Abstract

Purpose – This paper aims to present an approach from first principles to the design of learning experiences in interactive learning environments, that is “learning designs” in the broadest sense.

Design/methodology/approach – The approach is based on conversation theory (CT), a theory of learning and teaching with principled foundations in cybernetics. The approach to learning design that is proposed is not dissimilar from other approaches such as that proposed by Rowntree. However, its basis in CT provides a coherent theoretical underpinning.

Findings – Currently, in the world of e-learning, the terms “instructional design” and “learning design” are used to refer to the application of theories of learning and instruction to the creation of e-learning material and online learning experiences. The paper examines the roots of the two terms and discusses similarities and differences in usage. It then discusses how the processes of learning design fit into the larger processes of course, design, development and delivery. It goes on to examine the concept of a “learning design pattern”.

Originality/value – The paper contends that, whilst learning design patterns are useful as starting-points for individual learning designs, learning designers should adopt the cybernetic principles of reflective practice – as expressed in CT – to create learning designs where received wisdom is enriched by contextual feedback from colleagues and learners.

Keywords Cybernetics, Learning, Design

Paper type Conceptual paper

1. Introduction

In this paper, we explore the relationship between the disciplines of cybernetics and design with specific and practical application to the interdisciplinary praxis of learning design for technology enhanced learning (TEL), which encompasses a range of topics from other disciplines including learning theory to software engineering (Koper and Olivier, 2004; Koper and Tattersall, 2005; MacLean and Scott, 2006). By learning design for TEL, we refer to the application of theories of learning and instruction to the creation of material resources and online learning experiences for training and education that will be mediated by information and communications technologies (this is explored in detail below). We focus on conversation theory (CT) (Pask and Scott, 1972). We describe how the cybernetic approach of CT provides both a principled foundation and a structured methodology for the discipline of learning design for TEL.

Given our specific concerns with learning design, we do not address at length the relationship between cybernetics and design in general. For such a discussion, we refer the reader to Glanville in this special issue. We do, however, briefly discuss how CT, as a second order reflexive theory, can be used to characterise designers in any domain of practice as reflective participant observers. We do this by making explicit the parallels between second-order cybernetics (von Foerster, 1984) and second-generation design methods (Cross, 1984). CT be seen as a second-generation design method, which
provides principled guidelines to help socially situated and reflective designers to tame problems in multi-disciplinary and ethically challenging domains.

The paper is structured as follows. First, we trace the evolution of learning design from its origins in the instructional design programme of the Second World War to the internet era. Second, we explore cybernetic principles for learning design by explaining the purpose and practice of CT. Third, we demonstrate how CT can be applied in the practical context of course, design, development and delivery. We then discuss learning design patterns, which are an emerging specialised application of design theory with substantial influences from the cybernetic tradition (Alexander, 1972, 1978; Alexander et al., 1978). We contend that, whilst learning design patterns are useful as starting points for individual learning designs, learning designers should adopt the cybernetic principles of reflective practice – as expressed in CT as a second order reflexive theory – to create learning designs where received wisdom is enriched by contextual feedback from colleagues and learners.

2. Instructional design, learning design and conversation theory
Currently, in the domain of TEL, the terms instructional design and learning design are used relatively interchangeably to refer to the application of theories of learning and instruction to the creation of material resources and online learning experiences. This section examines the roots of the two terms and discusses similarities and differences in usage. We conclude that learning design is the more generic term and that it encompasses both first and second order theories of human learning and first and second-generation design methods. We advocate the use of the term in TEL and beyond to encompass all aspects of the design of learning experiences.

2.1 Origins of instructional design
The origins of the term instructional design can be traced back to the USA during the Second World War. In order to achieve swift military success, the USA required a rapid and effective means of preparing its armed forces personnel for their combat roles. Among the people recruited by the US Department of Defence to assist in the task were well established research psychologists with an interest in learning theory. Building on the work of early twentieth century, educational thinkers such as John Dewey and Robert Thorndike (Reigeluth, 1983, p. 27) the psychologists investigated how systems engineering principles could be combined with learning theory to develop effective training and instruction on a large-scale. Their research resulted in a systems approach (Dijkstra et al., 1997) to the design of instructional materials which focussed on defining the training requirement at an early stage of a development lifecycle borrowed from the systems engineering model of analyse, document, design, and develop. Intended learning goals, expressed in terms of expected performance of a specified task, were analysed and broken down into component tasks. These tasks became learning goals for which learning experiences were designed and developed. Delivery methods were decided upon during the development cycle and media and communications technologies were frequently selected to deliver the results of these design processes. This approach equates to a procedural first-generation design method, as discussed above. However, training military personnel for combat is clearly a wicked problem as it contains moral, political and professional dimensions
(the relationship between cognitive psychology and morality in this context is discussed in depth by DeLanda (1992)).

Owing to its success in wartime training, the instructional systems approach was widely adopted in North America and Europe during the 1950s and 1960s. It is interesting to note the investment in applied cybernetics and design theory during the same period and their influence upon and influence by the new sciences of information technology (Heims, 1991; Edwards, 1996). Information technology took on a new importance in education in this period and much emphasis was placed on the potential use of teaching machines in the classroom. Programmed learning, a highly structured and sequenced teaching method based on behaviourist theory, was introduced into schools. It was largely due to the work of the psychologists B. F. Skinner, Jerome Bruner, and David Ausubel, that programmed learning and the systems approach evolved into the discipline of instructional design (Reigeluth, 1983). At first, the new discipline continued to be oriented towards the behaviourist theories of Thorndike (1911) and, later, Skinner (1954). However, research into how humans learn continued and inspired the development of new theories. The most significant of these for instructional design were the cognitive theories of Ausubel, Bruner and others which led to a steady drift away from behaviourism. Among those drawn to a cognitivist orientation were many individuals who had played leading roles in the development of instructional design theory including Robert Gagne Robert Glaser and Gordon Pask (Dijskstra et al., 1997). We suggest that this movement was heading towards a second-order and second-generation approach[1].

2.2 Origins of learning design
Learning design’s origins as a term associated with TEL are obscure and its use is somewhat confusing. It first appears in the literature of psychology and education in North America during the 1960s and 1970s (Moment and Zaleznik, 1963; Schmuck and Schmuck, 1974) where, learning design is occasionally used as a singular noun to describe a method of instruction for a particular learning session. Later, it is expressed as “a format that structures the process of learning by providing a framework of orderly steps for acquiring knowledge, attitudes, or skills” (Mouton and Blake, 1984) and it is in the context of designing conventional learning that it continued to be used until the late 1990s. Again, this approach carries some hallmarks of procedural first-generation design method, as discussed above.

In the mid-1990s, learning design started to become associated with the design of learning that would harness the promise of the internet and “the several attributes of the Superhighway and PCs that can be utilised to facilitate learning” (Riding and Rayner, 1995). The internet offered a relatively low cost and democratic medium that enabled some of the more constructivist minded researchers, typified by Duffy and Jonassen (1992) to join the mainstream of TEL. Only after Jay Cross coined the expression e-learning in 1998 does learning design appear to be closely associated with the creation of online learning resources, online learning experiences and now TEL. From this time, it starts to be used, often interchangeably, with instructional design in commercial and educational contexts relating to e-learning and loses its association with traditional pedagogy. Britain (2004, p. 2) redresses the imbalance to point out that “designing for learning” is not a new concept and learning design is, in fact, part of everyday teaching practice.
A major driver for the increased use of the term learning design in a TEL context was the development of the Instructional Management System Learning Design (IMS LD) specification released in 2003. IMS LD aims to expand upon and remedy perceived shortfalls in earlier e-learning specifications, such as ADL SCORM[2] with its roots in instructional design practice[3]. The IMS LD specification sets out to represent the “learning design” of traditional teaching sessions – “units of learning” – “in a semantic, formal and machine interpretable way” (Koper and Olivier, 2004). Koper (2006, p. 13) unambiguously states that the key principle in learning design is “that it represents the learning activities and the support activities that are performed by different persons (learners, teachers) in the context of a unit of learning”. This concept effectively extends the scope of the teacher – the designer of learning – to take advantage of technology-based environments as another area where learning can occur.

Instructional design is a clearly defined and established discipline aimed at “aiding the process of learning rather than the process of teaching” and the creation of “intentional learning” rather than “incidental” learning (Gagné et al., 2005, p. 2). Instructional design theory is design oriented and is a theory that “offers explicit guidance in how to help people learn and develop” (Reigeluth, 1999, p. 5), which is, as we have suggested above, very close to first-order cybernetics and first-generation design. This explicit guidance has been successfully applied in many situations as evidenced in Reigeluth (1983, 1999) but has mainly been concerned with designing training materials for individual learners. How usable is it in scenarios such as academic learning? Laurillard (2002) identifies several inadequacies in the model originally published by Gagné in 1965. She argues that it has probably been well received because of its logical structure but is flawed because it lacks an empirically grounded theory and, while it might be explicit in how to design learning, Laurillard suggests that it builds on supposition. The implications here are that Gagné’s and other instructional design models are suitable for straightforward and limited learning scenarios and that while they might answer questions about how to learn they fail to look deeper. The fifth edition (2005, p. 20) of Gagné’s work appears to refute this view and suggests that instructional systems design is sufficiently capable of being used to create very advanced learning environments. To us, this type of controversy indicates that both sides either explicitly or tacitly appreciate the need for second-order cybernetics and second-generation design methods in the domain. Such advocates of constructivist approaches to TEL already existed on both sides of the Atlantic (Pask and Scott, 1973; Duffy and Jonassen, 1992) but, it could be argued, prevailing belief systems, particularly in the USA, had rather marginalised them in a similar way that, for example, neural networks and associated philosophies (McCulloch, 1988) had been eclipsed by expert systems and associated philosophies (Simon, 1969; Edwards, 1996). Just as there was a renaissance in neural networks (Rumelhart and McClelland, 1993) and systems thinking (Kauffman, 1993) in the 1990s, a balance started to be restored in TEL when Laurillard (1993, 2002) brought light to a considerably different approach to learning design in its broader sense that also encompasses the use of technology. The approach was aimed at higher education students and sought to understand the ways in which students experience learning. In contrast to the “transmission of knowledge” model found in much instructional design, she uses a theory of “conversational frameworks” to give an account of how active interaction between teacher and student in the form of dialogue about tasks set can lead to
effective learning. This approach is based directly on Pask’s CT (Pask and Scott, 1972). We will explore CT and its applications in the next sections.

2.3 Learning design as the superset of instructional design
When viewed from the above perspective, it can be clearly seen that instructional design can be a highly didactic and prescriptive subset of the potential domain of learning design. For these reasons, we propose the use of learning design as the more generic term and that, in the diverse world of TEL, instructional designers should more aptly refer to themselves as learning designers. At risk of over simplification, we feel that instructional design equates closely with first-order cybernetics and first-generation design methods, while learning design also encompasses the more metaphysical second-order cybernetic approach and second-generation design methods. We propose that learning design should be adopted as the preferred generic term. Such adoption extends its current standard usage (Koper and Tattersall, 2005) and also indicates the level of situated skill which we believe is a pre-requisite for professional learning design. We therefore advocate that professional learning designers adopt the kind of second-order cybernetic approaches and second-generation design methods exemplified by CT.

3. Cybernetic principles for learning design
CT, as developed by Pask and Scott (1973), originated from a cybernetics framework and attempts to explain learning in living organisms, organisations and machines. The power of CT is that it encompasses and unifies many different theories of learning and teaching[4]. It can be applied in any education or training context for the design of both individual and group learning scenarios. CT takes as its starting point the concept of a self-organising system (SOS) (Ashby, 1947; von Foerster, 1960) that adapts, habituates and learns[5]. It goes on to describe human-machine and human-human interactive as the synergistic composition of SOSs into a larger whole (Pask, 1996).

Underlying assumptions of CT include the following. The brain/body system is a dynamic self-organising, “variety eating” adaptive and habituating system, subject to boredom and fatigue. As Pask (1968, p. 137) puts it, “Man is a system that needs to learn” thus the problem of motivation is not “that we learn” it is rather what is learned and why. The basic mechanisms that support learning and adaptation are the various forms of conditioning that take place in associative networks (parallel distributed systems), with attentional systems subject to sensory-motor feedback (including proprioception and kinaesthesia) and algedonic (pain, pleasure) feedback. Thus, cognition is inseparable from affect: to think is to feel[6]. For humans, learning is also about the construction of symbolic representations, subject to constraints of logical coherence, acquired through the medium of dialogic, conversational interaction and the inner dialogic processes of strategic and tactical attention directing. In conversation, narrative forms are constructed and exchanged. What is memorable is that which can be “taught back” (Pask and Scott, 1972). Remembering is understood as a dynamic process of reconstruction that is always contextualised and social.

CT has become fairly widely known in the UK through the writings of Laurillard (1993, 2002) and Harri-Augstein and Thomas (1991). However, their accounts are fairly superficial, failing to capture the full depth and richness of CT and its applications.
It is useful to introduce CT by considering the interaction between a teacher and a learner where a specific subject domain is being addressed. The theory can be generalised to adumbrate more general, many person interactions and conversations where the topic addressed may be many levelled and may evolve in open-ended ways. Indeed, in CT, the conversation itself may be a topic of conversation.

Some key ideas from CT are shown in Figure 1, the “skeleton of a conversation”. Notice the distinction between verbal, “provocative” interaction (questions and answers) from behavioural interaction via a shared modelling facility or “micro-world”.

The horizontal connections represent the verbal exchanges. Pask argues that all such exchanges have, as a minimum, two logical levels. In the figure, these are shown as the two levels: “how” and “why”. The “how” level is concerned with how to “do” a topic: how to recognise it, construct it, maintain it and so on; the “why” level is concerned with explaining or justifying what a topic means in terms of other topics.

The vertical connections represent causal connections with feedback, an hierarchy of processes that control or produce other processes. At the lowest level, in the control hierarchy, there is a canonical world, a “universe of discourse” or “modelling facility” where the teacher may instantiate or exemplify the topic by giving non-verbal demonstrations. Typically, such demonstrations are accompanied by verbal commentary about “how” and “why”. In turn, the learner may use the modelling facility to solve problems and carry out tasks set. He or she may also provide verbal commentary about “how” and “why”.

Note that the form of what constitutes a canonical “world” for construction and demonstration is itself subject to negotiation and agreement. Here, a brief example will have to suffice.

**Figure 1.**
The “skeleton of a conversation”

**Source:** Scott (2001)
Consider topics in chemistry. A teacher may:

- model or demonstrate certain processes or events;
- offer explanations of why certain processes take place;
- request that a learner teaches back his or her conceptions of why certain things happen;
- offer verbal accounts of how to bring about certain events;
- ask a learner to provide such an account; and
- ask a learner to carry out experiments or other practical procedures pertaining to particular events or processes.

A learner may:

- request explanations of why;
- request accounts of how;
- request demonstrations;
- offer explanations of why for commentary;
- offer explanations of how for commentary; and
- carry out experiments and practical activities.

Pask refers to learning about “why” as comprehension learning and learning about “how” as operation learning and conceives them both as being complementary aspects of effective learning. These distinctions allow Pask to give a formal definition of what it means to understand a topic. Understanding a topic means that the learner can “teachback” the topic by providing both non-verbal demonstrations and verbal explanations of “how” and “why”.

Pask notes that conversations may have many levels coordination above the why level: levels at which conceptual justifications are themselves justified and where there is “commentary about commentary”. Harri-Augstein and Thomas make this notion central in their work on self-organised learning, where the emphasis is on helping students “learn to learn”.

In brief, they propose that a full “learning conversation” has three main components:

1. conversation about the how and why of a topic, as in the basic Pask model;
2. conversation about the how of learning (for example, discussing study skills and reflecting on experiences as a learner); and
3. conversation about purposes, the why of learning, where the emphasis is on encouraging personal autonomy and accepting responsibility for one’s own learning.

### 3.1 A framework for course design

The framework for course design that we propose is not dissimilar to other approaches such as that proposed by Rowntree (1990). However, its basis in CT provides a coherent theoretical underpinning, three central features of which are:
(1) the assessment of understanding based on “teachback” procedures (first expounded in Pask and Scott, 1972), both for formative and summative assessment purposes;
(2) the use of a sophisticated knowledge and task structure elicitation and representation methodology (Pask et al., 1975; Scott, 1999); and
(3) a well articulated theory of scaffolding and adaptive teaching (Lewis and Pask, 1965; Patel et al., 2001.)

The framework has four major components:
(1) a description of course aims and desired learning outcomes;
(2) a specification of course content, describing knowledge and skills and desired learning experiences;
(3) specification of the learning designs and tutorial strategies to be employed, including sequencing of learning experiences, choice of media and the role of dialogic interactive activities designed to encourage and reinforce effective learning; and
(4) the assessment strategy to be used (for both formative and summative assessment).

The essential principles of good quality course design can be summarized as follows:
- There should be a clear mapping between the statements of learning outcomes and the specification of course content.
- An analysis of course content should be carried out in order to specify appropriate learning designs and tutorial strategies.
- There should be a clear mapping between course content and assessment activities which preserves the mapping between learning outcomes and course content.

These ideas are shown in Figure 2[7].

4. Course design, development and delivery
Our account of the practice of learning design would not be complete without our positioning it within the larger context of the business processes that constitute course design, development and delivery. These processes are shown in Figure 3. In contrast to some other design domains, the aesthetic quality, beauty or elegance of a learning design is predominantly an aspect of its form as a pedagogically effective support for learning. Other qualities, such as representational attractiveness are secondary. If the principles of good course design are not adhered to, a particular learning design, presented as a pleasing to look at and entertaining to interact with piece of multimedia, may be pedagogically inferior compared to a learning designs presented as text and simple graphics.

5. Second-order cybernetics and second-generation design methods
Within the discourse of second-order cybernetics[8], von Foerster (1991) coined the term “metaphysical” to describe domains whose navigation requires participant observers to perform value judgements in selecting a problem-setting framework
Perceived need for a new or revised course

1. Needs Analysis
   Population, Context, Business Case

2. Specify Aims and Learning Outcomes
   Performance, Cognitive, Attitudinal

3. Specify Course Structure
   Sequencing, Signposting

4. Specify Content
   Knowledge and Task Analysis

5. Specify Learning Designs
   Activities, Formative Assessment, Use of Media

6. Specify Student and Tutor Support Systems
   Induction, Study Guide, Tutor Guide, Student/Tutor Communication, Course Team Communication, Tutor Mentoring and Monitoring

7. Specify Assessment Procedures
   Tasks, Delivery, Analysis, Feedback

8. Development
   Support Systems, Implementation Plan, Learning Resources

9. Implementation
   Start-up Support, Course Management, Maintenance

10. Evaluation
    Summative Assessments, Student Feedback, Staff Feedback, Reporting and Dissemination

Note: All items of any of the four components should map on to corresponding items of other components.

Any of the above activities may take place in parallel. At any stage of the design process, the outcome may be revised in the light of experience as indicated by the anti-clockwise arrows.
and a set of guiding principles. Such metaphysical domains are contrasted with more trivial domains where apparently objective agents can navigate via deterministic problem-solving methodologies (von Foerster, 1991). This distinction has a parallel in design research, where Rittel and Webber (1973) drew a distinction between “tame” and “wicked” domains. In tame domains, problems come pre-framed such that an apparently objective agent can apply deterministic procedures to solve them. In wicked domains, the framing of a problem by participant observers is a fundamental part of addressing it. Further, a genuinely wicked problem contains irreducible moral, political and professional dimensions which participant observers must take into account (see Cooley, 1980, for an account of such professional issues in the context of design). This distinction between tame and wicked problems was re-invented by others working in adjacent domains, such as the systems thinkers Ackoff (1974) and Checkland (1981).

Design researchers such as Archer (1979), Broadbent and Ward (1969) and Jones (1977) appreciated the distinction between tame and wicked problems. They also recognized that the majority of design methods that had been developed during a well funded period of research following the Second World War were aimed at tame domains (Cross, 1984). These researchers rose above these highly procedural first-generation design methods and began to develop second-generation design methods, which were structured yet acknowledged the personal values and histories of socially situated designers (for further history, see Cross, 1984). Hence, we suggest that there are many design-domains, which can, depending on the observer’s context, equally well be described as metaphysical or wicked (see also Papanek, 1984; Grudin, 1990, for parallel discussion of design and ethics). This is useful, because it provides a cross-disciplinary bridge and enables research and praxis to be ported to and fro between cybernetics and design. We argue that learning design for TEL constitutes a metaphysical domain which yields wicked problems that require second-order sensibilities and second-generation design methods. We have two reasons to make this claim. First, learning design for TEL is extremely complicated. It requires “interdisciplinary collaboration across the disciplines of learning, cognition, information and communication technologies (ICT) and education, and the broader social sciences” (Teaching and Learning Research Programme, 2006) and hence requires diligent professionalism (MacLean and Scott, 2006). Second, since learning design ultimately involves the education of real people, its moral, political and professional dimensions cannot be ignored. So addressing problems in learning design for TEL in an ethical fashion (von Foerster, 1991) requires learning designers to recognize that they are socially situated, participant observers who need to tame problems with well founded and appropriately structured methodologies.

6. Learning design patterns
To bring the discussion of cybernetics, design and learning design up to date we would like to discuss how the tenets of second order cybernetics and second-generation design methods can enhance the application of learning design patterns, which are an increasingly popular innovation in the praxis of learning design for TEL (Mor and Winters, 2007).

The concept of a “design pattern” originated as a second-generation design method in the domain of architecture. The architect and design theorist, Christopher Alexander...
observed that “timeless” structures tend to contain recurrent patterns of features that can be thought of as recurring solution to common problem in a particular contexts. A design pattern:

... describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice (Alexander et al., 1977, p. x).

Alexander and his colleagues published a guide to 253 patterns, in each case illustrating contexts for use and recommending partner patterns. For example, Alexander defined the pattern “arcade” as pattern number 119. An arcade is a covered walkway at the edge of one or more buildings, which is partly within and partly without and which plays a defining role in how people will interact with some building(s). Alexander offers the advice that arcades should be used, at the very least, to provide covered paths between buildings. Importantly, Alexander also suggests that designers consider the arcade pattern in the context of three other patterns, viz. “cascade of roofs” “circulation realms” and “pedestrian street”. These patterns, in turn, suggest other useful patterns for use in context. The task of selecting and adapting an appropriate bricolage of patterns for a particular context remained a meaningful and interpretive assignment that depended upon the values and experience of the designer. Applying design patterns should be an example of what Jones termed “designing designing” (Jones, 1991), i.e. a reflexive and reflective praxis. Thus, in the context of the current narrative, the process of applying design patterns is suited to navigating metaphysical domains and also qualifies as a second-generation design method. There is also an aesthetic dimension to design patterns as successful patterns tend to capture and engender aesthetic pleasure on the parts of the designer and the end-users (Jordon, 2000). Particular aesthetics might be visible within the finished artefact or they could be found in the process of design itself or within a particular production process or, as noted and emphasised above, in the perceived pedagogical effectiveness of the design.

Alexander was mindful of cybernetic principles and thus embedded design patterns in a reflective and participative tradition with Taoist influences (Alexander et al., 1977; Alexander, 1979). So, it is important to grasp that Alexander’s patterns are not designed as recipes. As Alexander (1979, p. 19) notes:

... there is a central quality which is the root criterion of life and spirit in man, a town, a building, or a wilderness. This quality is objective and precise, but it cannot be named. The search which we make for this quality, in our own lives, is the central search of any person, and the crux of any individual person’s story. It is the search for those moments and situations when we are most alive.

So Alexander’s patterns capture wisdom as a spur for contemplation and inspiration in a way that is reminiscent of texts such as the I-Ching (Wilhelm and Baynes, 1989) whose application requires a reflective participant observer. Comparable experiences are recounted by Pye (1978) in his exegesis of how designers approach their work. Reflective practice has been discussed in detail by Schön (1983). Schön (1987) explores the relationship between reflective practice, design and education.

Since, the 1990s design patterns have been extremely influential in software engineering (Gamma et al., 1995), project management (Brown et al., 2000) and knowledge management (Huges, 2006). We observe that as design patterns have passed through the software engineering mindset, logical positivism has influenced practice such that
some treat them as recipes or even a mere “generative grammar”. For example, Hughes (2006) takes a knowledge management approach to design patterns and regards them as “knowledge assets” that can be entered, stored and retrieved via a knowledge-based system. We consider this approach naïve because, for example, Hughes (2006, p. 14) recommends that “whoever manages or administers usability testing within an enterprise ... prepares for design sessions by searching the KMS for relevant patterns and presenting those patterns during the design sessions” and “enters new patterns into the KMS after every usability test and to cross-reference existing patterns if appropriate with the newly acquired data”. Searching a knowledge base is, in principle, comparable to search a book. However, we suggest that Hughes and others who take a knowledge management approach to design patterns accredit an implicit authority in the knowledge-base and in the pattern matching abilities of knowledge-based systems. Moreover, deriving new patterns from isolated experiences is contrary to an approach that distilled knowledge from “timeless structures”. This is not to discredit Hughes’ approach. Rather, the contents of the knowledge base are probably better regarded as use cases, i.e. descriptions of how a user might approach a particular function performed by a software system (Bittner and Spence, 2002), instead of design patterns. However, the example does demonstrate that design knowledge is sometimes reified into design patterns which are also erroneously used in a first order, first generation mode where they are perceived as prefabricated methods rather than as inspirations to individual reflective design.

Design patterns have also migrated from software engineering to learning design for TEL (Anthony, 1996; Eckstein et al., 2002; Garzotto et al., 2004; Goodyear, 2004; Koper and Tattersall, 2005; Bailey et al., 2006; Mor and Winters, 2007). The literature reviews associated with this migration tend to mention the origin of design patterns in design research as well as their success in software engineering, project management and knowledge management. However, the move towards logical positivism, reified knowledge and a first-order, first-generation approach to design processes and the role of the designer as a reflective participant observer goes unmentioned. Projects such as E-LEN, have produced online repositories of learning design patterns (E-LEN, 2005). However, although the home page of the E-learning Design Patterns Repository places learning design patterns in the context of the quote by Alexander which we cited in the beginning of this section, we are concerned that learning designers will regard such putative learning design patterns as authoritative and complete rather than as spurs to action for reflective participant observers. Moreover, in many cases the individual learning design patterns are based on isolated experiences (pace Hughes, 2006). We contend that such learning design patterns are closer to use cases and are thus useful starting points for individual learning designs.

CT, as evidenced by the forms of learner – teacher interaction imminent in Figure 1, is a rich source of learning design patterns and can also be used retrospectively to bring order to a wide variety of individual use cases (Pask, 1975, 1976). The authors of this paper are working to apply CT to the current world of learning design for TEL, including the development of a conceptually coherent taxonomy of learning designs (Maclean, 2007).

Beyond those applications of CT, we recommend that learning designers adopt the cybernetic principles embedded in reflective practice, as exemplified by CT, to create learning designs where received wisdom is enriched by contextual feedback from colleagues, mentors and learners. Indeed, we have found within our own practice that
CT can be used to structure such conversations and reflective processes. At the lower levels of CT, participants can discuss the opportunities and outcomes of selecting and applying learning particular design patterns in concrete contexts. As participants climb the hierarchy of CT, the process can become more reflective such that abstractions and helpful generalizations emerge. In summary, we believe that when learning designers create new learning design patterns, the outcomes of “the central search of any person, and the crux of any individual person’s story” (Alexander, 1979, p. 19) must remain irreducible elements of a living tradition. Similarly, learning designers need to perceive themselves as participant observers operating ethically in a metaphysical domain throughout the praxis of applying existing patterns.

7. Some concluding comments
In this paper, we have used a cybernetically formulated theory of learning and teaching (CT) as a basis for a discussion of what is learning design and what is learning design practice. In particular, we have compared second-order cybernetics and second-generation design methods to demonstrate a theoretical and practical mutualism between these disciplines. We have noted how the concept of a design pattern has migrated into the world of learning designs and indicated how CT can bring order to the business of creating and classifying learning designs. Finally, we have suggested that learning designers (indeed, designers of any kind) can usefully apply CT to their own practice as reflective, participant observers.

Notes
1. Pask (1972) provides an early, spirited attack on the limitations of instructional design as then practiced.
2. Advanced Distributed Learning Systems’ Shareable Content Object Reference Model. “SCORM is a collection of standards and specifications adapted from multiple sources to provide a comprehensive suite of e-learning capabilities that enable interoperability, accessibility and reusability of Web-based learning content” available at: www.adlnet.gov/scorm/index.cfm (accessed 28 January 2007.)
3. For more information about specifications and standards for TEL see the website of the UK’s Centre for Educational Technology and Interoperability Standards (CETIS). www.cetis.ac.uk (accessed April 2007.)
4. Pask (1968) defines teaching in cybernetic terms as “the control of learning”.
5. Cybernetics deals with control and communication in complex systems that adapt, evolve and learn. For summaries of the principles underlying cybernetics, see Ashby (1956) and the websites www.cybsoc.org/ and http://pespmc1.vub.ac.be/ (both accessed April 2007.)
6. See also D’Amasio (1999) on this topic.
7. Biggs (1999), in a separate development, makes similar proposals with respect to the need for course components to be “constructively aligned”.
8. Von Foerster (Von Foerster et al., 1974) distinguishes between first order cybernetics (the study of observed systems) and second order cybernetics (the study of observing systems).

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**Further reading**


**About the authors**

Bernard Scott is Head of the Flexible Learning Support Centre, Cranfield University, Defence College of Management and Technology, Shrivenham. Previous appointments have been with: the University of the Highlands and Islands Millennium Institute, De Montfort University, the Open University and Liverpool John Moores University. His research interests include: theories of learning and teaching, course design and organisational change and foundational issues in systems theory and cybernetics. He has published extensively on these topics. He is a Fellow of the Cybernetics Society and an Associate Fellow of the British Psychological Society. Bernard Scott is the corresponding author and can be contacted at: B.C.E.Scott@cranfield.ac.uk

Simon Shurville holds a BA and a PhD in artificial intelligence and an MA in change management. His PhD integrated artificial intelligence with design-theory, including participative design and socio-technical theory. His post-doctoral research focused on artificial intelligence, conversation theory and flexible learning. He returned to industry to architect an
intelligent learning environment for postgraduates. He also started a consultancy, from which he has co-directed blended courses for City University and the University of Essex. In 2002, became a Project Director at the University of Sussex, where he introduced managed and virtual learning environments via participative design. He later moved to Cranfield University, Defence College of Management and Technology, Shrivenham, to lecture in Knowledge Management. He was promoted to a new post to support flexible learning within the university's Flexible Learning Support Centre. He is currently interested in applying cybernetics to change management and developing personalized learning environments.

Piers Maclean is a Lecturer in the Flexible Learning Support Centre, Cranfield University (CU), Defence College of Management and Technology, Shrivenham. He started his teaching career as a Burnham lecturer providing Arabic language tuition to Armed Forces personnel. After some years as a senior Lecturer, he decided to embark upon a career in IT which saw him working as an IT manager at the Air Warfare Centre, RAF Cranwell. This combination of teaching and technical experience was to lead him to take up a position as the E-Learning Development Manager on the RAF’s Air Warfare Training Management Team. His interest in the design and provision of online learning experiences continued to develop to the extent that he decided to undertake a MSc by Research with CU to investigate learning design within the UK. Towards the end of his studies, he was recruited into his current post.

Chunyu Cong is a research student with Cranfield University at the Defence College of Management and Technology, Shrivenham. She holds a BSc in Computer Science and a MSc in Educational Technology. Her research is concerned with the design and evaluation of interactive learning environments.