget as follows,

"... without interchange of thought and co-operation with others the individual would never come to group his operations into a coherent whole ..." (Intelligence, p. 163.)

and specifically advocates group work.

McNally [1977: 87] says

"The facilitative effects of interpersonal interaction on intellectual development are important for all levels of thought but become particularly important in adolescence with the development of formal thinking."

One aspect of intellectual development, from babyhood, involves the learner's concept of self, of others and ultimately of groups and interaction. Initially the infant has no real concept of either himself as an entity or others. In time he realises that objects have permanence, the objects can be people and eventually, at about the age of 6 or 7, that he himself is also an object. An extremely important stage is reached when the child is able to imagine things from someone else's perspective, read social signs and master the concepts of social acceptance and rules. This has implications for learning as it is only by recognising a difference in opinions and perspectives that a learner will be motivated to accommodate them in his existing schema. Hence, we can trace a progression from subjective to objective to intersubjective, although at all times the concept of self is present. This final stage of intersubjective understanding is probably never entirely mastered and is linked to emotional maturity as well as intellectual maturity. It is this skill that is extended and exercised during the collaborative learning and virtual teamwork that is the subject of the research in this thesis.

Piaget's concept of the stages of intellectual development has immense importance for what material is presented to learners at specific times during their education. Material which is too advanced, because relevant schemas are not available, will simply be ignored. Material that is too simple will cause boredom and the learner will lose interest. Hence, material must be moderately novel and above all the learner must be able to relate it to his previous experience and current cognitive structures [McNally, 1977: 11-12].

3.6.2.5 The sociocultural learning theory of Vygotsky

Socioculturalists believe that the ideal of subjective interpretations of reality being as close as possible to a universal objective reality is in fact not desirable. They emphasise the fact that a learner will only readily accept and understand concepts that he can relate to his own environment, culture and history. Each individual will also have a unique interpretation of reality which reflects his unique lifeworld. Vygotsky emphasises a social origin for learning. Thought is a form of "inner dialogue" modelled on interaction between people [Thomas, 2000]. Learning is seen as a social process that involves human beings in communication with one another. Hence, he advises that teams should be made up of more advanced learners and less advanced learners so that the learners can learn from one another. This is, therefore, a model that fits in with an intersubjective view of social and physical reality. Despite the fact that both sociocultural learning theory and constructivism are both cognitive models, they differ with respect to how closely the subjective interpretation should coincide with objective reality.

3.6.3 Bloom's taxonomy

Bloom's taxonomy of educational objectives [1956] is widely accepted and consists of two groups of objectives. The first is knowledge and the second consists of intellectual abilities and skills. He defines knowledge as "... *recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure or setting.*" [Bloom, 1956: 201]. This includes knowledge of: terminology, specific facts, conventions, trends and sequences, classifications and categories, criteria, methodology, principles and generalisations, theories and structures. Thus, this level includes the recall of highly complex and abstract concepts. Since the use of "knowledge" to identify this category of educational objective is somewhat misleading, I will refer instead to "recall".

The next group of objectives are those in which meaning is applied or constructed. "*The abilities and skills objectives emphasize the mental processes of organizing material to achieve a particular process.*" [Bloom, 1956: 204] The abilities and skills in this group are: understanding (comprehension), application, synthesis, analysis, and evaluation. Knowing the rules of a game

such as chess is at the lowest level, memorisation. Being able to actually play the game is at the next level. Being able to play well, by foreseeing the possible results of a move which may only be significant several moves ahead and thus planning strategies by planning several moves, would demonstrate the ability to synthesize information and analyse it. Choosing between different strategies shows an ability to evaluate.

The process preceding learning is the subconscious process of appropriation where information is decoded and part of it is selected for attention and further processing. Learning theories, such as that of Bloom, can be used in analysing the levels of constructing meaning which follow appropriation. The first level of learning involves remembering facts, at least in short term memory. Meaningless data can be remembered in the short term but they exist as a collection of unrelated facts which are difficult to recall. The new information must be related to existing information in long term memory in order for it to be accessible in future. Even if someone can recall an observed fact that seemed completely meaningless when it was observed and there is no explanation as to why that fact was remembered, it will be remembered in some context. This shows that some interpretation and association (some development of meaning) precedes any learning.

This appropriation is followed by a level of learning during which the learner applies the facts. Analysis involves further interpretation of the information. Synthesis involves associating it with previously acquired information. As was pointed out above, there is a certain amount of inherited information accessed by means of links between the new information and existing information. ("Nested in" is the term used by Mingers [1995] which he attributes to Dreske.) The highest level of Bloom's taxonomy is evaluation. Here inconsistencies or contradictions between the new information and existing knowledge are recognised and an attempt is made to reconcile them. During the reconciliation the original, lifeworld knowledge may be modified or the incoming information may be queried (practical discourse) until the inconsistencies can be resolved. This critical process is an essential process of learning and understanding.

During any learning, aspects of more than one of these learning processes will be required and there is a need to interpret information and associate it with existing information during all of them.

3.6.4 Conclusion

As is the case when defining the concepts of data, information and meaning, learning can be seen from a variety of perspectives. The consensus which most authors reach is that it is necessary to incorporate aspects of all the learning theories when teaching, although the choice of a specific strategy at any stage will depend on a number of factors.

“No particular model is the best approach; indeed, different learning approaches will be appropriate depending on the circumstances- course content, student experience, maturity, intelligence, and instructor goals, skills, and preferences, amongst others.
[Leidner & Jarvenpaa, 1995]

3.7

Conclusion to chapter

In this chapter the basic concepts required in order to understand how meaning can be shared were examined. In Section 3.2 it was noted that these concepts are used in a variety of academic disciplines. In Section 3.3, an attempt to define the terms began by reviewing how the concepts of data, capta, and information have been defined traditionally in the context of information systems. In a further attempt to understand what information is, different types of information were identified in Section 3.4. These are all capable of carrying meaning and different types can carry meaning which is more or less rich. (The idea of the richness of information will be explored further in Chapter 5.) Information¹ can be created by computerised information systems and is limited to factual information. Information² is communicated using any of a wide variety of media, recorded on an external medium or spoken. It may be equivocal, and make any of the three validity claims (truth, right or beauty reflecting the three spheres of

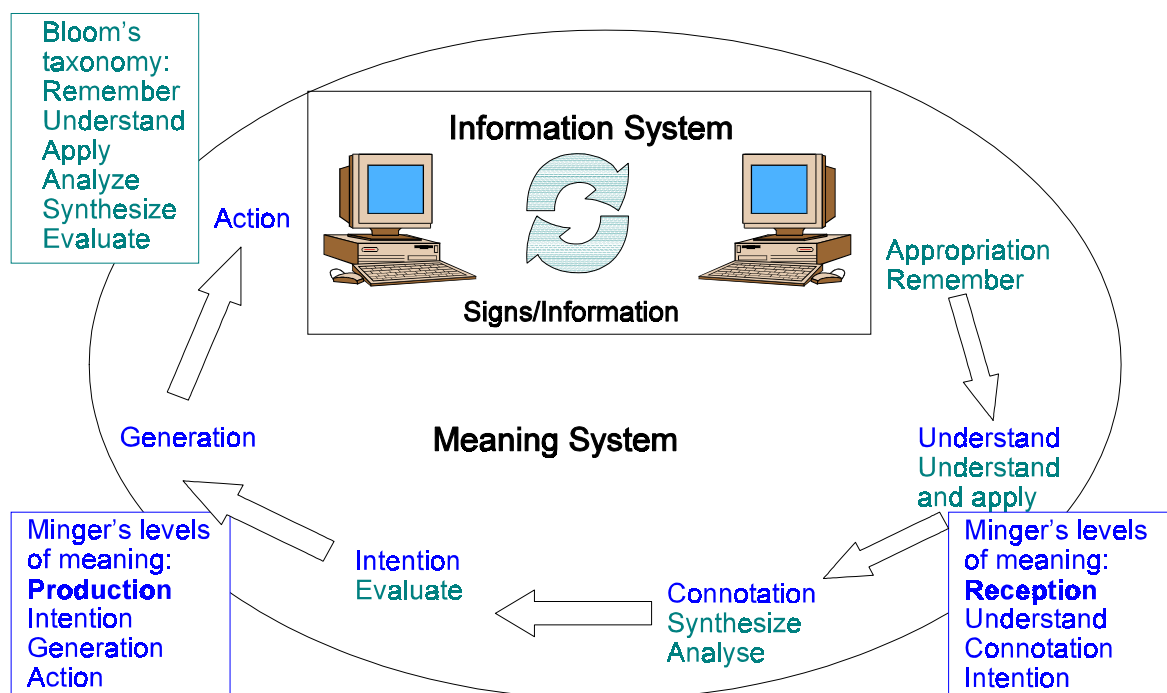


Figure 3.3: Information system as part of a meaning system
(adapted from Mingers [1995])

the objective world, the intersubjective world, and the subjective world). Information³ is the internal personal view of the world held by any individual and this includes tacit knowledge (Information⁴) which is difficult to make explicit.

In the discussion in Section 3.5 the relationship between information and meaning was explored. Basically information carries meaning but this meaning is only immediately accessible in the form of Information³ and Information⁴ and can only be communicated as Information¹ or Information². As shown in Figure 3.3 (adapted from Mingers [1995]) any Information System must be seen as part of a Meaning System and information systems must be designed with this in mind. The relationships between information, meaning and learning can also be detected by noting how different forms information are suitable for processing automatically (data and Information¹), communicating (Information¹ and Information²) and understanding (Information³ and Information⁴).

Three different models, namely the well-known data cycle, Minger's cycle showing levels of meaning - Figure 3.3, and De Villiers' cycles of teaching and learning - Figure 3.2, show that information which exists in digital or explicit form, is communicated, interpreted, initiates decisions, and may result in action being taken. The action may be in the form of communicating ideas or may result in new events, which are recorded in turn as further digital information or data.

As is indicated in the cycle of teaching and learning [De Villiers, 1995] there is a clear link between the discussion regarding information and meaning, and the processes of learning and teaching. This aspect was explored further in Section 3.6 by referring to learning theories and in particular the constructivist philosophy of learning which collaborative learning is based on. The research described in Chapters 7, 8 and 9 explores collaborative teamwork with respect to the effective sharing of meaning by dispersed or virtual teams. Hence, the research draws on this chapter in a variety of ways. It refers to theories of learning, the concept of communicative rationality and general ideas concerning information and how it can be communicated particularly when Information Technology is used in some way in the process.

In the next chapter this discussion will be continued by examining information from the perspective of the increasingly important role it plays in modern society. Hence, it will be studied from a more philosophical point of view relying on the insights obtained from Habermas and Giddens.