Spring 4-11-2011

Structured Reflection In Information Systems Teaching and Research

Mark Gregory
ESC Rennes School of Business, Mark.gregory@esc-rennes.fr

Irena Descubes
ESC Rennes School of Business, irena.descubes@esc-rennes.fr

STRUCTURED REFLECTION IN INFORMATION SYSTEMS TEACHING AND RESEARCH

Mark Gregory,
ESC Rennes School of Business, 2 rue Robert d'Arbrissel, 35065 Rennes Cedex – France
Email: mark.gregory@esc-rennes.fr

Irena Descubes
ESC Rennes School of Business, 2 rue Robert d'Arbrissel, 35065 Rennes Cedex – France
Tel: +33 2 99 33 48 55 Fax: +33 2 99 33 08 24
Email: irena.descubes@esc-rennes.fr

Abstract:

This paper contends that improved teaching and the emergence of research questions may be based on reflective self-observation, structured by means of personal knowledge management tools, often between and after cycles of action research. The paper revisits the concepts of data, information, knowledge, meaning and action. It proposes that knowledge be enacted in engaged teaching and research. It discusses how reflection on teaching and research can be structured as self-observation made visual in the form of concept maps. Concept maps are used both to illustrate learning and as a means of making initially personal knowledge more explicit, particularly in the early stages of inquiry and learning and particularly as part of an abductive logic of enquiry. Structured self-observation is distinguished from merely descriptive auto-ethnography by means of explicit model building informed by Ashby's law of Requisite Variety and Conant and Ashby's Good Regulator theorem. The method used to illustrate the paper's propositions is case-based reflection on a teaching situation. Similar reflection in the research context is additionally informed by a discussion of Checkland's LUMAS (Learning for a User by a Methodology-informed Approach to a problem Situation). We conclude by suggesting that enquiry may initially be informed by structured self-observation and then proceed by further learning, informed by theory and enacted in practice.

Key words: systematic self-observation, reflection and reflexivity in IS research and teaching, tools of inquiry and learning, personal knowledge management, concept mapping

1. Introduction

This paper has as its primary objective to engender debate on the ways in which:

- Relevant research propositions may emerge from a researcher's reflection on their own experience;
- Those propositions and reflection may be further developed by structured self-observation (SSO) as part of a process of inquiry and learning.

The authors' motivations lie in a desire to be engaged in relevant and even passionate research and related teaching.

The paper initially reconsiders the concepts of data, information, knowledge, meaning and action. It then addresses five propositions which have arisen as part of research in progress. The propositions are not, in isolation, novel; however taken together they have new impact. The propositions are these:

1. That knowing and doing are almost inextricably interlinked and meet in individual knowledge and action.
2. That in the early stages of the research process a powerful source of insight is reflection on the researcher's own knowledge and practice.
3. That that reflection may take the form of self-observation structured by means of model building; the modelling technique we highlight is concept mapping which explicitly distinguishes processes from concepts.
4. That effective teaching similarly requires reflection on the teacher's own knowledge and practice.
5. That Ross Ashby's law of requisite variety (Ashby 1956) continues to have value in justifying modelling in information systems teaching and research.

This paper is supported and illustrated by the analysis of a case: the teaching of an undergraduate module in business information systems analysis and practice. Revisiting the law of requisite variety arose or emerged from reflection on that teaching.

2. A context for reflection: our teaching and doctoral research

For both co-authors, the journeys of our working lives have started in the practice of business, proceeded to teaching and are continuing in doctoral research. The work-in-progress of one co-author has given rise to (Truong et al. 2009). The work in progress of the other co-author has previously been reported upon in (Gregory & Norbis 2008a), (Gregory & Norbis 2008b), (Gregory & Norbis 2009a) and (Gregory & Norbis 2009b).

Initially as practitioners, subsequently as teachers of long standing who both currently teach in a French business school and most recently as academic researchers engaged in doctoral studies in two rather different institutions (British network university and Czech traditional brick-and-mortar university), we consider ourselves to be knowledge workers who analyse, synthesise and teach existing knowledge and who seek to create new. In doing so, we also engage in metacognitive processes (Flavell 1976), that is, we build our personal knowledge concerning our own cognitive processes and learning-relevant properties of knowledge, information or data. In addition we are aware that the theory of the "adaptive unconscious" (Wilson & Dunn 2004) plays a significant role in an initial ***systematic self-observation SSO*** process (Rodriguez & Ryave 2002). According to Wilson and Dunn, a common source of self-knowledge failure is the adaptive unconscious: the inaccessibility of much of the mind to consciousness. Introspection cannot provide a direct pipeline to these mental processes, though some types of introspection may help people construct beneficial personal narratives.

We suggest that it is possible to speak meaningfully about introspection in academic research, that is, conscious mental self-observation as a purposive process relying on thinking, reasoning and analysing one's own cognitive processes. We posit that researchers engage in reflection – more or less inevitably biased by earlier experience – which then shapes the research process.

To contextualise and illustrate this proposition we firstly summarise an earlier paper (Gregory et al. 2010). In that paper, our starting point was literature based and our approach was to analyse existing work, to observe certain paradoxes, and to attempt to synthesise a clearer understanding of the relationship between data, information and knowledge. Reflection on the conclusions of that earlier paper and observation of our own work practices has led us to the five tentative propositions of this present paper.

3. Data, information and knowledge: an initial understanding

It is a long established common understanding that data is transformed into information, and information then feeds or becomes knowledge or even translates into further levels, these being understood and praised as wisdom (Ackoff 1999). In an earlier paper (Gregory et al. 2010) we argued that that sequence is limited and does not encompass the reality of systematic and pragmatic approaches to personal information management (PIM) and personal knowledge management (PKM) systems. We also pointed to an insufficient level of understanding of how to make the best use of personal information management systems to extend the power of knowledge workers to think and to create. In this paper we firstly summarise and then extend the discussion of that paper.

The relationship between data and information was initially established in the seminal work of Shannon and Weaver reported in the 1940s (Shannon 1948), (Shannon & Weaver 1949). (Floridi 2005) largely confirms what he identifies as the Dretske-Grice approach, that meaningful and well-formed data constitute semantic information, even as he adds as a qualification that they be contingently truthful. This is despite Claude Shannon's own later observation that "It is hardly to be expected that a single concept of information would satisfactorily account for the numerous possible applications of this general field" (originally written in 1953; see (Shannon 2003)). See also (Capurro & Hjørland 2003).

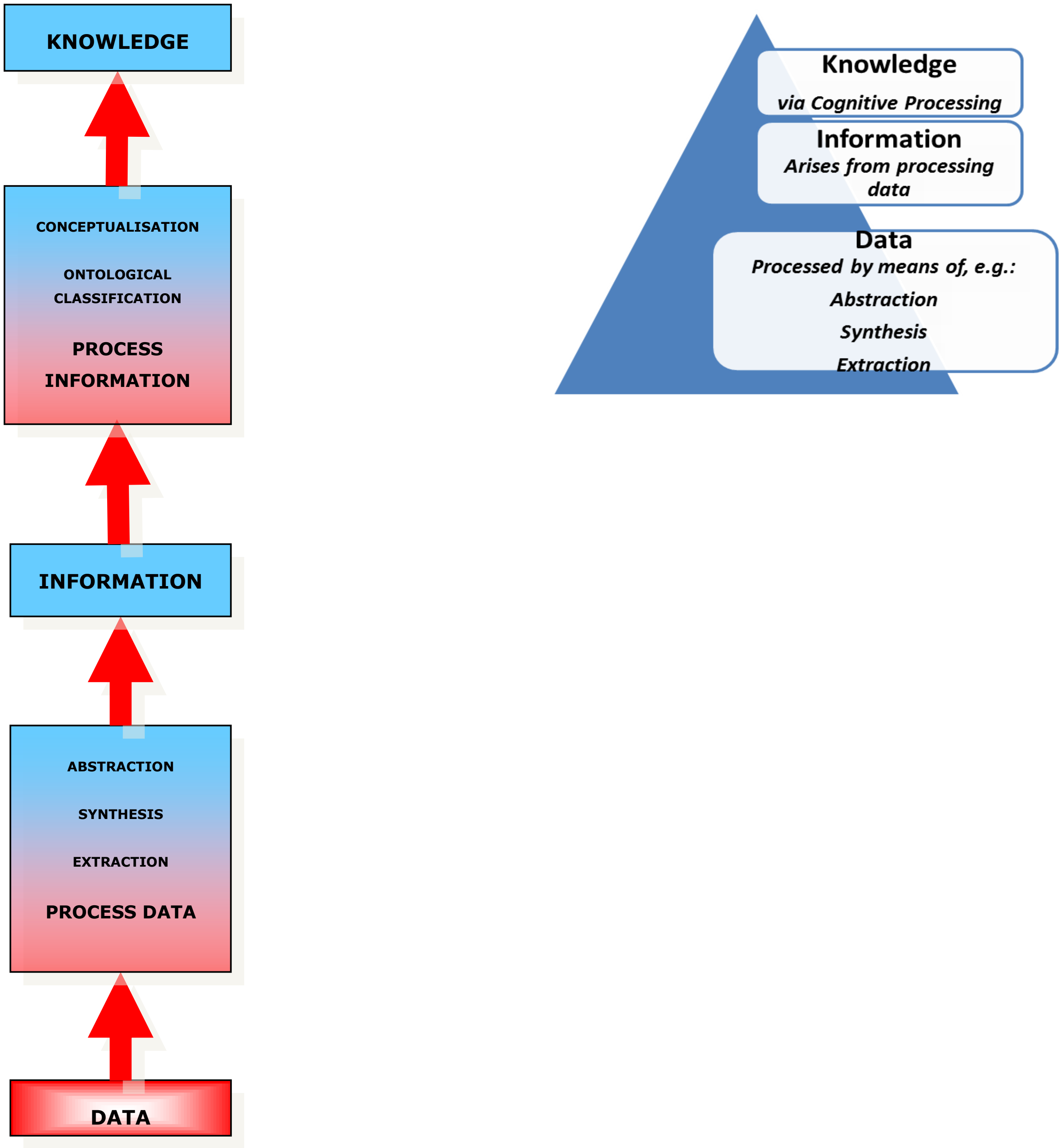

Figure 1: Simple hierarchical data, information and knowledge sequence & "pyramid"

Figure 1 illustrates the commonly-posited data, information, knowledge hierarchy. The diagram is ours, and is illustrative only, being obviously incomplete – for example in its failure fully to elaborate what it means by "process data".

4. The practice of systematic self-observation: visualised knowledge representation by means of concept maps

In the processes of teaching and of research, we frequently resort to creating simple diagrams or sketch maps of the topics we are seeking to illustrate. One largely-informal representation mechanism which has seen widespread use is that of mind mapping (T. Buzan & B. Buzan 1996). Mind maps can be criticised for giving primacy to a single central concept or question. A related technique, also widely used, gives primacy to a single question but does not make one single concept central to the whole diagram. ***Concept maps*** were identified by Joseph Novak (Cañas & Novak 2006); (Novak & Cañas 2008). They are a very useful way of summarising the model-maker's understanding of knowledge and, as such, highly complementary to the use of natural language, specifically as represented textually. We are making use of a particular kind of concept map as described by Gilbert Paquette and his co-workers at the LICEF research centre of the Télé Université of Montreal (Paquette 2010). Paquette and his co-workers distinguish ***processes, concepts and principles*** – see Figure 2. Their approach, *la modélisation par objets typés*, is implemented by means of software called Mot+.

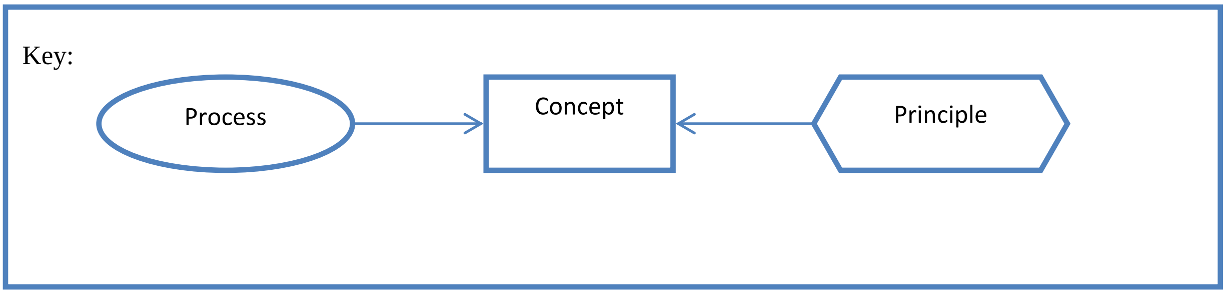

Figure 2: Objects (and links) have type (Paquette 2010)

They also classify the links (relationships) between objects:

C	Composition
S	Specialisation
R	Regulation
P	Precedence
I	Instantiation
IP	Into Product
A	Application

C*	multiple Composition
NT	Non-typed (untyped)

Table 1 Link types in Mot+

Mot+ modelling can be seen to be heavily influenced by object oriented analysis and design, as described by (Deacon 2005), (Bennett et al. 2010)

In Figure 3 we present an example of a concept map with forward and feedback loops highlighted; the application is to research on personal knowledge management PKM. A consideration of knowledge creation by researchers and knowledge synthesis by teachers suggests the need for an inner-loop and an outer-loop. The inner loop depends on the practice of SSO to ***generate*** concepts and the subsequent outer loop concentrates on engaged research, e.g. action research, to ***refine*** them. Hence, we consider that we individually observe our own practice of PKM (SSO) as also we observe and work with others as they practise PKM (action research). So the SSO method is a crucial part of a reflective ***study*** of PKM. That reflection is greatly informed by the discovery of paradox and by learning from mistakes (ours and others). We are working with our information and knowledge base, partially explicit in the form of tables of data and documents relating to teaching and research, but partially also tacit in the sense discussed by (Nonaka & Takeuchi 1995). We interact in a complex network with other intelligent agents. The importance of reflection on practice is described in (Argyris 2000), as is the notion and utility of a double loop; see also (Smith 2001) for a recent summary of Argyris' work.

Figure 3 is in fact a small extract of the overall concept map which describes and guides the doctoral research of one of the authors. It is at the same time a developing part, but also a product, of systematic self-observation and of reflection on the learning process.

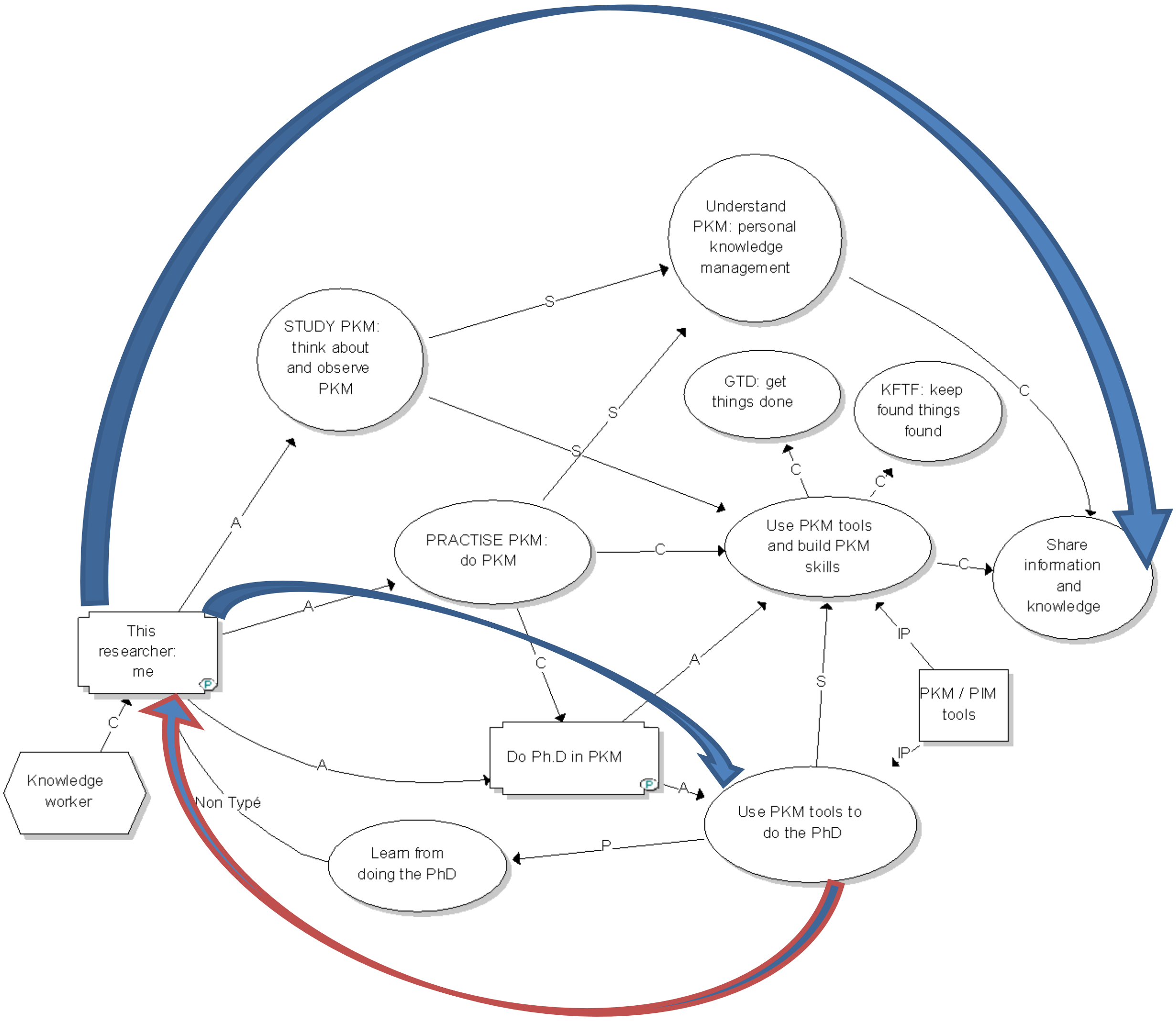

Figure 3: Part of a concept map with forward (high- and low-level) and feedback loops emphasised: a model of undertaking a Ph.D. concerning and using PKM

5. Knowledge, information and data revisited

(Wright 2005) views knowledge as an organisational resource or asset, but one that is always vested in the individual. Early knowledge management (KM) initiatives adopted a knowledge-leverage model, based on a view that computers could capture and disseminate information and knowledge throughout the organization leading to increased productivity, cost savings and innovative capacity (Davenport & Prusak 1998). We follow Wright in suggesting that, at least at this stage in the development of artificial intelligence (AI), all knowledge is intrinsically personal.

The very idea that knowledge can be managed is cogently criticised by (Wilson 2002), who reports that he cannot distinguish much KM from re-engineered information management. Both Wright and Wilson agree that what is manageable by computer is information; for them, knowledge is intrinsically human.

(Tuomi 1999) suggests that it is necessary to reverse the pyramid and create a seemingly illogical sequence “Knowledge -> Information -> Data”. Tuomi emphasises the dependence on knowledge for the interpretation of information, and of information to situate the processing of data. The contrasting points-of-view are well summarised by (Alavi & Leidner 2001). We have conceptualised these two views in Figure 4, which shows the forward DIK and reverse KID pyramids in a concept map.

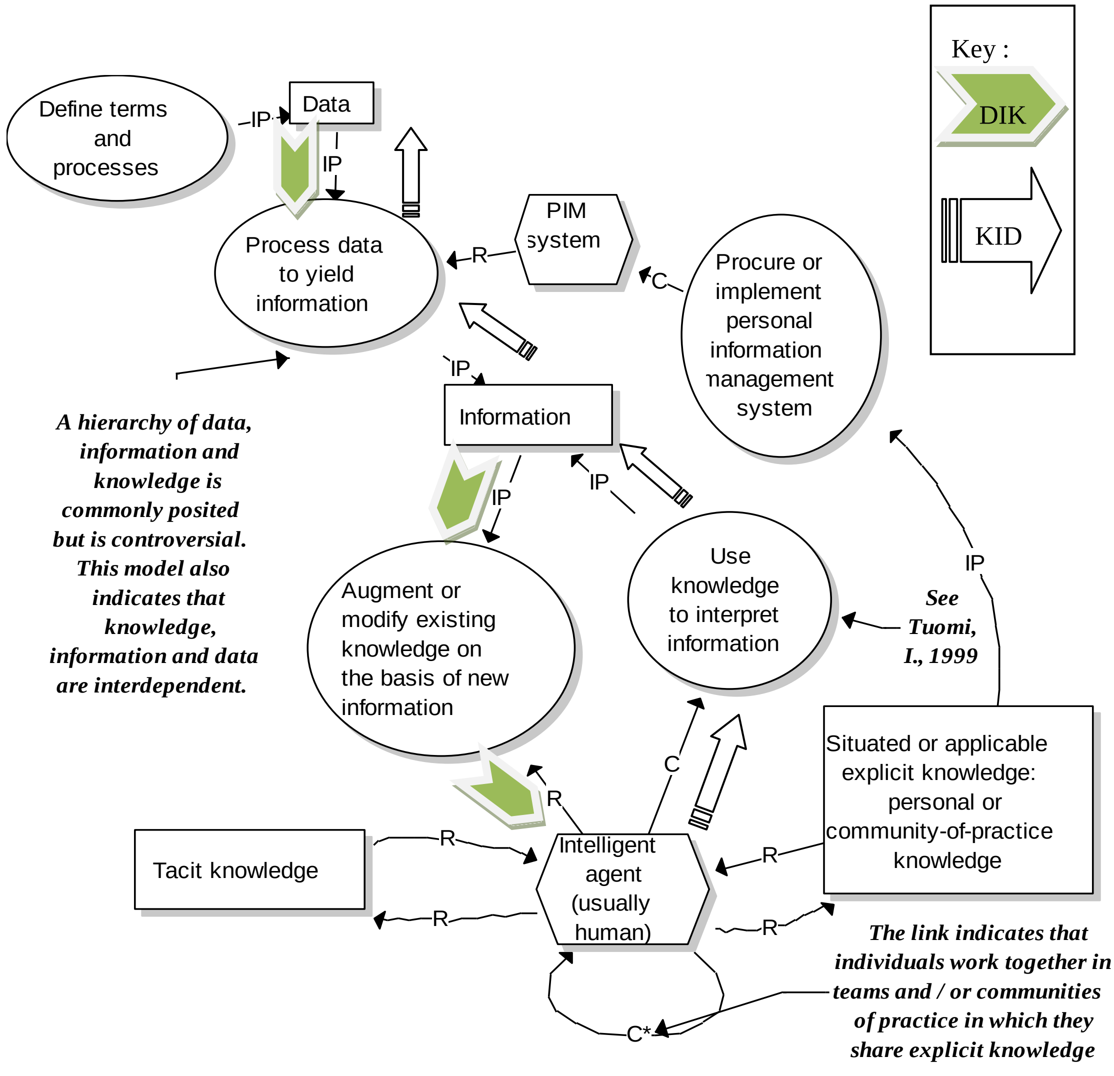

Figure 4: “Data -> Information -> Knowledge” Pyramid revisited: our initial interpretation of the concepts and processes involved

This reversed hierarchy has itself been criticised in an approach developed recently by (Kettinger & Li 2010). Kettinger and Li have extended (Langefors 1980)' infological equation, suggesting that ***information is the joint function of data and knowledge***. They name their approach the KBI theory, the knowledge-based information theory. They put forward the following initial definitions:

1. Data are the measure or description of states of objects or events, usually referred to as a set of interrelated data items that measure the attributes of the objects or events.
2. Knowledge is justified true belief of the relationship between concepts underlying these states.
3. Information is the meaning produced from data based on a knowledge framework that is associated with the selection of the state of conditional readiness for goal-directed activities.

Information, representing a status of conditional readiness for an action, is generated from the interaction between the states measured in data and their relationship with future states predicted in knowledge. Different forms of IS are conceptualized as the embodiments of knowledge domains capable of processing specific categories of data into information for business operations and decision-making.

They conclude that the production of information from data needs knowledge, and when knowledge varies, so does information.

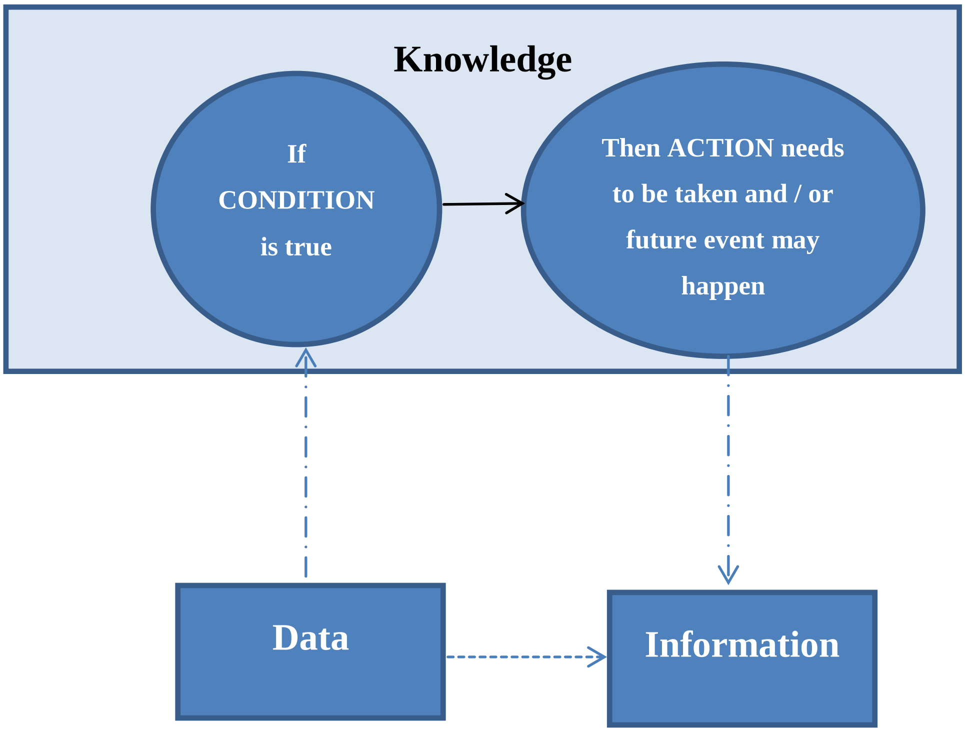

Figure 5: General depiction of the relationship between data, knowledge and information - (Kettinger & Li 2010)

We would comment that (Kettinger & Li 2010):

1. Emphasise ***meaning*** as an integral element of information; they do this by reference to (Mingers 1995). Viewing information not as processed data but rather as 'data plus meaning', Mingers distinguishes four levels of information: symbolic empirics, syntactics, semantics and pragmatics. Meaning is generated from the information carried by signs. Information is objective, but inaccessible to humans, who exist exclusively in a world of meaning. Meaning is inter-subjective — that is, based on shared agreement and understanding — rather than purely subjective. Information and information processing systems exist within the wider context of meaning or sense-making (Weick et al. 2005).
2. Implicitly reintroduce a crucial element inevitably omitted in any view of data, information and knowledge as static concepts. The missing element is that of ***process***.

Extending their discussion, we suggest that a more or less knowledgeable agent transforms data to create meaningful information. The transformation may be represented as a function, or more generally it may be a ***process*** carried out by a more or less intelligent ***agent*** within a socio-technical information system. We favour (Paquette 2010)'s concept maps over those of (Cañas & Novak 2006) precisely because Paquette's model explicitly distinguishes processes from concepts. Knowledge is not a static store, as data can sometimes be. Instead, to use the language of (Maturana & Varela 1980) and (Maturana & Varela 1987), all knowledge requires essentially to be ***enacted***. Knowledge can be represented as information, as for example in a Wikipedia page. But knowledge to be useful must be contextualised in that usage, that is, it must be enacted. That enactment is a purposive act by an engaged human agent.

(M. Johnson 2007) in his review of John Mingers' book (Mingers 2006) on critical realism in management science suggests that:

> "The fundamental question that Mingers poses is to what extent can a 'critical agent'… stand outside the thing they intervene in, and what is the driving force for them to intervene in the first place?"

For Mingers, motivation for intervention can only come from the individual, who must act either to remove constraints or fulfil absences. A praxis-based conception of knowledge does not separate mind and body: the difference between knowing and doing is dissolved.

Because management information systems MIS is (with management science) one of Herbert Simon's "sciences of the artificial" (Simon 1996), we would similarly hold that knowing and doing are almost inextricably interlinked and that they meet in individual knowledge and action. (Agerfalk et al. 2006) argue the generality of this proposition. Our emphasis in what follows is on the need for personal reflection, implication and action.

6. Reflection and reflexivity as an essential step in the research process

(Schön 1983) powerfully argued for ***reflection*** in and on practice a generation ago. A similar but distinct concept is that of ***reflexivity*** (Van de Ven 2007). In using the word reflexivity we are consciously referring to a concept which is well understood in the sociological literature (Denzin & Lincoln 2000) , (Denzin & Lincoln 2005) and which is closely related to auto-ethnography. The associated community of practice (Wenger 1998) ranges in its expression from the frankly autobiographical (Ellis 2002) - as self-justified in (Ellis 1997) in (Tierney & Lincoln 1997) - through the merely personal (Boje & Tyler 2009), (Holbrook 2005) to the more objectively reflective (Humphreys 2005). (McIlveen 2008) explicitly links auto-ethnography and reflexivity in arguing for their admissibility in the context of vocational psychology research. Reflection on reflection is discussed by (Wall 2008).

There has been a recent backlash against the validity and verifiability of scientific conclusions drawn from auto-ethnography alone and a consequent attempt to reposition it: e.g. (Tsekeris & Katrivesis 2009).

In our use of the term, we are in no way claiming scientific rigour for “conclusions” drawn solely from reflexivity. Many sociologists would agree; thus Norman Denzin (Denzin 1970) describes triangulation, the use of multiple methods which if they converge indicate the trustworthiness of the individual finding.

Instead we are suggesting reflexivity as being in practice a common starting point for conceptualization and modelling. Rigour may subsequently emerge as the concepts are put under more scientific scrutiny and as they receive peer review in the wider scientific community.

Recognising the related concepts of “explicit” and “tacit” knowledge (Nonaka & Konno 1999) and the debate which continues to surround knowledge creation and diffusion (Nonaka & Von Krogh 2009) we choose to focus on PIM and PKM. We further suggest the utility to each and every knowledge worker of systematic self-observation (SSO) as an efficient and proto-scientific method allowing for gathering accurate descriptions of one’s own experience (Rodriguez & Ryave 2002).

We argue that the overwhelmingly functionalist exploitation of

1. data transformed into information, often with a strong quantitative, statistical component; and
2. information giving rise to a corpus of macro theoretical knowledge;

does not fully reflect the process by which advances in knowledge take place.

As (Brown et al. 1977) have already written: "…positive science gives procedures for identifying shared attributes and temporal correlations of entities… Yet, … these procedures offer no help in knowing either the nature of the entities themselves or the meaning or relevance of the attributed causes, probabilities or laws" (Brown et al. 1977). Therefore, we believe that researchers should not be ashamed of the applied meta-research processes of subjectively relevant and socially constructed elements of conceptualisation and information management that they are using. They need not hide these away from the scientific community behind a positivist rational discourse. (Piore 1979) claimed that "information" in economics research often meant values of parameters in suggested research models – in our terms, data. (Van de Ven 2007) quotes (Adler & Jermier 2005) as understanding that the idea of being reflexive remains unpopular with many social scientists. Adler and Jermier go on to challenge the very possibility of value neutrality. Instead scholars should reflect on their underlying epistemological assumptions and develop an awareness of their standpoints, even consciously choosing them. Reflexivity is presented as a close cousin of reflection as espoused by critical thinkers; Andrew Van de Ven cites (Alvesson & Sköldberg 2009 edn. 2) as holding that reflexivity "is characterised by different types of recursive turns each providing different insights and perspectives".

Earlier in his same book van de Ven sees reflection arising when an anomaly disconfirms our (working) theories as one way that new knowledge is created. This logic of discovery or creativity was identified by Charles Peirce as the ***abduction*** logic of enquiry:

> "This form of reasoning begins when some surprising anomaly or unexpected phenomenon is encountered. This anomaly would not be surprising if a new hypothesis or conjecture was proposed… I argue that researchers and

> practitioners create or discover theories through a process of abduction." (Van de Ven 2007)

See also (Alvesson & Sköldberg 2009), whose favoured research approach is essentially abductive.

The academic and business communities sometimes underestimate if not refute the extraordinary importance of ***reacting to "failure" or anomalies and of reflection*** (e.g. SSO) in the initial conception of grounded and relevant research problems as a foundation and a repeatedly-revisited milestone (usually on the feedback path) of the whole epistemological process. This epistemological issue seems to us to be a crucial aspect particularly for developing new concepts rather than continuing to apply pre-existing concepts supportive of a current paradigm. Given the contemporary lack of interest by the business practitioner community in the theories and findings of information systems research, it can well be argued that it is precisely the development of nascent but grounded concepts that is needed today. It might leverage MIS once again into becoming a crucial and central differentiation feature both of ad hoc academic research and of business practice.

7. An example reflection: Revisiting Ashby's Law of Requisite Variety in the context of teaching

We choose to illustrate our proposition by reference to a case. One of the co-authors is responsible for teaching a second level undergraduate module called Electronic Business Management. This module is part of the core curriculum for the largest programme in our business school; in the module operation in the current year, there were 470 students organised into twelve teaching groups. A large part of the teaching and learning activity of that module centres on teaching business modelling techniques to (often reluctant!) business students and assessing their learning as they model their chosen "context" company. The students are presumed already to be moderately proficient in the conception of databases and their implementation using Microsoft Access as a relational database management system and rapid application (RAD) tool since they learn Access and some data modelling at the first level of their studies.

The intended learning outcomes of the second level module are two-fold:

1. State what an Information System (IS) is, and describe its role in the effective management of enterprise.
2. Contribute to the specification of requirements for a procurement to meet the information systems needs of a business, being ready as business professionals to collaborate with and manage IS professionals in the effective analysis, design, procurement, implementation and management of e-business information systems.

We teach that the practice of business information systems involves certain steps. Note that steps 3 and 4 require to be enacted in parallel.

1. ***Business professionals*** recognise a ***problem***.
2. Solving this problem requires a new or amended ***work system*** (Alter 1999)**,** (Alter 2003)**,** (Alter 2010)**.**
3. The business professionals ***procure*** a ***business information system*** to make the changed work system work.
4. Effective procurement requires that business professionals work together with IS professionals to ***specify the requirements*** for a ***business information system BIS*** by a ***process of analysis and modelling*** often involving ***prototyping.***
5. ***Systems professionals build, test, and enhance the IS*** in ongoing collaboration with the business professionals.
6. ***Business managers manage the BIS-based work system*** as it is maintained and enhanced by IS professionals.

Thus a large part of the teaching and learning on the module centres on the use of modelling techniques set within a framework:

Analysis need	Framework or model: diagram type
WHAT business context?	(1) Work Systems Framework **(WSF)**
WHO uses a system to do WHAT process (and WHEN)?	(2) Use Case Diagram (**UCD**)
HOW the system must function?	(3) Data Flow Diagram (**DFD**)
WHAT data?	(4) Entity Relationship diagram **(ERD)** (5) **Prototype** system (Microsoft Access)

Table 3 Analysis needs and corresponding model (that is, diagram type)

The strong emphasis on analysis and modelling may at first sight appear strange, and certainly its continuation requires practical and theoretical justification. We suggest that teaching and learning are instances of cycles of action research, loosely following (Shah et al. 2007). Action research, especially in the action science guise associated with the work of Chris Argyris, emphasises the need for the action researcher to reflect during and after each intervention: see (Argyris et al. 1985); but also (Checkland & Holwell 1998).

During the teaching and learning process of the module, it became evident that students were reacting against the model-based approach, which they found hard because abstract and – to them as pre-internment students with limited in-company experience – overly theoretical. An earlier paper, (Gregory 2010), discussed different capacities for abstraction and their effects. Reflecting as a teacher on the need for theoretical justification for the emphasis on modelling enabled us to present a theory-based justification for the apparently-heavy emphasis on modelling in the "wind-up" final teaching session of the EBM module; we summarise that justification here.

The original action researcher, Kurt Lewin, stated that "there is nothing so practical as a good theory" (Lewin 1951). Good theory has explanatory power and suggests extrapolation into new applications. As an example of such theory we suggested Ross Ashby's Law of Requisite Variety: "Variety absorbs variety, defines the minimum number of states necessary for a controller to control a system of a given number of states" (albeit in a discrete state controller) (Ashby 1956). Ourselves reflecting on that law, we rediscovered (Conant & Ashby 1970). Roger Conant produced his ***Good Regulator theorem*** stating that "every good regulator of a system must be a model of that system". The design of a complex regulator includes the making of a model of the system to be regulated. The theorem shows that any regulator that is maximally both successful and simple must be isomorphic with the system being regulated. ***Making a model is thus necessary.***

Drawing together the law of requisite variety and Conant's theory, we suggest that a business information system (viewed broadly as including the people who use and manage it as well as any computer-based elements) has to be sufficiently rich in its variety and close in its internal models to the business process it serves if it is to be effective. It must be isomorphic with the business process. Furthermore, when the BIS is being designed it must itself be modelled and that model – the outcome of an analysis partnership between business and IS professionals – must be as ***simple*** and ***accurate*** as it can be. ***Accuracy*** in the sense of fidelity of model to situation modelled is implicitly increased by the increased possibility for partnership and communication that arises when models are shared and jointly developed. ***Simplicity*** is pragmatically essential because business students and business professionals resist analytical complexity. We aim for simplicity by a ***separation of concerns*** (following (Rzevski 1981), who is himself following (Dijkstra 1974), reproduced as (Dijkstra 1982)). So students learn the different modelling approaches numbered as in Table 3 above: (***2) use case, (3) dataflow*** and ***(4) entity relationship***, unified by the business-oriented ***work systems framework (1).*** Finally a small ***prototype BIS (5)*** is built.

Students report their general satisfaction with their teaching and learning experience (while still complaining that an inherently practical approach to IS is too theoretical!). They are also well prepared for subsequent optional level 2 semester 2 modules in the Management of Information Systems (MIS) and the Implementation of Business Information Systems (IBIS). However, very few of them really grasp the orthogonal and complementary nature of the models they build, to judge from their answers to a mandatory exam question.

8. Some implications for research and researchers

We suggest that the case of teaching business information systems at least illustrates the value of engaged reflection in the teaching and learning aspects of our professional activity. What of our research? Ashby and Conant went on to suggest that the living brain, to be successful and efficient as a regulator for survival, must proceed in learning by the formation of a model (or models) of its environment. This leads us to suggest that research has ***essentially*** to be grounded in modelling, regardless of the explicit research design. Graphical models such as concept mapping and similar techniques can assist here, since visual maps are generally easier to grasp than long texts and are potentially easier to discuss and validate. That is why we have used concept mapping as a vital and ongoing element of our doctoral research, just as we have used many other personal information management tools and techniques.

Of the admissibility and usefulness of concept maps as part of published research, we invite you the reader to be the judge.

Of the absolute necessity to be as effective as we possibly can be in the management of our – always limited - ***personal*** information (as of organisational), and of the pressing pragmatic need to aid the learning of people as they struggle to create and maintain personal information and knowledge management systems, we cite (Georgiou 2008) who himself cites (Bennis & O'Toole 2005). Bennis and O'Toole discuss how business schools have 'lost their way' since decision makers need guidance in 'making decisions in the absence of clear facts'. As such, decision makers must be able to resourcefully use whatever limited information is available and advantageously portray its implications. Georgiou claims to demonstrate how decision makers can make systemic decisions in situations characterised by extremely limited information and, furthermore, what form such decisions can take; in effect, operational research can effectively address what appears to be a gap in management training.

Our linked contention – the subject of one co-author's ongoing doctoral research – is that a teaching and learning based approach to prior improvement of personal information management systems can assist. The question that that research asks is this: ***How can knowledge workers be helped to improve their personal knowledge management (PKM) by means of a useful and applicable teaching, learning and evaluation framework?*** In other words, how can they be encouraged to create and maintain computer-based information and an evolving system to maintain and exploit information supporting knowledge ***in advance of*** the situations which will demand its use? That research question itself originally emerged during a long reflection on effective and ineffective processes which we have previously suggested (Gregory & Norbis 2008b) lie at the heart of personal information management: processes we summarise as ***GTD Getting Things Done*** (Allen 2003) and ***KFTF Keeping Found Things Found*** (Jones 2007).

9. Synthesis

In this paper, we have explored and illustrated five propositions which we deem to be essential for understanding the personal information and knowledge management that underlie inquiry and learning.

Number	Proposition	Observation
1.	That knowing and doing are almost inextricably interlinked and meet in individual knowledge and action.	This proposition derives from a reconsideration of the concepts of knowledge, information and data which is synthetic and not original.
2.	That in the early stages of the research process a powerful source of insight is reflection on the researcher's own knowledge and practice.	We have illustrated this in a research context. Such auto-ethnography is not in itself a verifiable source of findings, but can provide initial insight.
3.	That that reflection may take the form of self-observation structured by means of model building.	The research example we highlight has involved concept mapping which explicitly distinguishes processes from concepts.
4.	That effective teaching similarly requires reflection on the	We have suggested that teaching can be viewed as a series of cycles of action research.

	teacher's own knowledge and practice.	Each cycle needs to be evaluated. That evaluation must include reflection.
5.	That Ross Ashby's law of requisite variety continues to have value in justifying modelling in information systems teaching and research.	We have re-explored the implications of Requisite Variety and revisited the associated Good Regulator theorem of Ashby and Conant in a teaching context. Their implications and wider application merit further work by ourselves and by other IS researchers, teachers and practitioners.

Table 4 Summary of propositions and observations

To expand upon the fifth proposition in particular. In systems terms, an evolutionary learning or semantic system (Macgilchrist sans date) exists which has to be open if it is to continue to evolve. Every researcher, as every teacher and every practitioner, has continually to struggle to make explicit her or his own knowledge and to reflect upon how it needs to change. We need to criticise and to encourage one another as we do that. The gradual process of refining a research question requires a learning and personal knowledge management approach which must be sympathetic to the emergent quality of a research project, at least in its early stages. The process is human and engaged; it can also benefit from effective personal information management systems. Thus we need to consider, alone and together, the role of information and communications technology (ICT) in improving everything we do. That should include imaginative use of tools and techniques, such as concept maps.

We present here a concept map which illustrates, in summary form, some of the propositions that we have discussed.

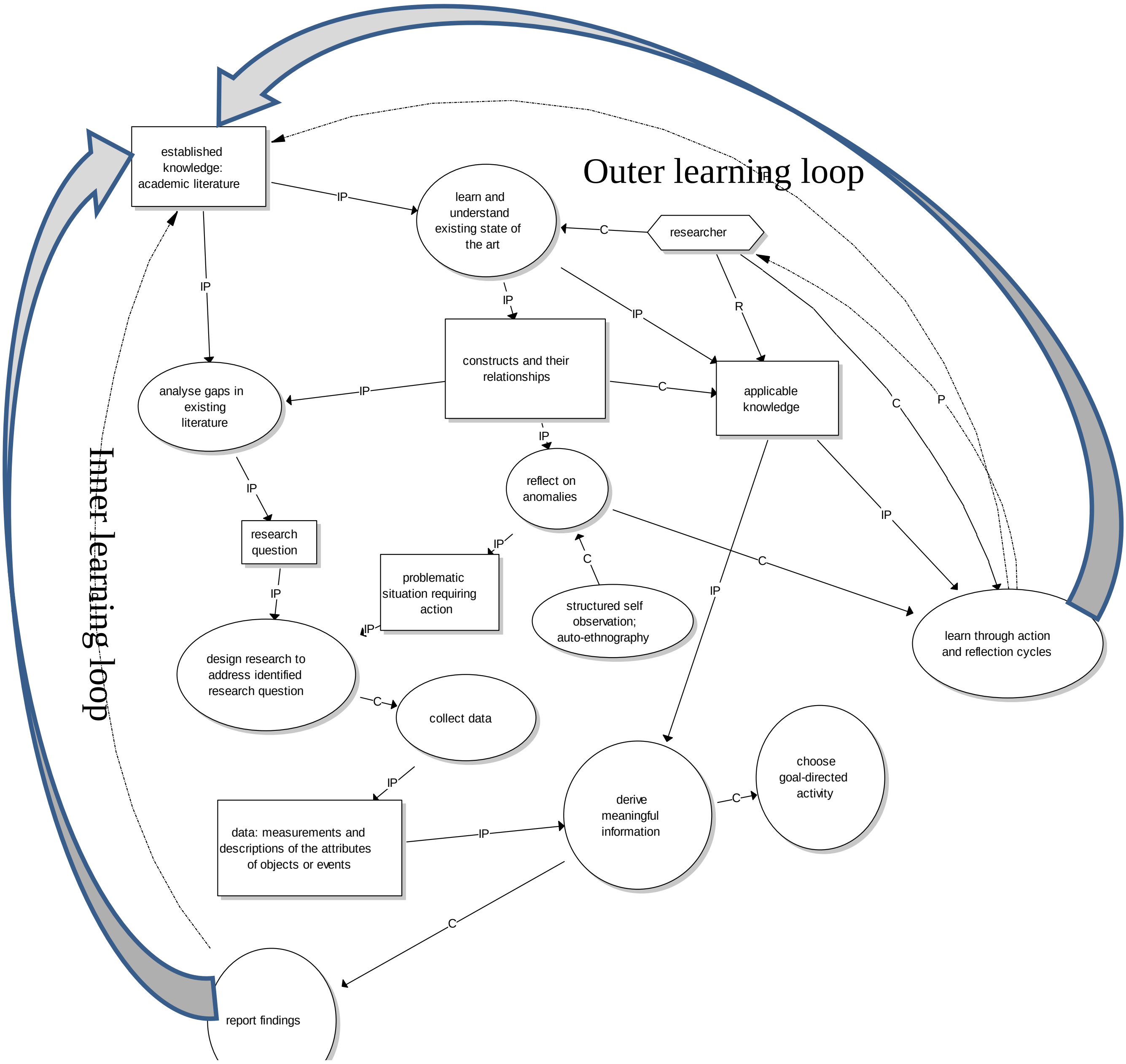

Figure 6: Illustrative summary of some of our propositions

We would comment that this diagram illustrates an ***inner learning loop*** as the researcher engages with perceived reality in accordance with some research methodology. She or he learns in a problem-focussed way as (s)he uses methods in an applied methodology. Just as (Argyris 2000) describes double loop learning in organisations, we suggest that there potentially exists also an ***outer loop*** by means of which the researcher may learn at the more profound level described by Peter Checkland. (Checkland 2000) presents (inter alia) LUMAS, Learning for a User by a Methodology-informed Approach to a problem Situation. Taking as his definition of methodology ‘a body of methods used in a particular activity’, Checkland suggests that a user knowledgeable about a methodology perceives a problem situation and uses the methodology to try to improve it. The methodology as a set of principles is converted by the methodology user into a specific method which the user feels to be appropriate for ***this particular*** situation at this moment in its history:

> "The user U, appreciating a methodology M as a coherent set of principles, and perceiving a problem situation S, asks himself (or herself): What can I do? He or she then tailors from M a specific approach, A, regarded as appropriate for S, and uses it to improve the situation. This generates learning L, which may both change U and his or her appreciations of the methodology: future versions of all the elements [of] LUMAS may be different as a result of each enactment of the process shown." (Checkland 2000)

Checkland stresses that it is not the methodology which leads to improvement. It is the user as (s)he benefits from using the guidelines, as (s)he takes the formally defined methodology M to create or tailor A, the actual, user- and situation-specific approach adopted to the Real –world problem R that (s)he perceives a concern for.

Thus we suggest the existence of ***problem-focussed or situational learning*** – using methods in an applied methodology; and ***higher-level learning*** – which will manifest itself in a deepening appreciation of methodology and a concern to develop it further in action. We also suggest the possibility that the outer loop corresponds more-or-less directly to the inquiring / learning cycle of Checkland's Soft Systems Methodology SSM.

10. Concluding remarks

We started this paper by declaring that our motivations lie in a desire to be involved in relevant, engaged and even passionate research and related teaching. We observe that some of the most influential research and teaching, as too the most entrepreneurial business propositions, are undertaken by iconoclasts whose methods are sometimes unsafe. Just as business must look for differentiators, so we in the research and teaching community should consider whether motivational change may best arise by a reconsideration of our own experiences and values and those of others. If we work forward by means of engaged scholarship based on values that matter to us and using methods which are congruent with our subject matter and that answer questions that matter: we may perhaps achieve in our work the “serendipitous bricolage” identified by (Ciborra & Jelassi 1994) in the context of strategic information systems planning practice.

Seeming paradox is very manna to an enquiring mind, and a failure of existing learning in teaching or research is the source of new inspiration, new conceptions and a spur to improved activity and revised process (Ackoff 1999); this process is discussed in much more depth by a colleague and mentor in a forthcoming paper on semantic morpho-genesis (Macgilchrist sans date). Often as teachers we assess whether people really know something by observing their ability to act, to do. So also as researchers, rather than always pretending to a positivist or ethnographic objectivity that somehow escapes us, we may believe in and value personal and shared ***action*** as the cockpit in which knowledge is enacted, tested, refined and in which it evolves. Following (Dewey 1960) we want knowledge that builds on what we already know and that we can believe and act upon. Scientific enquiry sometimes builds exhaustively on existing research, identifies a knowledge gap and seeks to fill it. But we have argued and illustrated here that the emergence of research questions may also be based on reflective self-observation, perhaps structured by means of personal knowledge management tools, often between and after cycles of action research. So inquiry may initially be informed by structured self-observation and then proceed by further learning, informed by theory and enacted and internalised by means of practice and further reflection.

Our thanks to Professor David Weir of Liverpool Hope University and ESC Rennes School of Business and to Dr. Renaud Macgilchrist of ESC Rennes School of Business for their helpful and perceptive comments which will guide us in further action and reflection.

Grateful thanks too to the anonymous reviewer of this article who suggested that we consider the two levels of learning loops now incorporated in Figure 6 and the use of Checkland’s learning model.

REFERENCES

Ackoff, R.L., 1999. On learning and the systems that facilitate it. *Reflections: The SoL Journal*, 1(1), p.14–24.

Adler, P. & Jermier, J., 2005. Developing a field with more soul: Standpoint theory and public policy research for management scholars. *Academy of Management Journal*, 48(6), p.941–944.

Agerfalk, P.J. et al., 2006. Reflecting on action in language, organisations and information systems. *European Journal of Information Systems*, 15(1), p.4–8.

Alavi, M. & Leidner, D.E., 2001. Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS quarterly*, 25(1), p.107–136.

Allen, D., 2003. *Getting things done: The art of stress-free productivity*, Penguin Books.

Alter, S., 2003. 18 reasons why IT-reliant work systems should replace "the IT artefact" as the core subject matter of the IS field. *Communications of AIS*, 2003(12), p.365-394.

Alter, S., 1999. A general, yet useful theory of information systems. *Communications of the AIS*, 1(3es), p.3.

Alter, S., 2010. Bridging the chasm between sociotechnical and technical views of systems in organizations. *Proceedings of the Thirty First International Conference on Information Systems, St. Louis 2010*.

Alvesson, M. & Sköldberg, K., 2009. *Reflexive methodology: New vistas for qualitative research*, Sage Publications Ltd.

Argyris, C., 2000. Double loop learning in organizations. *Classics in management thought*, p.115-125.

Argyris, C., Putnam, R. & McLain Smith, D., 1985. Action science: concepts, methods, and skills for research and intervention. Available at: http://actiondesign.com/resources/research/action-science [Accessed Mai 1, 2010].

Ashby, W.R., 1956. *An introduction to cybernetics*, Chapman & Hall London.

Bennett, Farmer & Mcrobb, 2010. *Object-Oriented Systems Analysis and Design Using Uml*, McGraw-Hill Education.

Bennis, W.G. & O'Toole, J., 2005. How business schools lost their way. *Harvard*

Business Review, 83(5), p.96–104.

Boje, D. & Tyler, J.A., 2009. Story and narrative noticing: workaholism autoethnographies. *Journal of business ethics*, 84, p.173–194.

Brown, R.H., Douglas, J.D. & Johnson, J.M., 1977. The emergence of existential thought: philosophical perspectives on positivist and humanist forms of social theory. *Existential sociology, edited by JD Douglas and JM Johnson. Cambridge: CUP*, p.77–100.

Buzan, T. & Buzan, B., 1996. *The mind map book: how to use radiant thinking to maximize your brain's untapped potential*, Plume Books.

Cañas, A.J. & Novak, J.D., 2006. Re-examining the foundations for effective use of concept maps. In *Concept Maps: Theory, Methodology, Technology. Proceedings of the Second International Conference on Concept Mapping*. p. 494–502.

Capurro, R. & Hjørland, B., 2003. The concept of information. *Annual review of information science and technology*, 37(1), p.343–411.

Checkland, P., 2000. Soft Systems Methodology: A Thirty Year Retrospective. *Syst. Res*, 17, p.S11–S58.

Checkland, P. & Holwell, S., 1998. Action research: its nature and validity. *Systemic Practice and Action Research*, 11(1), p.9–21.

Ciborra, C. & Jelassi, T., 1994. *Strategic information systems: a European perspective*,

Conant, R.C. & Ashby, W.R., 1970. Every good regulator of a system must be a model of that system. *International journal of systems science*, 1(2), p.89–97.

Davenport, T.H. & Prusak, L., 1998. *Working knowledge: How organizations manage what they know*, Harvard Business School Pr.

Deacon, J., 2005. *Object-oriented analysis and design: a pragmatic approach*, Addison-Wesley; Pearson Education.

Denzin, N.K., 1970. Strategies of multiple triangulation. *The research act in sociology: a theoretical introduction to sociological method*, p.297–313.

Denzin, N.K. & Lincoln, Y.S., 2000. The discipline and practice of qualitative research. , vol. 2, p.1–28.

Denzin, N.K. & Lincoln, Y.S., 2005. *The SAGE handbook of qualitative research*, Sage Publications.

Dewey, J., 1960. *The quest for certainty*, Capricorn Books.

Ellis, C., 1997. Evocative autoethnography: Writing emotionally about our lives. In *Tierney, W.G. & Lincoln, Y.S., 1997: Representation and the text: Re-framing the narrative voice.* p. 115–139.

Ellis, C., 2002. Take no chances. *Qualitative Inquiry*, 8(2), p.170-175.

Flavell, J.H., 1976. Metacognitive aspects of problem solving. *The nature of intelligence*, 12, p.231–235.

Floridi, L., 2005. Is semantic information meaningful data? *Philosophy and Phenomenological Research*, 70(2), p.351–370.

Georgiou, I., 2008. Making decisions in the absence of clear facts. *European Journal of Operational Research*, 185(1), p.299–321.

Gregory, M., 2010. Collaboration and end-user information management tools. In 16th Americas Conference on Information Systems: AMCIS 2010. Lima, Peru.

Gregory, M., Descubes, I. & Makovsky, P., 2010. Data, Information and Knowledge: a candid and pragmatic discussion. *Proceedings of the 4th International Conference on Advanced and Systematic Research, Zagreb, Croatia, Nov. 11th.-13th, 2010*.

Gregory, M. & Norbis, M., 2009a. Auditing Personal Information Management. In UKAIS 2009. St. Anne's College, Oxford.

Gregory, M. & Norbis, M., 2009b. Evaluating Situational Applications Builders. In CITSA 2009: The 6th International Conference on Cybernetics and Information Technologies, Systems and Applications. Orlando, FA.

Gregory, M. & Norbis, M., 2008a. The business of personal knowledge. In 8th International Conference on Knowledge, Culture and Change in Organisations. Cambridge University, United Kingdom.

Gregory, M. & Norbis, M., 2008b. Towards a Systematic Evaluation of Personal and Small Group Information and Knowledge Management. In 5th International Conference on Cybernetics and Information Technologies, Systems and Applications: CITSA 2008. Orlando, FA.

Holbrook, M.B., 2005. Customer value and autoethnography: subjective personal introspection and the meanings of a photograph collection. *Journal of Business Research*, 58(1), p.45–61.

Humphreys, M., 2005. Getting personal: Reflexivity and autoethnographic vignettes. *Qualitative inquiry*, 11(6), p.840.

Johnson, M., 2007. Review of" Realising Systems Thinking: Knowledge and Action in Management Science". By John Mingers. New York: Springer, 2006. *Journal of Critical Realism*, 6(2), p.312.

Jones, W.P., 2007. *Keeping found things found: The study and practice of personal information management*, Morgan Kaufmann Pub.

Kettinger, W.J. & Li, Y., 2010. The infological equation extended: towards conceptual clarity in the relationship between data, information and knowledge. *European Journal of Information Systems*, 19, p.409-421. Available at: http://www.palgrave-journals.com/doifinder/10.1057/ejis.2010.25 [Accessed Juin 15, 2010].

Langefors, B., 1980. Infological models and information user views. *Information Systems*, 5(1), p.17–32.

Lewin, K., 1951. Field theory in social science: Selected theoretical papers (edited by Dorwin Cartwright.). *Harpers*.

Macgilchrist, R.S.R., Learning and the Semantic Web.

Maturana, H.R. & Varela, F.J., 1980. *Autopoiesis and cognition: The realization of the living*, Springer.

Maturana, H.R. & Varela, F.J., 1987. *The tree of knowledge: The biological roots of human understanding*, Shambhala Boston, MA.

McIlveen, P., 2008. Autoethnography as a method for reflexive research and practice in vocational psychology. *Australian Journal of Career Development*, 17(2), p.13–20.

Mingers, J., 1995. Information and meaning: foundations for an intersubjective account. *Information Systems Journal*, 5(4), p.285–306.

Mingers, J., 2006. *Realising systems thinking: knowledge and action in management science*, Springer Verlag.

Nonaka, I. & Konno, N., 1999. The concept of 'Ba': building a foundation for knowledge creation. *The knowledge management yearbook 1999-2000*, p.37.

Nonaka, I. & Takeuchi, H., 1995. *The knowledge-creating company: How Japanese companies create the dynamics of innovation*, Oxford University Press, USA.

Nonaka, I. & Von Krogh, G., 2009. Tacit Knowledge and Knowledge Conversion: Controversy and Advancement in Organizational Knowledge Creation Theory. *Organization Science*, 20(3), p.635–652.

Novak, J.D. & Cañas, A.J., 2008. The theory underlying concept maps and how to construct and use them. *Florida Institute for Human and Machine Cognition Pensacola Fl, www. ihmc. us.[http://cmap. ihmc.*

us/Publications/ResearchPapers/TheoryCmaps/TheoryUnderlyingConceptMaps. htm].

Paquette, G., 2010. *Visual Knowledge and Competency Modeling - From Informal Learning Models to Semantic Web Ontologies.*, Hershey, PA: IGI Global.

Piore, M.J., 1979. Qualitative research techniques in economics. *Administrative Science Quarterly*, p.560–569.

Rodriguez, N. & Ryave, A., 2002. *Systematic self-observation*, Sage Publications, Inc.

Schön, D.A., 1983. *The reflective practitioner: How professionals think in action*, Basic Books.

Shah, H., Eardley, A. & Wood-Harper, T., 2007. ALTAR: achieving learning through action research. *European Journal of Information Systems*, 16(6), p.761-770.

Shannon, C., 2003. The lattice theory of information. *Information Theory, IRE Professional Group on*, 1(1), p.105–107.

Shannon, C.E. & Weaver, W., 1949. The mathematical theory of communication. *Urbana, Univ. Illinois Press*.

Shannon, C.E., 1948. A mathematical theory of communication. *Bell Syst. Tech. J*, 27(1), p.379–423.

Simon, H.A., 1996. *The sciences of the artificial*, The MIT Press.

Smith, M., 2001. Chris Argyris: theories of action, double-loop learning and organizational learning. *The encyclopedia of informal education*. Available at: http://www.infed.org/thinkers/argyris.htm [Accessed Juin 9, 2010].

Tierney, W.G. & Lincoln, Y.S., 1997. *Representation and the text: Re-framing the narrative voice*, State University of New York Press.

Truong, Y., McColl, R. & Descubes, I., 2009. Testing US Advertising Belief and Attitude Measures in France. *Journal of Euromarketing*, 18(1), p.35–46.

Tsekeris, C. & Katrivesis, N., 2009. Ethical Reflexivity and Epistemological Weakness. *Tamara Journal*, 7(3).

Tuomi, I., 1999. Data is more than knowledge: implications of the reversed knowledge hierarchy for knowledge management and organizational memory. *Journal of Management Information Systems*, 16(3), p.p103-117.

Van de Ven, A.H., 2007. *Engaged scholarship: A guide for organizational and social research*, Oxford University Press, USA.

Wall, S., 2008. An autoethnography on learning about autoethnography. *International Journal of Qualitative Methods*, 5(2), p.146.

Weick, K.E., Sutcliffe, K.M. & Obstfeld, D., 2005. Organizing and the process of sensemaking. *Organization science*, 16(4), p.409–421.

Wenger, E., 1998. Communities of practice: Learning as a social system. *Systems thinker*, 9(5), p.1–5.

Wilson, T.D., 2002. The nonsense of knowledge management. *Information Research*, 8(1), p.8–1.

Wilson, T.D. & Dunn, E.W., 2004. Self-knowledge: Its limits, value, and potential for improvement. *Psychology*, 55.

Wright, K., 2005. Personal knowledge management: supporting individual knowledge worker performance. *Knowledge Management Research and Practice*, 3(3), p.156–165.