Philosophical Frameworks and Cognitive Profiles: Tools for the IS Student and Practitioner?

Ray Webster
Dr Philip Dobson

School of Management Information Systems
Edith Cowan University
Western Australia
e-mail: r.webster@ecu.edu.au , p.dobson@ecu.edu.au

Abstract

This paper considers the possible role of an understanding of philosophical and cognitive variants in the education of information systems (IS) students. It is argued that this is important for delivering information systems and e-business value in a networked society. The first section argues that philosophy can play an active role in IS research and practice. It suggests that a particularly useful frame for integrating philosophical issues within IS research and practice is critical realism. The emphasis within critical realism suggests a consideration of both ontological and epistemological issues and that what the world is seen to be largely defines the way it can be studied. It also argues for the importance of understanding how we come to know in relation to our cognitive processes. Given this underlying framework the paper argues for the importance of an understanding of philosophical and cognitive variants by information systems students. It suggests that the reality of people's cognitive styles affects the way that they see the world and the way they develop practice within that world. This is followed by a consideration of some the factors contributing to the cognitive profile of each individual. For the purposes of this paper, a cognitive profile is considered to consist of measures of an individual's cognitive style, learning style and personality. IS student and practitioner awareness of these variants is an important element in their understanding of how individuals in a variety of organisational roles interact with each other and with information systems.

Keywords

Critical realism, cognitive profile, information systems curriculum

> *"We were sitting outside when the rain started. As it rattled away on the metal roof of the patio, one of my dinner companions sighed and said – "isn't that such a wonderful sound". "No" I said, rather churlishly – "it reminds me of wet holidays in North Wales when I was a kid". The first speaker was brought up in a remote mining town in outback Australia – 9 inches of rain a year – the sound of rain on a tin roof meant only good things. This contrasted with my sober memories of precious vacation days spent trapped inside, peering anxiously out to see if the rain had stopped and the fun could restart."*

INTRODUCTION

As the above quote indicates each of us views the world through our own individual lens. For one of the dinner partners the rain forms good pleasurable associations, for the other hardened English holidaymaker rain was associated with gloom and wet uncomfortable days. The power of association is a simple construct that impacts our understanding of particular events.

There are other constructs that affect how we see and interpret the world at a more fundamental level – our often unacknowledged philosophical stance and our inbuilt cognitive profile are two important ones. This paper suggests that there is benefit to be gained by IS students becoming more aware of possible philosophical and cognitive positions and how such positions can influence the perspective of various stakeholders involved in IS development. In addition, a consideration of two different frameworks for viewing the world – the philosophical and the cognitive – can help the IS student better understand some of the underlying roots of the variety of viewpoints encountered over the duration of a systems development project. The paper argues that such fundamental understandings can help to reduce some of the problems of communication and meaning interpretation that bedevil many IS projects. It can be argued that this is indeed very important for delivering information systems and e-business value in a networked society. The continuing high cost of IS project failures demands that we consider all aspects of the development lifecycle in our attempts to ensure a successful implementation. A recent KPMG International report (KPMG, 2002) of 134 listed companies worldwide

reported that 56% had experienced an instance of IS project failure within the previous year at an average loss incurred of A$15 million – "*Commonly cited reasons for failure were inadequate planning, poor scope management, and poor communication between the IT function and the business."* . The scope of the paper relates to the last cited reason.

PHILOSOPHY, US RESEARCH AND IS PRACTICE

Philosophy can be defined as "the critical examination of the grounds for fundamental beliefs and an analysis of the basic concepts employed in the expression of such beliefs" (Encyclopaedia Britannica). A fundamental definition would be as "a reflection upon the varieties of human existence" or as the "rational, methodical, and systematic consideration of those topics that are of greatest concern to man" (Macropedia, Vol. 25, p. 742, 1985 edition).

This section argues that philosophy can play an active role in IS research and practice. It suggests that a particularly useful frame for integrating philosophical issues within IS research and practice is critical realism. Critical realism is a type of external realism in that it suggests that there exists a reality totally independent of our representations of it; the reality and the "representation of reality" operating in different domains – roughly a social, historical and transitive epistemological dimension and a natural, (relatively) enduring, intransitive ontological dimension. The philosophy stresses the importance of ontological matters in its emphasis on the real underlying deep structures and mechanisms making up the natural and social world. This emphasis within critical realism suggests a consideration of both ontological and epistemological issues. It suggests that what the world is seen to be largely defines the way it can be studied.

The importance of philosophical matters is perhaps not well recognized within such a heavily practical field as Information Systems. As Orlikowski and Barley (2001) argue, IS has much in common with engineering where the major focus is on such practical questions as "what works?". Ormerod (1997), for example, dismisses the role of philosophy when he discusses organisational intervention from an operational research perspective:

> *Any choice mechanism should, in my view, be rooted in practical requirements rather than in theoretical considerations with which very few practitioners could feel at home. In simple terms the approach (methods and their theories) chosen must support a process of intervention (practice) in a particular context to achieve the desired outcome. (p. 421)*

He goes on to suggest that philosophy plays a secondary role by supporting particular interventions only if needed and after the event:

> *...If a philosophical justification for action is needed it can be found in American pragmatism, Bhaskar's transcendental realism, Feyerabend's iconoclastic critique of philosophical positions or postmodernism (p. 421)*

Such a view neglects the useful role that philosophy can play as underlabourer to research and practice - the term underlabouring taken from Locke (1894, p. 14) as "clearing the ground a little...removing some of the rubbish that lies in the way of knowledge". Critical realism argues that philosophy can play an important and useful role in practical research. Collier (1994, p. 17) answers the question "why bother with philosophy?" with the following:

> *A good part of the answer to the question "why philosophy?" is that the alternative to philosophy is not no philosophy, but bad philosophy. The "unphilosophical" person has an unconscious philosophy, which they apply in their practice – whether of science or politics or daily life.*

Similarly Gramsci (1971, p. 323) argues "…everyone is a philosopher, though in his own way and unconsciously, since even in the slightest manifestation of any intellectual activity whatever, in "language" there is contained a specific conception of the world" (from Collier 1994, p. 17).

"Philosophizing" can be seen to be a reflective or meditative activity and as the IS field has matured a number of IS researchers in recent years have called for a clearer definition of the underlying philosophy and assumptions inherent in IS research (e.g. Mumford, et al. 1985; Banville and Landry, 1989; Iivari, 1991; Orlikowski and Baroudi, 1991; Nissen, et al. 1991; Hirschhein, Klein and Lyytinen 1995, 1996; Iivari and Hirschheim, 1996; Winder, Probert, and Beeson, 1997; Mingers and Stowell (eds.) 1997). An understanding of the implications of different philosophical positions should be seen as an important part of the IS curriculum.

Nissen, Klein and Hirschheim (1991, p. 4) suggest that the debate regarding research approaches should centre around two basic issues :

(i) the nature of what is investigated (ontology)

(ii) the nature of human knowledge and understanding that can possibly be acquired through different types of research and the appropriateness of the methods of investigation (epistemology).

Page (1998) in his examination of contemporary development methodologies argues persuasively about the need to deal with "the ontological/epistemological dichotomy". Kuutti (1996) argues that in a research situation a fundamental consideration needs to be given to the *object* under investigation, rather than the method used to investigate it. They suggest that the blind acceptance of a particular methodological approach inevitably ends up defining the object to be studied. Archer (1995, p.16-17) suggests that the linkage between ontology and methodology is a vital issue in any social investigation:

> *the nature of what exists cannot be unrelated to how it is studied…the social ontology endorsed does play a powerful regulatory role vis-à-vis the explanatory methodology for the basic reason that it conceptualises social reality in certain terms, thus identifying what there is to be explained and also ruling out explanations in terms of entities or properties which are deemed non-existent.*

Such arguments suggest that an understanding of the possible range of ontological and epistemological assumptions "brought to the table" by the various stakeholders involved in a systems development project is important knowledge for the analyst. This argument has resonance for the teaching and practice of IS developments skills, techniques and methodologies.

The Consequences of Social Constructivism

As Sayer (2000), p. 36 suggests "the elimination of the referent – the death of the object – is…consistent with the turn to discourse and away from materialism". This neglect of the object can be seen to be a by-product of approaches that emphasise the social construction of reality. As Dobson (2001) suggests this neglect of the object is particularly disadvantageous in the IS field as such a position denies much of the underlying reality so important to IS and IT people.

Realism in its argument for the presence of a reality external to perception places a needed emphasis on ontological issues and provides a means for a consideration of the underlying "object". Modern realist approaches such as critical realism suggest that there exists a reality totally independent of our representations of it; the reality and the "representation of reality" operating in different domains – roughly a social, historical and transitive epistemological dimension and a natural, (relatively) enduring, intransitive ontological dimension.

In contrast to what may be termed the naïve brand of realism used to support much of the derided positivist argument, modern realist approaches, such as Giddens' structuration theory and Bhaskar's critical realism, emphasise the richness and complexity of social reality. Disappointingly, however, the methodological consequences of such a rich and complex ontology have in general been very poorly addressed within such modern realist positions. Outhwaite's (1987) contention that contemporary realism is "ontologically bold and epistemologically cautious" is correct in that the realist appreciation of the richness and complexity of social life has not been matched by an increased sophistication in the necessary means to acquire knowledge of that complexity. Stones (1996) argues that the modern realist ontology has important methodological consequences in that methodologies and the knowledge claims derived must reflect this underlying ontological complexity. There thus needs to be an associated continual commitment to caution, scepticism and reflexivity in consequent knowledge claims made – important considerations for the student IS developer.

Rowland (1995), from an interpretive perspective, usefully argues that any research study reflects a particular worldview composed of at least three philosophical layers - ontological beliefs, epistemological assumptions and methodological choices:

> *Ontological beliefs are our beliefs regarding reality (or what it is), epistemological assumptions are our assumptions regarding how we come to know about our world (i.e. our sources of knowledge, or how we make sense of reality); and methodological choices are the means we choose in attempting to achieve desired ends. ...Particular ontological beliefs lead us to make particular epistemological assumptions... That is, our explanations of how people come to know about the world depend on what we believe the world to be. Likewise, particular epistemological assumptions lead us to choose certain methodologies over others. We choose to carry out activities that fit with how we assume humans come to know. (Rowland, 1995, p. 278)*

This explanation of the research process is similar to that for the realist except for the fact that it emphasises epistemology in preference to ontology. For the realist ontological beliefs are of more immediate concern than

epistemological assumptions. In order for the IS student to develop an understanding of these issues, he or she must first define what reality is seen to be as this then directs us towards how we look at it (methodological choices) and impacts on models for how we make sense of it (epistemological assumptions). Rather than Rowland's "We choose to carry out activities that fit with how we assume humans come to know" the realist would argue that "We choose to carry out activities that are consistent with what we believe the world to be". As stated above, an awareness of the range of different positions (often unconsciously) adopted by stakeholders, can be an important instrument in the toolkit of the student IS developer.

Perhaps there needs to be a synthesis of both of these views in that understandings of how "humans come to know" and what "we believe the world to be" are equally as important in both developing meaningful IS research and successfully completing information systems projects.

How we Come to know – Cognitive Styles and Personality Variants

Cognitive positions fundamentally affect this dimension and developing metacognitive skills would help the student to reflect on the range of philosophical and cognitive influences on stakeholder viewpoints. Metacognition can be described as thinking about thinking, a definition that is, interestingly, also applied to philosophy (see Honderich, 1995, p. 666). A more comprehensive definition is provided by Flavell (1976) who suggested that:

> "*Metacognition refers to one's knowledge concerning one's own cognitive processes or anything related to them, e.g. the learner-related properties of information or data. For example, I am engaging in metacognition if I notice that I am having more trouble learning A than B; if it strikes me that I should double check C before accepting it as fact."*

In a study concerning the potential role of reflective learning and metacognitive processes in the development of capable and competent computer users, the authors came to the conclusion that *"Reflection and metacognition is central to the development of 'expert learners' and thus can be seen to provide a sound framework for the development of 'capable' computer users."* (Phelps et al, 2001). One aim of this paper is to suggest that helping students to be aware of their own cognitive resources will help in the understanding of the different positions taken by others.

For the selection of the features of the cognitive profile, one factor contributing to the decision to adopt the three measures chosen was the assertion that:

> *"The particular combination of aptitudes and traits possessed by each individual is reflected in the individual's cognitive styles, personality, and learning styles." (Jonassen & Grabowski, 1993).*

In addition, a model (Sadler-Smith, 1996) has been adopted which itself was derived from Curry's "Onion Model" of individual differences (Curry, 1983). This model attempts to define and show the relationship between personality, cognitive styles, learning styles and learning strategies. These elements make up an individual's cognitive profile. The core of the model represents the individual's "central personality dimension" with the next layer being cognitive style. Between cognitive style and learning strategies lies learning style. The outer layer is that of learning preferences where the individual has a general preference for one specific mode of learning over others. Three well-known and reliable measures, Richard Riding's Cognitive Styles Analysis, Entwistle's Approaches to Study Inventory and the Myers-Briggs Type Indicator are used to develop the concept of the cognitive profile and provide illustrative examples.

Measures

The following three measures were selected based on empirical evidence of their validity and reliability as measurements and constructs.

- Cognitive Styles Analysis (Riding, 1991) - a computer-based test which measures personal preferences for representing and processing information.
- Approaches and Study Skills Inventory for Students (ASSIST) (Tait et al., 1998)- aims to measures deep, surface and strategic approaches to learning in addition to other categories of learning.
- Myers-Briggs Type Inventory (Myers et al., 1999) - a well known management and educational tool for classifying personality type which can also be used to measure cognitive style. Although there has been and continues to be a debate on the reliability of the MBTI (Nowak, 1996), its widespread use in HE studies and close connection to measures of cognitive style (Scholl, 1999) led to it being adopted.

Cogntive Styles Analysis (CSA)

Cognitive Style can be defined as "an individual's preferred and habitual approach to organising and representing information ." (Riding & Rayner, 1998). This instrument deals directly with the form and content of the information which each individual processes. Its development (Riding & Cheema, 1991) was based on an extensive review and consolidation of many other measures. The two cognitive style dimensions identified by the CSA and have the following characteristics:

- **Verbal-Imagery** - an individual's position on this dimension determines whether that person tends to use images or verbal representation to represent information when thinking.
- **Wholist-Analytic** - an individual's position on this dimension determines whether that person processes information in parts or as a whole. (Riding and Cheema, 1991)

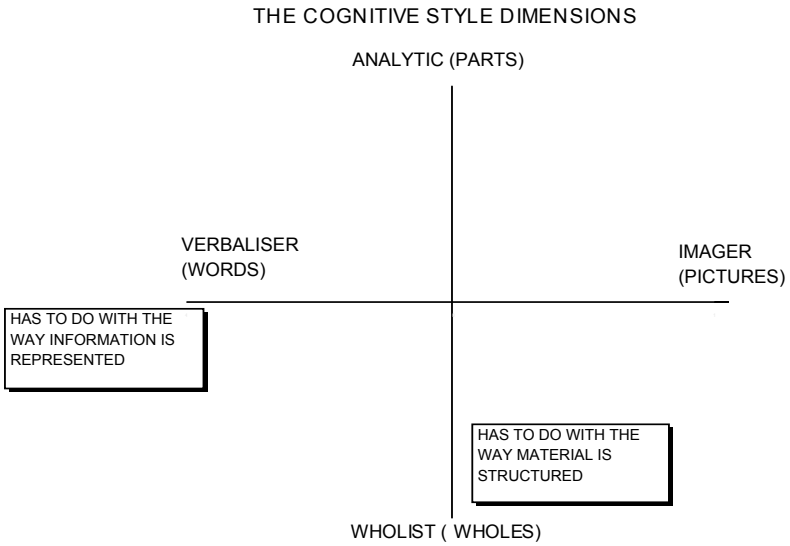

Figure 1: Cognitive style dimensions (Riding, 1991)

It can be argued that Riding's (1991) analysis is primarily concerned with what the critical realist would call the transitive knowledge-focused dimension. His ontological position is not stated and there seems to be little consideration as to whether different objects of investigation may in fact prompt the use of different imaging or processing characteristics.

As Archer (1995) argues above, the methodology used cannot be considered separately from the underlying ontology in that our ontological position largely defines the objects of enquiry and thus the means by which we come to know those objects. For the realist it would be an interesting task to examine whether, and to what extent, one's ontological position predefines the cognitive style we use. Perhaps a social constructivist in arguing for the social construction of reality is displaying a preference for wholist representations and reinforcing a focus on imagery. Perhaps a realist, in their concern for explanation and analysis of underlying deep structures and mechanisms is displaying a preference towards analytic representations. Given this understanding we could draw a modification of Figure 1 above as in Figure 2 below. On first consideration we would expect that most methodologies and techniques would lie in the Realist/Word dimension or the Constructivist/Image dimension since these representations seem the most compatible.

Different techniques, however, can be fitted into each of the quadrants. Some suggestions for the possible positions of well know methodologies and techniques on such a framework are presented in Figure 2 below. The placement of such techniques within the model is illustrative only but it suggests that the understanding of these techniques is made easier if underlying assumptions are made explicit. Such an explicit framework may also prove useful in helping to appreciate why some techniques are more preferable than others to different individuals.

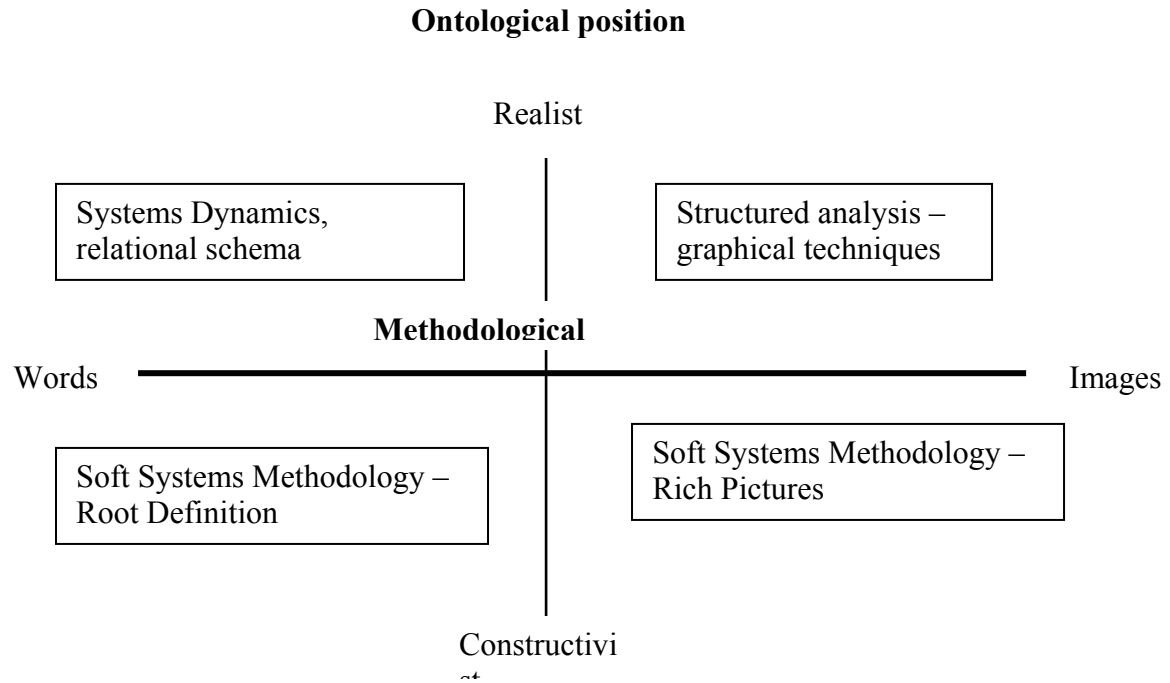

Figure 2: Ontological position versus methodological focus

Cognitive Style and IS Development

There have been several studies that have considered the effect of cognitive styles on areas of information systems development and human computer interaction. Ford (2000) studied the implications of the distinction between holist and serialist cognitive styles for supporting individual users through user interface design. Another study looked at the possible impact of cognitive styles on the user-model based design of adaptive human-computer interfaces (Averbukh et al., 1997). With the advent of the web, the amount, range and quality of information available to users have increased enormously. Consequently, there has been an increased interest in, for example, the relationship between cognitive style, on-line database search experience and effectiveness in Web search performance (Palmquist & Kim, 2000). Additional studies have attempted to look at the relationship between cognitive style and the format of learning materials for computer assisted instruction or web-based learning (Pillay, 1998, Boles and Pillay, 1999, McKay, 1999).

Myers-Briggs Type Indicator (MBTI)

The Myers-Briggs Type Indicator (MBTI) is developed from the work of C. G. Jung and his theory of psychological types (Jung, 1923). Myers suggested 16 basic personality types which were created by the combinations of the elements of the four main scales (Myers and Myers, 1980):

Extraversion (E) and Introversion (I)
Sensing (S) and Intuition (N)
Thinking (T) and Feeling (F)
Judging (J) and Perceiving (P)

The results of an individual's MBTI assessment give a provisional type such as ENTJ, ISFP or ESFJ - i.e. the type is composed of one element from each of these pairs of preferences. This measure is widely used in educational and managerial research (Hammer, 1996).

MBTI and IS Development

Personality factors and the Myers-Briggs Type Indicator (MBTI) also have a long association with systems development, human computer interaction and interface design (Weinberg, 1971; Shneiderman, 1980, 1998; Buie, 1988). In terms of e-learning, a recent study (Dewar & Whittington, 2000) has looked at the effect of MBTI type on strategies for online learning. Hulme (1994) considered the role of MBTI and cognitive preferences in diverse learning environments. In addition, MBTI has been used as a measure of both learning

style (Kerr & Matta, 1987; Scholl, 1999) and cognitive style (Jones, 1994), the first and last of these in studies looking at educational computer use.

Approaches and Study Skills Enventory for Students (ASSIST)

ASSIST is developed from the earlier versions of the Approaches to Study Inventory (Tait et al., 1998). The main section of ASSIST consists of a self-report questionnaire. It measures approaches to learning on three main scales - deep, surface and strategic. Each of the main scales is comprised of several sub-scales:

Deep: seeking meaning; relating ideas; use of evidence; interest in ideas

Strategic: organised study; time management; alertness to assessment demands; achieving; monitoring effectiveness

Surface/Apathetic: lack of purpose; unrelated memorising; syllabus boundness; fear of failure

The Approaches to Study Skills Inventory for Students (ASSIST) (Tait et al, 1996) provides a useful instrument for providing accessible learning related information which students can reflect on. One reason for ASSIST's development was to help identify "*students at risk through ineffective study strategies"* (Tait & Entwistle, 1996), but it can also be used to illustrate different approaches to learning. The instrument provides a clearly laid out profile of the learning approaches of each student identified via the administration of a self-report questionnaire. With suitable additional information, discussion and reflection, the profile offers the potential of being of great help in raising the awareness of students to the differences in learning styles. Interestingly, students are often vaguely aware of their own "style" being different from others, but often consider this as being some sort of deficiency in their own approaches to learning.

On Learning Styles and Cognitive Styles

The relevance of an individual's learning style and cognitive style to that person's performance in a range of learning situations has been explored by many authors over the years (Kolb, 1985; Honey & Mumford, 1992; Riding, 1991, 1997; Laurillard, 1979, 1993; Ford 2000). Although the terms have often been used interchangeably (Sadler-Smith, 1996; Riding, 1996; Curry, 2000), learning styles can be considered to cover a much broader range of approaches to learning. They often consider factors that can vary for the individual – i.e. an individual's learning style could differ according to the subject s/he is studying, the mode of assessment employed or even the amount of time available. Indeed, the possibility of variance over time and learning situation can call into question the relevance of attempts to use *individual* learning styles to inform the development of computer-based learning material, (Valley, 1997). It is considered that cognitive styles are more fundamental to the individual's personal and psychological makeup and constitute a stable trait. Sadler-Smith (1996) considers learning styles and cognitive styles to be "*fundamentally quite distinct and having differing but complementary implications for the design of teaching".* In terms of IS development, the interplay between cognitive styles and learning styles suggest that those factors relating to the impact of cognitive styles on the development process remain relevant here.

CONCLUSION:

This paper has suggested a potential role for an understanding of philosophical and cognitive variants in the education of information systems (IS) students. The philosophical and cognitive perceptions that individuals' function within are considered to be important factors in shaping the outcome of systems development projects. Raising the awareness in information systems students of this range of philosophical and cognitive stances and how their impact on the ways in which developers can vary in their perceptions of the world (and thus, any given IS project) is suggested as a useful addition to the information systems curriculum. The role of philosophy in information systems research and development was discussed. This was followed by consideration of some the factors contributing to the cognitive profile of each individual. With reference to critical thinking, Soraj Hongladarom (1998) comments on Richard Sutton's concept of "ironic distance" (Sutton, 1995). Hongladarom suggests that:

> *"Sutton would like to see critical thinking be thought of in such a way that students appreciate the claim that there is no final set of vocabularies to describe reality, and that the students develop "ironic distance" from any of the positions being studied and their "redescription."'* (Hongladarom, 1998, p1)

Re-describing organisational activities and systems processes from the descriptions of others is central to the work of the systems developers. Understanding the range of perspectives, their roots in the philosophies and cognitive profiles of different stakeholders and developing the ability to maintain an ironic distance from any given one is a powerful tool for the systems developer. Raising the awareness of IS students of these issues is seen as a useful addition to the range of mechanisms and instruments at their disposal. In the long run, it is

argued that these developments are important for delivering information systems and e-business value in a networked society.

REFERENCES:

Archer, M. (1995), Realist social theory: the morphogenetic approach, Cambridge University Press, Cambridge.

Banville, C. and Landry, M., (1989), "Can the field of MIS disciplined?", Communications of the ACM, Vol. 32, No. 1, pp. 48-60

Boles, W. and Pillay, H. (1999). A Study on the Impact of Designing Computer-Based Instruction Considering Preferred Cognitive Styles, In Proceedings, 11th Annual Conference and Convention Australasian Association for Engineering EducationAAEE, , 66-71.

Collier, A. (1994), Critical realism: an introduction to the philosophy of roy bhaskar. London: Verso.

Chen, C. (2000). Individual Differences in a Spatial-Semantic Virtual Environment. Journal of the American Society for Information Science, 51, 529-542.

Curry, L. (1983). An organization of learning styles theory and constructs. In Curry, L. (ed), Learning style in continuing education (115-131). Dalhousie University.

Dobson, P. (2001), "The Philosophy of Critical Realism - An Opportunity for Information Systems Research", Information Systems Frontiers, July 2001.

Ford, N. (2000). Cognitive styles and virtual environments. Journal of the American Society for Information Science, 51, 543-557.

Flavel, J.H. (1976). Metacognitive aspects of problem solving. In Resnick, L.B. (ed)The nature of intelligence, 231-235. Erlbaum.

Gramsci, A. (1971), Prison Notebooks, Lawrence & Wishart, London.

Hammer, A. L. (ed.) (1996) MBTI Applications: A decade of Research on the MBTI, Consulting Psychological Press, Paolo Alto, CA.

Hirschheim, R. and Klein H.K. and Lyytinen, K., (1995), Information Systems Development and Data Modeling: Conceptual and Philosophical Foundations, Cambridge University Press, Cambridge, UK

Honderich, E. (ed.) (1995) The Oxford Companion to Philosophy, Oxford University Press, Oxford.

Hongladarom, Soraj. (1998). Critical Thinking and the Realism/Anti-Realism Debate, http://pioneer.chula.ac.th/~hsoraj/web/CT.html. Last access 31/3/03.

Iivari, J. and Hirschheim, R., (1996), "Analyzing information systems development: a comparison and analysis of eight IS development approaches", Information Systems, Vol. 21, No. 7, pp. 551-575

Iivari, J., (1991), "A paradigmatic analysis of contemporary schools of IS development", European Journal of Information Systems, Vol. 1, No. 4, pp. 249-272

Jonassen, D. H. and Grabowski, B. L. (1993) Handbook of Individual Differences , Learning , and Instruction, Lawrence Erlbaum Assocs,.

Jung, C. G. (1923) Psychological Types, Routledge and Kegan Paul, London.

KMPG (2002), Failed IT projects cost business over #8 million a time. KPMG UK News, kpmg.co.uk/kpmg/uk/press/detail.cfm. Last accessed 30/5/03.

Kuutti, K. (1996), Debates in IS and CSCW Research: Anticipating System Design for Post-Fordist Work in Orlikowski, W.J., Walsham, G., Jones, M.R. and DeGross, J.I. (eds), Information Technology and Changes in Organisational Work, Chapman and Hall, London.

Marton, F. and Saljo, R. (1976). On Qualitative Differences in Learning: I. Outcome and process. British Journal of Educational Psychology, 46, 4-11.

McKay, E. (1999). An investigation of text-based instructional materials enhanced with graphics. Educational Psychology, 19, 323-335.

Mingers, J and Stowell, F. (eds.), 1997, Information Systems: an Emerging Discipline?, McGraw-Hill, London.

Mumford, E., Hirschheim, R., Fitzgerald, G. and Wood-Harper, A.T. (eds.), (1985), Research Methods in Information Systems, North-Holland, Amsterdam

Myers, I. B., McCaulley, M. H., Quenk, N. I. and Hammer, A. L. (1999) MBTI Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator, Consulting Psychologist Press, Paolo Alto, CA.

Myers, I. B. and Myers, P. B. (1980) Gifts Differing, Consulting Psychologist Press, Paolo Alto, CA.

Nissen, H.-E., Klein, H.K. and Hirschheim, R. (eds.), (1991), Information Systems Research: Contemporary Approaches & Emergent Traditions, North-Holland, Amsterdam

Nowack, K. (1996). Is the Myers Briggs Type Indicator the Right Tool to Use? Performance in Practice, American Society of Training and Development, 6.

Orlikowski W.J. and Baroudi, J.J., (1991), "Studying information technology in organizations: research approaches and assumptions", Information Systems Research, Vol. 2, No. 1, pp. 1-28

Orlikowski, W.J. and Barley, S.R. (2001), Technology and institutions: What can research on information technology and research on organizations learn from each other?, MIS Quarterly, Vol: 25, Iss: 2, pp. 145-165.

Ormerod, R.J. (1997), The design of organisational intervention: choosing the approach, Omega, Vol: 25, Iss: 4, pp. 415-435.

Outhwaite, W., (1987), New philosophies of social science: realism, hermeneutics, and critical theory, New York: St. Martin's Press.

Page, S. (1998) The Ontology/Epistemology Dichotomy in Information Systems Development. Proceedings: 7th International Conference of Information Systems Development, Bled, Slovenia, Sept. 21-23, 1998.

Phelps, R., Ellis, A. and Hase, S. (2001). The Role of Metacognitive and Reflective Learning Processes in Developing Capable Computer Users. In G. Kennedy, M. Keppell, C. McNaught & T. Petrovic (Eds.), Meeting at the Crossroads. Proceedings of the 18th Annual Conference of the Australian Society for Computers in Learning in Tertiary Education, 481-490. University of Melbourne.

Pillay, H. (1998). An Investigation of the Effect of Individual Cognitive Preferences on Learning through Computer-based Instruction. Educational Psychology, 18, 171-182.

Riding, R. J. (1991) Cognitive Styles Analysis, Learning and Training Technology, Birmingham.

Riding, R. and Cheema, I. (1991). Cognitive Styles: An overview and integration. EducationalPsychology, 11, 193-213.

Riding, R. and Rayner, S. (1998) Cognitive Styles and Learning Strategies: Understanding Style Differences in Learning and Behaviour, David Fulton Publishers, London.

Riding, R. J. and Rayner, S. G. (2000) International Perspectives on Individual Differences - Volume 1: Cognitive Styles, Ablex Publishing Corporation, Stamford, Conneticut.

Rowland, G, (1995), Archetypes of systems design, Systems Practice, Vol: 8, Iss: 3, pp. 277-289.

Sadler-Smith, E. (1996). 'Learning Styles' and Instructional Design. Innovations in Educational and Training International, 33, 185-193.

Sayer, A. (2000), Realism and Social Science, Sage.

Scholl, R. W. (1999). Cognitive Style and the Myers-Briggs Type Inventory (MBTI). [Web page].http://www.cba.uri.edu/Scholl/Notes/Cognitive_Style.htm. Accessed 6/12/02.

Stones, R. (1996), Sociological Reasoning: Towards A Past-Modern Sociology, MacMillan.

Sutton, R. (1995). Realism and Other Philosophical Mantras. Inquiry: Critical Thinking Across the Disciplines.

Summerville, J. (1999). Role of awareness of cognitive style in hypermedia. International Journal of Educational Technology, 1.

Tait, H. and Knight, P. (Eds), (1996). The Management of Independent Learning. London: Kogan Page.

Tait, H., Entwistle, N. J. and McCune, V. (1998). ASSIST: a reconceptualisation of the Approaches to Studying Inventory, In Improving Student Learning(Ed, Rust, C.) Oxford Centre for Staff and Learning Development, Oxford, 262-271.

Winder, R.L., Probert, S.K. and Beeson, I.A. (Eds), 1997, Philosophical Aspects of Information Systems, Taylor & Francis, London.

Witkin, H. A., Moore, C. A., Goodenough, D. R. and Cox, P. W. (1977). Field-Dependent and Field Independent Cognitive Styles and Their Educational Implications. Review of Educational Research, 47, 1, 1-64.

COPYRIGHT