4

Teaching for Quality Learning Online

A Layered Design Model for Higher-order Thinking

Paul Nicholson and Geoff White
School of Scientific and Developmental Studies, Deakin University, Burwood, 3125, Australia
pauln@deakin.edu.au

Keywords: learning models, learner-centred learning, thinking, internet, electronic communication

Abstract The majority of online instructional programs are transmissive, viewing learning as passive, rather than as interactive and engaging – important attributes for the promotion of higher order learning. We argue that the lack of clear pedagogical models for online learning is a critical limiting factor in the development of quality teaching online. We present a model for designing online learning environments for facilitating higher-order thinking in traditional and 'fuzzy' contexts. Conceptualising user interaction with the instructional system under the categories of 'Interaction and 'Expertise Development' greatly facilitates the incorporation of effective pedagogical approaches in the instructional design process.

1. INTRODUCTION

The majority of online instructional programs are transmissive, viewing learning as passive, rather than as interactive and engaging – important attributes for the promotion of higher order learning. Why do online course designers routinely ignore such well-known pedagogical approaches to facilitating effective learning? Presumably, this neglect is a consequence of a focus on developing lower-order thinking or skills, sharing with the traditional classroom a passive and transmissive pedagogy as the default design model. However, in this paper we argue that the lack of clear pedagogical models for online learning, particularly for supporting the development of higher-order thinking, is a critical limiting factor in the

D. Watson et al. (eds.), *Networking the Learner*

development of quality teaching online. As a step towards overcoming this barrier, we present a design model that we have developed and refined over the past ten years, and which we believe provides significant advantages for designing online learning environments for facilitating higher-order thinking.

2. WHY HIGHER ORDER THINKING AND LEARNING?

The constant change that characterises contemporary workplaces is nowhere more apparent than in the dynamic organisations that value and utilise their employees' capacities for strategic and responsive thinking. For such organisations, learning is their central and strategic focus (Zuboff 1988). The 'knowledge era' organisation generates its own knowledge and understandings and anticipates, defines and understands its own strategic opportunities. Such organisations place significant learning demands upon its employees as they operate within workplaces described by Barnett (1999) as characterised by 'supercomplexity'. Contrasting with these 'knowledge era' organisations are those which are reactive to change, preferring instead to focus upon the maintenance of traditional practices.

But what exactly is required of those who work in supercomplex contexts? Despres and Hiltrop (1995) identify the following attributes of a knowledge-era workplace: knowledge and skills are specialised and deep; groups and projects provide the locus of activity; skill obsolescence is rapid; performance measures value process effectiveness; customers, problems and issues are the focus of work activity; employee loyalty is to the profession, networks and peers. Finally, the individual worker's impact on organisational performance is infrequent but strategic.

Within the context of online training and development, what design models will help people efficiently develop and refine their capacities to contribute to organisational survival in the new economies – to think and learn in higher order ways? The cognitive competencies involved in such thinking include the ability to:

1. analyse claims, opinions and complex situations
2. make critical judgements of alternative views
3. evaluate and synthesise a variety of positions into a coherent whole
4. apply their knowledge and understanding in productive and defensible ways
5. meet strategic challenges facing their organisation.

3. DEVELOPING ONLINE ENVIRONMENTS FOR TRADITIONAL CONTEXTS

Traditional education and training contexts are those that focus on developing clearly defined knowledge and skills, and which constitute a bounded knowledge system (Nicholson and Johnson 1999). These contexts usually require the incisive and expert transfer and application of existing knowledge to new, but predictable, situations. In such cases, there is a well-defined knowledge base of content, rules and practices to guide the development of both traditional and on-line training programs (e.g., Murray 1996), the majority of which focus on developing low-level skills and knowledge. Such programs are often characterised by:

1. A transmissive instructional model
2. Direct trainer-to-learner delivery
3. Clearly specified and delineated content – skills, software, procedures
4. Little long-term retention unless in a workplace context.

Such knowledge bases commonly contain both declarative and procedural knowledge – a structure that simplifies the development of software-based training packages by providing functional decomposition of the knowledge base for a particular area into knowledge and process components. This fragmentation is critical to the success of program designers who attempt to recreate expert knowledge in adaptive software environments that require precisely articulated knowledge structures at their core. In this instructional-design paradigm, incorrect or misunderstood knowledge is referred to as 'buggy knowledge' because it introduces 'errors' into the self-consistent data model that commonly underpins such software. Dealing with buggy knowledge is a major design problem in both traditional and on-line programs, both in terms of identifying the strategies that could begin to address it, and in terms of the time and resources needed to be devoted to it's inclusion in an otherwise clearly articulated instructional sequence. This is particularly so in situations that are trying to change, or to build on, long established workplace practices where the persistence and resilience of deeply held situative beliefs and practices are well documented (e.g., Anderson, Greeno, Reder, and Simon 2000, Putnam and Borko 2000).

Adult learning theories such as Mezirow's Transformational Learning Theory, Knox's Proficiency Theory, Self-directed Learning, and Knowle's Androgyny, while widely discussed and employed in varying ways and degrees in face-to-face training, have little impact on the design of traditional on-line learning environments (DeMartino 1999). This appears to be a consequence of the perceived conflict between the instructional design paradigms (as above) and the requirements of the learning theories. For example, the following aspects of adult learning theories (DeMartino 1999, p.786) raise serious, but not insurmountable, challenges to instructional designers intent on developing an instructional sequence predicated on the transfer of a fixed body of knowledge and skills:

1. Individual experience of the world is important to learning
2. Learning is not the discovery of independent, pre-existing knowledge but the construction of meaning through experience
3. Learning is more subjective than objective
4. The emphasis is on the individual learner's interpretation, integration and transformation of knowledge
5. Knowledge is actively constructed by the learner, not passively received from the environment.

This perceived mismatch, however, disappears when the focus of 'instruction' shifts from delivering content to developing higher-order thinking as naive assumptions about the passive learning of content have to be replaced by a more sophisticated understanding of the requirements of person-centred, active-learning models. This reconceptualisation is necessary because higher-order thinking results from information and information stored in memory being interrelated and/or rearranged to achieve a purpose or find possible answers to complex problems. (Lewis and Smith 1993). Cognitive complexity is the hallmark of such learning contexts and demands the use of an active learning sequence as in Figure 1 for the achievement of the necessary higher order learning.

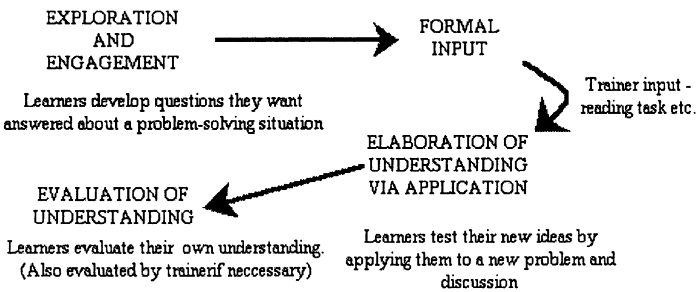

Figure 1. Essential components of an active learning sequence (Nicholson and White 2000)

Initial exploration and engagement are key aspects of an active learning sequence, as this is the part of the learning sequence that engages and contextualises issues by providing learners with the opportunity to locate the issue or content in their own context. Contextualisation requires the learners to bring their prior knowledge, experiences, and interpretations into an authentic learning sequence. Formal instructor input into the sequence is also required, as simply engaging with the issues does not guarantee higher order learning will occur. This stage, of course, is one that dominates many passive learning models.

Subsequent stages in the active learning sequence have the learners testing their own understandings by applying them to new problems and, in some cases, evaluating their own understandings. This combination of a focus on higher-order thinking, active learning, and a situative approach has been described as comprising a Rich Environment for Active Learning (REAL) (e.g. Dunlap 1999). The most important aspect of a REAL is the engagement and interaction of participants between themselves, external mentors, and the course content. Online technologies are able to support such interaction, and can be used in many ways to structure interactions amongst the participants of a REAL.

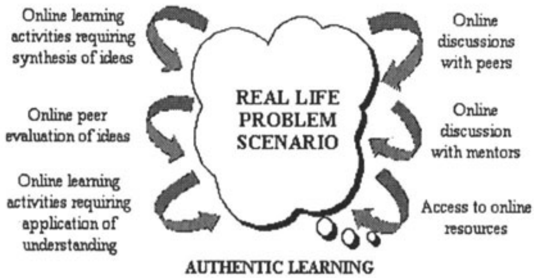

Figure 2. Conceptual design of a generic online REAL (Nicholson and White 2000)

Figure 2 depicts a conceptual design for an online REAL that is based on our work over the past 10 years in developing online adult learning environments for facilitating higher-order thinking. It was used as the basis of a state-wide professional development program for the Victorian Department of Employment, Education and Training. This was to assist teachers in adopting successful planning, teaching and classroom management strategies that would help to provide a better environment for their children's learning in the Middle Years of Schooling (MYS). The design required the development of an online learning environment that would eventually replace an effective face-to-face professional development program. The program was not particularly focused on higher-order thinking about the embedded issues, but rather, about the transfer of existing knowledge and skills to new contexts – in this case a 'traditional' context. The initial stage provides the participants with an overview of the nature and content of the course, and provides the participants with the opportunity to meet with other course participants – an aspect we suspect is due largely to the demographics of the teacher workforce and their lack of experience in, and confidence with, online learning.

We fitted our REAL design to an apprentice-based learning model (Guzdial and Kehoe 1998) as this is a proven approach to adult online learning in this context. Figure 3 shows how our generic conceptual design for a REAL was implemented in this particular case. Due to teacher resistance to working solely in an online mode, the initial and final phases of the program are conducted face-to-face. The role of technology in the MYS program is simply to facilitate participants' access to people and resources; there is no inherent cognitive scaffolding, other than that provided by the mentors. The outcome of the course is the production of an action plan for implementing MYS strategies in each participant's school – an instance of the peer-evaluation aspect of the REAL design in Figure 1.

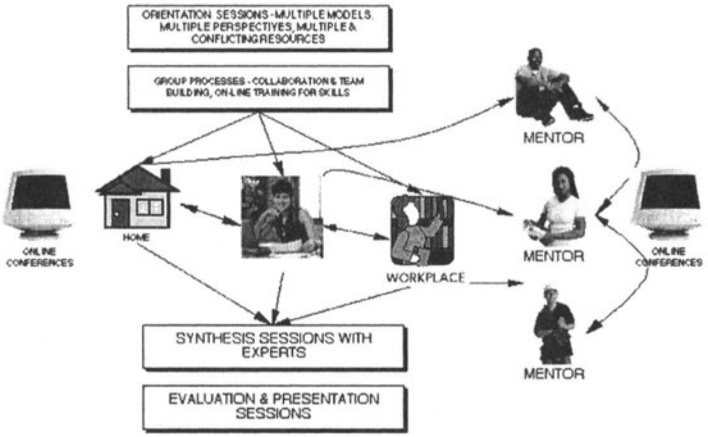

Figure 3. The Middle Years of Schooling REAL structure

4. FUZZY CONTEXTS AND HIGHER-ORDER THINKING

There is no argument that development of a REAL, either face-to-face or online, is a reasonable approach for traditional contexts. However, it is problematic for developing higher order thinking and understanding when the issue or content is 'fuzzy' and does not comprise a bounded knowledge system (as in the MYS project above). This means there is an absence of key factors such as a well-articulated (or perhaps cohesive) knowledge base, a clear solution, or an obvious basis for decision making.

Because unbounded knowledge systems lack ready-made answers to be 'learned', fuzzy environments need a design that accommodates uncertainty as a key feature, and one that is focused upon higher-order thinking. In such designs, the learner has to develop an answer meaningful within the context of the learning experiences provided by the teacher or course. Examples of contemporary fuzzy problems in a 'real-world' business context include issues such as deciding on strategic e-commerce structures and processes, and meeting the challenges of globalisation. Within the education context, coping with the 'threat' of virtual schooling or the commercialisation and internationalisation of education present similar levels of conceptual complexity characteristic of fuzziness. Such fuzzy problems intersect with both knowledge and value domains, and are not amenable to simple solutions. The challenge for designers trying to develop courses for such fuzzy contexts then becomes a matter of responding to a set of difficult questions that include:

1. How to facilitate higher-order learning & knowledge growth?
2. How to structure and sequence tasks with 'fuzzy' outcomes and unbounded knowledge bases?
3. How to build on existing expertise and 'intellectual capital'?
4. How to evaluate 'fuzzy' program outcomes?

In general, traditional instructional design paradigms cannot cope with the nature, scope, and incorporation of uncertainty and values that fuzzy contexts contain. We argue that any instructional design model that purports to address fuzzy contexts must include aspects that deal with the following (cf. Dunlap 1999) as basic design requirements:

1. Uncertainty ('fuzziness')
2. Decisions on a path of action
3. Judgement & interpretation
4. Multiple perspectives
5. Imposing meaning, effortful thinking and multiple solutions
6. Self-regulation of thinking.

In order to accommodate these features, the traditional instructional design process of creating a predetermined learning *sequence* needs to be replaced with one that creates a set of *loosely structured learning* pathways, as the notion of sequential learning is problematic in fuzzy contexts. There is a clear need for a range of new design paradigms that can be adapted to suit a wide range of fuzzy contexts. The layered-design model in Figure 4 is one such approach to developing higher-order thinking in fuzzy contexts that has proven its value in this regard.

5. A DESIGN FOR FUZZY ENVIRONMENTS

We developed the layered-design model (Figure 4) over time, as it became clear that in designing for fuzzy contexts, at least four separate design processes had to be undertaken.

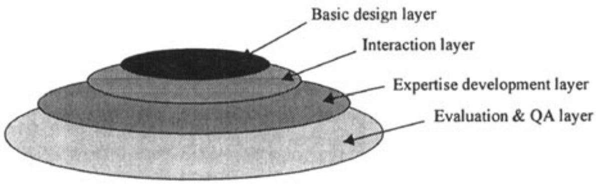

Figure 4. A layered-design model for fuzzy environments

These focus on (a) technical aspects of the design; (b) the nature and purposes of the ways in which learners will interact with the course content, other participants, and external individuals; (c) the pedagogical structures and processes that will build upon the interactions to develop expertise in the particular fuzzy context; and (d) the authentic assessment processes that need to be developed to ensure the attainment of expertise can be evaluated in a meaningful, as opposed to simplistic, manner. While these might seem to be straightforward, in our experience it is not an easy task to develop the content and processes with the same level of certainty as in a traditional design context. Indeed, the design task becomes more of a 'crafting' of the learning environment than one of technical construction.

The first design task examines the basic design layer – the choice of platform, software, and other essentially technical considerations. These are often seen as precursors to the design process, however we believe they have to be integrated because of the implications of such decisions for the rest of the design process. In other words, learning needs, not the platform or software, should dictate the design (cf. Alexander 1999).

Figure 4 is an abstraction of aspects of Figure 2, focusing on ensuring that specific aspects of the online discussions and engagement with content and resources are properly structured to achieve the desired learning outcomes. Content, while critical, is no more important than the discussions and arguments associated with its analysis. We have found it is important to differentiate between interaction and the development of expertise, as the two are fundamentally distinct, a point often overlooked in traditional contexts. Simply planning structures and processes such as learning sequences, discussions and online seminars etc. to engage learners with content is insufficient for the facilitation of higher order learning. These components must be supplemented by the purposeful development of expertise arising from such interactions.

The expertise development stage is also affected by the situative nature of fuzzy contexts. For example, in the case of a business trying to address the challenges of globalisation, the required expertise is not only that of understanding the issues (which might be amenable to a traditional design context), but also includes an understanding of situative aspects such as strategies for the development of a management-team approach, the sharing of understandings and the leveraging of group intellectual capital in the pursuit of corporate goals. In Education, it could relate to university students developing a real (as opposed to mathematical) appreciation of the basis of non-deterministic chaos theory. In both cases the desired outcomes include personal and group aspects that have to be developed along with the content knowledge needed to support them.

Similar issues also affect the assessment process. The notion of peer and self-assessment was raised in Figure 2, and it is relevant here. For example, how should the evaluation of the business case (above) be conducted, and by whom? There is no 'correct' answer to assess, other than that the participants' ability to perform the desired tasks has improved, an issue best determined in the workplace. In such cases, the assessment layer design would include a large element of employer evaluation of performance over time, a distinguishing feature relative to the all too common 'end of course' competency assessment which is axiomatically unsuited to fuzzy contexts.

6. CONCLUSION

Being grounded in notions of active learning and authentic contextualised settings, the layered design model we have outlined in this paper stands in stark contrast to many of the mastery-learning based online environments currently available for knowledge and procedural competency training. Our model has been used for a range of higher order learning purposes, and through this experience we have learned the significant dependence of the model upon detailed knowledge of the learning theories literature, an understanding of the dynamics of learning, and expertise in the delivery of instruction designed to facilitate higher order thinking and learning. Our experience affirms the importance of these understandings and competencies, rather than technical imperatives, as the primary driver of design for higher order learning online. After all, online technologies are a medium, not a training solution, most particularly so when the desired training outcome is the higher order strategic thinking valued by today's knowledge era organisations.

REFERENCES

Alexander, S. (1999) Selection, dissemination, and evaluation of the TopClass WWW-based course support tool. *International Journal of Educational Telecommunications, 5* (4), pp. 271-283.

Anderson, J., Greeno, J., Reder, L. and Simon, H. (2000) Perspectives on learning, thinking and activity. *Educational Researcher, 29* (4), pp. 11-13.

Barnett, R. (1999) Learning to work and working to learn. In *Understanding learning at work,* D. Boud (ed.), Routledge, London, pp. 29-44.

DeMartino, D. J. (1999) Employing adult education principles in instructional design. In *Proceedings of SITE'99,* J. Price, J. Willis and D. Willis et al. (eds.), San Antonio, February, pp. 783-788.

Despres, C. and Hiltrop, J. (1995) Human resource management in the knowledge age: current practice and perspectives on the future. *Employee Relations,* 17 (1), pp. 9-23.

Dunlap, J. (1999) Rich environments for active learning on the web: guidelines and examples. In *Proceedings of WebNet 99 – World Conference on the WWW and Internet,* P. de Bra and J. Leggett (eds.), Honolulu, October, pp.313-318.

Guzdial, M. and Kehoe, C. (1998) Apprenticeship-based learning environments: A principled approach to providing software-realized scaffolding through hypermedia. *Journal of Interactive Learning Research, 9* (3/4), pp. 289-336.

Lewis, A. and Smith, D. (1993) Defining higher-order thinking. *Theory into Practice, 32*(3), pp. 131.

Murray, T. (1996) Special purpose ontologies and the representation of knowledge. In *Proceedings of the International Conference on the Learning Sciences, 1996,* D. Edelson and E. Domeshek (eds.), Evanston IL., July, pp. 235-242.

Nicholson, P. and Johnson, R. (1999) MetaMaps: Assessing understanding of large, complex or distributed knowledge domains. *Education and Information Technologies, 4* (3), pp. 297-312.

Nicholson, P. and White, G. (2000) *Rich Environments for Active Learning.* Paper presented at the Australian Institute of Training and Development seminar on Adult Learning, Melbourne.

Putnam, R. and Borko, H. (2000) What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher, 29* (1), pp. 4-15.

Zuboff, S. (1988) *In the age of the smart machine: the future of work and power.* New York, Basic Books.

BIOGRAPHY

Paul Nicholson and Geoff White both have current research interests in the design and use of online environments for developing higher-order thinking and the development of ICT-based tools to support effective online teaching. Paul has undertaken a number of projects in researching and evaluating the role of ICT in education and adult training. Geoff has undertaken a number of major evaluation projects in adult learning, quality teaching, and national policy impact studies.