Embedding Pedagogical Principles and Theories into Design Patterns

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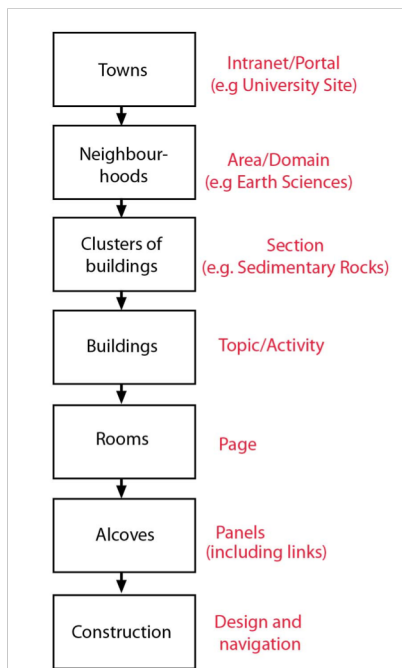By Fiona Chatteur, Lucila Carvalho and Andy Dong

Introduction

The design of e-learning courseware is a careful balancing act between pedagogy and technology, often at the expense of pedagogy (Neal & Miller, 2005). Experts at teaching in their field are not necessarily experts at mapping classroom teaching into the online domain (Vrasidas, 2004). One way of aiding e-learning development has been to create *pattern languages* as *design* patterns and *pedagogical* patterns. Pedagogical patterns address teaching practices, but not the design of e-learning courseware. Current design patterns for e-learning do not explicitly state why pedagogical theories and practices are selective to certain pattern language structures and design solutions. One such language, based on a hierarchical design analysis model (Retalis, Georgiakakis, & Dimitriadis, 2006; Van Duyne, Landay, & Hong, 2003), takes a design gaze clearly positioned from principles of human-computer interaction design rather than pedagogic theory. The problem with the current practice of design patterns prioritizing usability over pedagogically-oriented environments is that the learning experience of the entire e-learning environment may be overlooked (Preece, Rogers, & Sharp, 2002). This is likely to compromise how learning materials are incorporated, the user-interface, modes of communication, collaboration spaces and so on. The environments may well be usable but not achieve pedagogical goals.

Current practices in e-learning design pattern construction are problematic in cases where pedagogy is neither explicitly integrated into the pattern design nor in the pattern making process. In Alexander's pattern language (Alexander et al., 1977), architectural practice was examined to generate the pattern solutions. Architecture is a field that has had thousands of years of practice from which to draw archetypal solutions: the same cannot be said for e-learning courseware. As such, our design for pedagogy pattern making method combines evidence from best-practice examples and peer-review from the e-learning research literature to form a pedagogically-based pattern language. The method adapts the Alexandrian pattern structure to create patterns from which design solutions and pedagogical practices to accompany them can be realized.

To illustrate the method, we describe the development of the design pattern EXPLORING KNOWLEDGE AND KNOWER STRUCTURES. This pattern aims to support the development of an e-learning environment that addresses sociological issues related to the environment's own learning context and discipline. It suggests ways of incorporating strategies to support students in exploring the existing value structure of knowledge within a given discipline. This pattern, when used as a the basis of a design solution, is expected to help learners to reflect about the "implicit rules" of the discipline under study.

Mapping E-learning to Design Patterns

Designing an e-learning application is a particularly complex task. Design is recognised as being a "wicked" problem (Rittel & Webber, 1973) – one that has numerous stakeholders with conflicting perspectives and that cannot be accurately modelled or addressed by the techniques of science and engineering. Wicked problems have multiple solutions which integrate multiple facets. One way of dealing with a wicked problem is the use of design patterns. By breaking a set of design problems down into smaller integrated components, a pattern language provides a shared vocabulary for designers to capture and transmit the design process (Chan, 2003). Design patterns create core modules that are composed of smaller elements, but which are linked in an integrated way (Derntl & Motschnig-Pitrik, 2004).
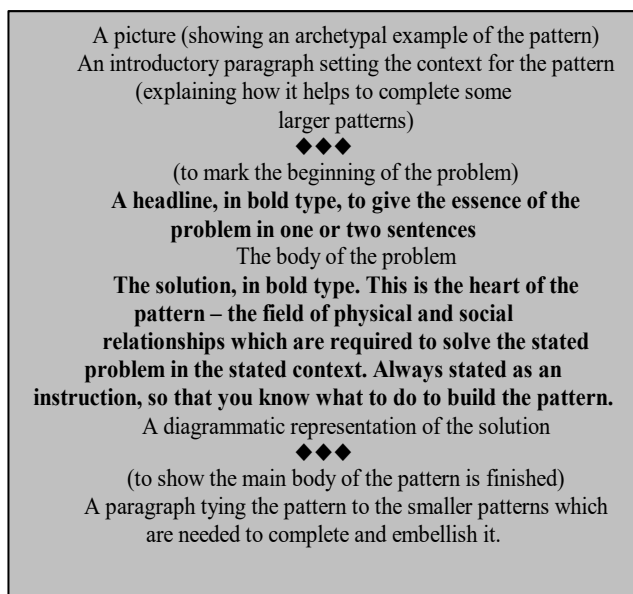
The problem with the classic Alexandrian pattern structure is that when attempting to map pedagogical theories into an Alexandrian pattern, the focus moves away from *design* onto *pedagogy*. The pattern becomes an entirely pedagogical one. If the focus is maintained entirely on design there remains little scope within the pattern structure for including pedagogy. It becomes an either/or proposition. In order to create a pedagogically-based design pattern it is first necessary to adapt Alexander's pattern structure.

One way to adapt the pattern language is to modify Alexander's notion of hierarchy. Although Alexander's pattern language dealt with architectural design and town planning, the hierarchy of large-to-small elements can be loosely mapped onto the structure of e-learning systems (see Figure 1). The organizing principle for this mapping is performativity (Dong, 2007). Under this perspective, any language of design must be comprised of coherent elements (aggregation), principles of re-contextualization (accumulation), and principles of selection (appraisal). Applying the design pattern enacts the principles of selection.

Figure 1. Mapping architectural design patterns (after Alexander) onto the e-learning domain.

In this case, the resources (e.g., Page, Section, etc.) are the elements needed to realize any e-learning system. Principles of re-contextualization operate when realizing the elements into a new design. These principles are embodied in the connectivity and hierarchy between elements. The realization of a resource depends on two factors: the functional characteristics and structural consequences from resources at the next level up (a vertical relation); and, the context in which the e-learning system is being developed (a horizontal relation). Likewise, an individual pattern is difficult to evaluate on its own; it is deployed within the context of the patterns that support and surround it

Figure 2. Alexander's pattern structure (Alexander et al., 1977).

(Alexander et al., 1977). The concern with the connectivity between patterns is outlined in the pattern structure created by Alexander, as can be seen in Figure 2. In his structure the introductory paragraph and the concluding paragraph tie each individual pattern into the entire design pattern language. Consideration must be given to the links and relationships between the patterns.

This mapping forms the foundation of a strategy for the creation of a pedagogically-based design pattern language for e-learning. A pattern structure needs to encompass and reference the larger and smaller patterns and clearly show the links between individual patterns, allowing complex and multiple relationships between them. In this way users can create their own pathways through the pattern language, enabling them to use whichever patterns suit their particular needs. Writing a pattern language is done on two levels, looking at the detail of the pattern itself and its relationship to those that surround it – a bottom up and top down approach at the same time (Alexander et al., 1977; Goodyear, 2004).

In the design of an e-learning system there are more aspects to consider than just the one-to-one mapping of an e-learning application to Alexander's language of physical space; there are pedagogical techniques to consider as well. Goodyear (2004) says that:

> Thinking in similar ways about the design space of networked learning, one can advance some tentative proposals about an equivalent pattern language. What would be the largest pattern, equivalent to Alexander's 'Independent region'? I suspect it would be a course, or Programme of study. This is the largest entity which can be designed. At smaller scale levels there are the building blocks of a course, however one labels them in one's own system or institution – Study unit, Module, etc. Then there are the kinds of pedagogical technique catalogued by Paulsen: Discussion group, Debate, etc. Within these are smaller pedagogical tactics (tasks), smaller organisational forms, as well as the tools and artefacts with which we populate the learning space.

However, neither the structure nor the content of an Alexandrian pattern contain sufficient elements to accommodate pedagogical practices. As well as the design solution, the pedagogical practices that accompany the solution need to be incorporated, along with higher level pedagogical issues. Goodyear (2005) describes these as the "pedagogical framework" that define the educational problem space. He conceptualises the educational problem space as having two layers of tasks (see Figure 3).
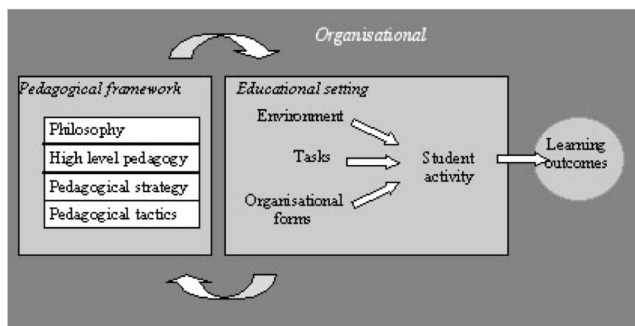
Figure 3. Conceptualising the problem space of educational design (Goodyear, 2005).

Goodyear's (2005) pedagogical framework considers:

- pedagogical philosophy (a set of beliefs on how we think people learn, what knowledge consists of, how we think people should be treated, etc.),

- high level pedagogy (broad approaches such as problem-based learning, cognitive apprenticeship, collaborative knowledge building),

- pedagogical strategy (directly related to action, e.g. the use of an online debate); and,

- pedagogical tactics (the detailed methods we use to set tasks for students, encourage their participation, offer guidance and feedback, etc.).

Therefore, the second adaptation of the Alexandrian structure is to embed a pedagogic philosophy at the top of the pattern. The pedagogical philosophy of this pattern language is

structured according to constructivist and experiential learning theories, and these two theories frame both the problem formulation and the solutions presented. This informs the high level pedagogy of each learning solution and the strategy and pedagogical tactics are therefore created in accordance with these teaching theories. These theories, their application and reasons for their use will be examined in detail in the next section.

Applying Pedagogical Theories to E-learning

Pedagogic-based interaction needs to allow students time for reflection, consideration, contemplation and interaction with the learning materials. E-learning should not depend simply on delivery of content, but should provide a satisfying learning experience for the student, as rich and diverse as can be found on any university campus. "Satisfying learning experience" includes observation, reflecting on those observations, constructing new knowledge, being able to create theories based on this new knowledge and putting those theories into practice. It also involves socializing with other students, interacting with peers, scholars and tutors, in an environment that is easy to move around in, that encourages interaction – with the materials themselves and with other people.

Interaction in e-learning applications must therefore be examined not only in terms of actions toward teaching and learning, but also in terms of interactions congruent with teaching strategies, or how they are to be used within the learning context. Design for e-learning therefore needs to be informed not only by theories of learning, but also the pedagogies that apply to those theories and how they impact upon instructional design and practice (Adams et al., 1996). Our work draws on constructivism and experiential learning theories, as these theories offer instruction-based ways to conceptualize what type of interactions should take place between the learner and the materials.

Constructivism

Constructivist theory sees learning as an active process in which, through interaction with materials, the learner makes links between the materials and prior knowledge (Ardito et al., 2004). Taking an epistemological perspective, constructivism is concerned with how we know and how we develop meaning. This process has to be internal to the learner, by integrating knowledge into pre-existing schemes (assimilation) or by changing the existing schemes to fit the new environment (accommodation) (Young & Collin, 2004). In order to be effective, a task must be included in an actual and collaborative context. This allows learners to understand the motivation and the final goal of the task itself, but also to incorporate other learner's opinions (Ardito et al., 2004).

Learning, according to the social constructivist approach, occurs not only with the student's interaction with the learning materials, but also with the teacher and with the student's peers, the community of scholars and like-minded students. Social constructivism maintains that knowledge and social interaction go together (Dalgarno, 2002; Young & Collin, 2004). Learners *construct their knowledge* from these interactions. Fellow students take on a number of roles, they are not only authors and presenters, but also peers, reviewers and active listeners (Derntl & Motschnig-Pitrik, 2004). Learning through guided discovery promotes active reflection in both student and teacher. However, in distance education these interactions between student and teacher and fellow students are limited, to the detriment of learning (Fabri & Gerharo, 2000).

Each person has a representation of knowledge. Learning occurs when a gap occurs in the learner's knowledge, or an inconsistency arises between their knowledge representation and experience (Dalgarno, 2002). Learners serve a cognitive apprenticeship, which should be dealt with by employing six teaching methods: modelling, coaching, scaffolding, articulation, reflection and exploration. Modelling, coaching and scaffolding lead to the acquisition of cognitive and metacognitive skills through their observations, then being supported and coached as they put their new skills into practice. Articulation and reflection allows students

to think about problem solving and finally, exploration leads to learner autonomy and problem formulation (Chee, 2004).

Based on these constructivist concepts of learning and interaction between the learner and the learning context, we identified a number of general interaction design principles when applying constructivist approaches to e-learning design:

- Given a choice of interactive materials, choose one that allows interactions with real-world examples. Simulations are one example.

- Design for collaboration and ease of access to collaborative tools, both on menus and through links within the content. Assign tasks that involve collaboration.

- Allow a community of scholars to organize and allow socialization as well as on-topic communication. Use tools such as bulletin boards, chat and social facilities such as Facebook or Second Life.

- Create learning through guided discovery. This can be achieved with highly interactive
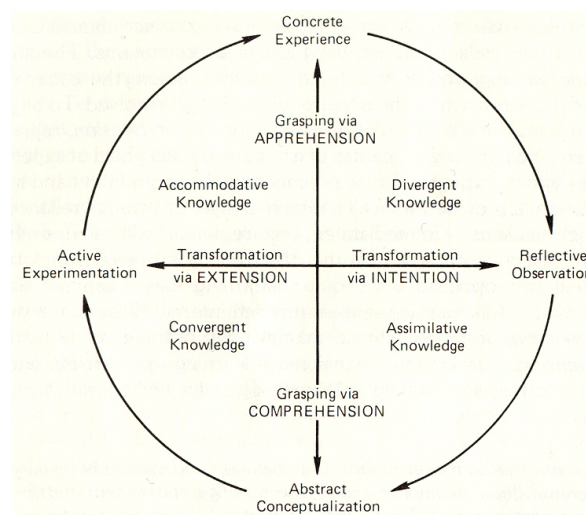
Figure 4. Kolb's diagram of structural dimensions underlying the process of experiential learning and the resulting basic knowledge form. (1984, p.42)

exercises using tools such as Adobe Flash.

- Allow as much tutor to student contact as is practical to allow mentoring, scaffolding and coaching. This can be on a public facing tool or privately via messaging, Skype, or e-mail.

Experiential learning

According to experiential learning theorists such as Kolb, learning is regarded as a process and should not be seen in terms of outcomes, or constant, fixed elements of thought. Experiential learning theory stems from a set of assumptions that ideas are not fixed, but are constantly being reformed through experience.

Learning is the "process whereby knowledge is created through the transformation of experience" (Kolb, 1984, p.38). Experience is always modifying thoughts, and that is why no two thoughts are ever the same – experience always intervenes. Learning is, by its very nature, a "tension and conflict filled process". Kolb (1984) proposes that effective learners should have four different kinds of abilities; *concrete experience, reflective observation, abstract conceptualization* and *active experimentation* (see Figure 4).

Kolb (1984) defines *concrete experience* as the learner's ability to involve themselves fully and openly in new experiences. *Reflective observation* is the ability of learners to reflect on their own experiences from many perspectives. The ability to integrate these observations into logically sound theories is *abstract conceptualization*. Learners use these theories to solve problems and make decisions through *active experimentation.*

In experiential learning theory the relationship between learner and the environment is symbolized in the dual meaning of the word *experience*. One meaning is subjective and personal, as in "I have experienced great joy", the other is objective, as in "She has 20 years' experience in her job". These two meanings interact in complex ways – every experience is at the same time subjective and objective (Kolb, 1984). The word *interaction*, according to Dewey (1938) assigns equal rights to both objective and subjective meanings of experience. Therefore, a learning experience cannot be divorced from its environment – the layers of meaning are intertwined. Kolb (1984) furthers this argument by stating that there are two distinct modes of grasping experience – comprehension and apprehension. Apprehension is the environment's input into a person's sense of situatedness. It is effortless – apprehended with "no need for rational enquiry or analytical confirmation" (Kolb, 1984, p.43). Kolb (1984) states that:

> "In this sense, concepts and the associated mode of knowing called comprehension seem secondary and somewhat arbitrary ways of knowing. Through comprehension we introduce order into what would otherwise be a seamless, unpredictable flow of apprehended sensations, but at the price of shaping (distorting) and forever changing that flow" (p.43).

Apprehension disappears as soon as you change your situation. The comprehension of the experience allows you to transmit that knowledge in the form of a model of that situation, to others (Kolb, 1984). It is here that we begin to understand the importance of the environment that encapsulates learning. The comprehension of learning materials is a way in which the learner orders what he or she has apprehended. The apprehension and the subsequent comprehension that the environment affords is key. Unlike other learning theorists, Kolb places equal importance on apprehension and comprehension in the learning process.

A "trying out" or experience-based approach is at the core of Kolb's experiential learning theory, and if encapsulated in a collaborative learning space provides the real-world context outlined in social constructivist theory.

E-learning provides the unique opportunity to cater for learners who transform their knowledge via intention (the more reflective type of learner) and for those who transform via extension (those who jump into a learning activity and are able to cope with mistakes). Those who transform their learning via intention need time to contemplate the theories and information given, to be certain of their thinking before they commence a learning activity. Because much of e-learning is not subject to time constraints these learners are able to spend the time they need to assimilate the knowledge enough to be confident when undertaking a learning activity. Similarly those who "transform via extension" can do so as the interactive nature of e-learning allows them to skip ahead to engage in the interactive activity before returning to additional materials as needed.

The interaction design principles arising out of experiential learning theory that can be applied to e-learning are:

- Create interactive learning exercises incorporating all four aspects of Kolb's learning cycle to cater to all types of learners. Allow ease of switching (e.g., through navigation) between them.

- Use visual cues and textual cues to allow apprehension with the learning environment. 3D environments such as Active World or Second Life provide a rich designed environment to make use of apprehension.
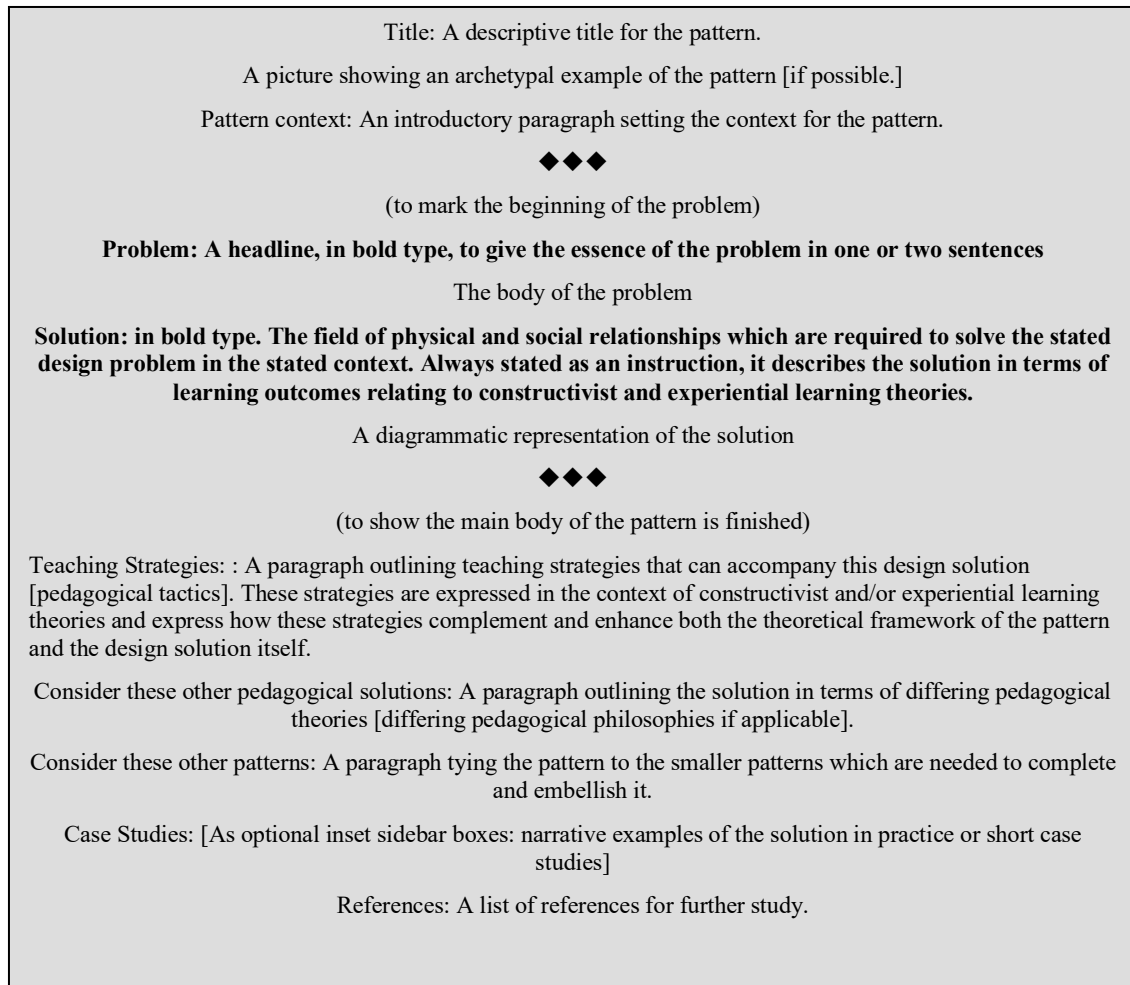
- Create exercises where learners can "try out" their new knowledge.

- Cater for both reflective users and those who like to jump straight in to the exercises, and create easy navigation between the different areas.

Methodology of Pedagogical Design Patterns

To demonstrate these principles, we created the pedagogically-based design pattern *Exploring Knowledge and Knower Structures*. The pattern uses the adapted Alexander pattern structure to include the two pedagogical theories and to accommodate Goodyear's pedagogical framework (see Figure 5). The differences between this pattern structure and that of Alexander are:

- The picture of the archetypal example of the pattern becomes optional, because a picture is not always possible in pedagogically-based patterns (Goodyear, 2004).

- The solution is not only stated as an instruction, but it is explained in terms of how it relates to the constructivist and experiential learning theories.

- Teaching strategies outline how the design pattern solution can be helped.

- Solutions that do not map to the constructivist and experiential learning theories may be used in the optional "consider these other solutions" section.

- Case studies are included within the pattern as a sidebar so that novice users can see how the pattern is used in context, and experienced users can omit them (Clancy & Linn, 1999).

Title: A descriptive title for the pattern.

A picture showing an archetypal example of the pattern [if possible.]

Pattern context: An introductory paragraph setting the context for the pattern.

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(to mark the beginning of the problem)

Problem: A headline, in bold type, to give the essence of the problem in one or two sentences

The body of the problem

Solution: in bold type. The field of physical and social relationships which are required to solve the stated design problem in the stated context. Always stated as an instruction, it describes the solution in terms of learning outcomes relating to constructivist and experiential learning theories.

A diagrammatic representation of the solution

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(to show the main body of the pattern is finished)

Teaching Strategies: : A paragraph outlining teaching strategies that can accompany this design solution [pedagogical tactics]. These strategies are expressed in the context of constructivist and/or experiential learning theories and express how these strategies complement and enhance both the theoretical framework of the pattern and the design solution itself.

Consider these other pedagogical solutions: A paragraph outlining the solution in terms of differing pedagogical theories [differing pedagogical philosophies if applicable].

Consider these other patterns: A paragraph tying the pattern to the smaller patterns which are needed to complete and embellish it.

Case Studies: [As optional inset sidebar boxes: narrative examples of the solution in practice or short case studies]

References: A list of references for further study.

Figure 5. Design pattern structure based on pedagogy.

With the pattern structure in place what remains is a methodology for the creation of a design pattern. In defining patterns generally the methodology would follow the process:

Peer-reviewed text search or identification of pattern problem. Taking the overall pattern language structure from Figure 1 as a guide, the creator of the pattern identifies the problem to be solved by the pattern, working from larger to smaller components and taking into account Goodyear's pedagogical issues.

Definition of problem. Based on the text search of existing literature and media, the e-learning problem is defined.

Text search for solution. A solution search is commenced, looking for solutions that fit with constructivist and experiential learning theories (or alternatively identifying solutions based on other pedagogical theories). Additionally, look for case studies and teaching strategies, within peer-reviewed articles, in conjunction with a critical examination of existing e-learning environments.

Solution in terms of constructivist and experiential learning theories. Create the solution in terms of these pedagogical philosophies.

By basing the text-based research on this meta-strategy, the embedding of pedagogical theories into the design patterns becomes operationalized. The aim here is to develop and refine the method for producing design patterns, not just to develop a pattern per se.

Pattern Background: The Sociology of Learning Within a Discipline

Structuring of knowledge refers to the arrangement of "knowledge" and "knowers" within intellectual and educational fields (Maton, 2000a; 2000b; 2004; 2006). The concept involves the idea that implicit agreements between members of a given field or discipline will form the basis for achievement and membership within the group. The theory assumes that the practice of professionals and educators reflects and shapes how knowledge and knowers (the people who possess, produce, valuate, and transmit the knowledge) are specialised in a given field or discipline. Therefore, the practice of professionals is realized according to their perceptions of what is being claimed as legitimate within their specific discipline or field. Membership in a discipline requires consequently that one is able to recognize what is implicitly being valued within the group, what is considered as being genuine or special by the current members of the discipline.

Maton (2000a, 2000b, 2004, 2006) proposes the "Legitimation Code Theory" (LCT) as a framework to analyse the structuring of knowledge within pedagogical and intellectual fields. An overview of LCT is presented within the pattern in the next section of this chapter. Recent research by Carvalho and Dong (2007) has used Maton's framework to analyse sociological perceptions of design students and professionals. The authors discuss how learners' difficulties in understanding the significant meanings (or codes) within the disciplinary group they are embarking into may affect their learning experience and compromise their future interest in a given discipline. The authors point out that it is crucial to devise strategies in which these learners may explore the social structuring of knowledge and knowers of a given discipline, so that they learn ways in which they may explore what is considered legitimate practice within a discipline. Such strategies should help learners to probe implicit agreements determining the basis of achievement and membership within a disciplinary group.

The Pattern

Exploring Knowledge and Knower Structures

Context: This pattern supports students in their investigation and reflection on what counts as "relevant practice" within a disciplinary group or field. The pattern is concerned with how the application design may incorporate a space, with materials and strategies, to stimulate students' reflection and investigation of the social structuring of a discipline. This pattern complements DISCUSSION GROUPS and INTEGRATED COURSEWARE

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Problem: When a novice enters a new field he or she is entering a new social group: a group that functions under its own established "sociological rules". These rules regulate the structuring of knowledge within the field: what counts as relevant and the values of its current members. The novice, entering the new field, needs to learn about these rules and how current members go about identifying genuine practices.

How does an e-learning designer build an environment that allows students to investigate/ probe/ explore/ check/ learn about the social structuring of knowledge and knowers of a given discipline?

In sociological terms, the student needs to recognize how knowledge and knowers (the people who possess, produce, valuate, and transmit the knowledge) are specialised within the discipline being studied. Whether this is a discipline about learning technical content, skills and procedures, or whether this is a discipline in which characteristics of the person, or who she or he is, is more important.

Maton (2000a, 2000b, 2004, 2006), expanding Basil Bernstein's theory (1977), proposes the Legitimation Code Theory (LCT) as a framework to analyse the structuring of knowledge

within fields. LCT considers that every practice or knowledge claim is made by "someone" and it is about "something". Some disciplines may consider that *what* professionals know is more important than *who* they are. Anyone can potentially be a professional in such a discipline, as long as the person learns the theoretical content and skills to do the job. In other disciplines, however, greater emphasis is placed on personal characteristics of the professional, rather than technical content. Here being empathetic, having special sensitivity, an "eye for the job", being from a certain background etc, is more important than what theoretical framework the professional is using. These "social rules" or "values" regulate the practice of professionals and they will influence these professionals' understanding of what is considered special and genuine in his or her field. A novice entering the field needs to learn how to identify these values.

LCT states that knowledge claims and practices comprise of two relations: the epistemic relation to the object; and the social relation to the subject, author or actor. Different practices may emphasise these two relations differently, and as a result these relations may be represented as being stronger or weaker within a continuum of strengths. Therefore, knowledge can be seen as specialised by its epistemic relation, by its social relation, by both or neither, depending on its specific structure, which would vary depending on the field or discipline.

Based on these assumptions the e-learning designer may devise a space, with materials and strategies, to support students' reflection of which relations are being emphasized within a given field. Is this a discipline where what counts is what is known, or is this a discipline that emphasizes the experience and background of a person? Every practice will always contain both relations, the epistemic (e.g. technical content, skills) and social relations (e.g. characteristics of the professionals), but may emphasise those differently. Therefore the space, materials and strategies should always encompass both knowledge (based on the strengths of epistemic relations) and knower (based on the strengths of social relations) structures so that learners can probe what type of relations exist for their chosen profession.

Solution: Develop an environment in which students can investigate what is considered relevant within the discipline (the strengths of epistemic and social relations). Populate the environment with real-life examples of how knowledge and knowers are valued within the discipline (e.g. clips of interviews with professionals, photos or examples of genuine work in the field, links to professional associations, links to conferences and seminars, relevant articles and publications in the field). By allowing a diverse range of materials, students will have an opportunity to explore this topic taking into account various perspectives, and construct their own theory of what is relevant within the discipline. Examples and activities should be supported by course material probing students reflection about what is being valued (e.g. provide students with a protocol to watch the interview or to read an article, invite a professional guest to contribute in a thematic forum about how one recognizes original work in the discipline). Activities should encourage insights into knowledge and knower structuring in the discipline, helping students in identifying the implicit values: is this discipline valuing the application of technical knowledge, or is it valuing how one experiences or feels about the object/product?

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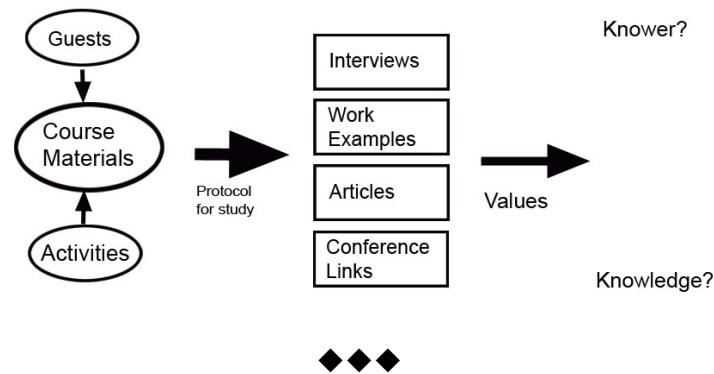
Teaching Strategies:

1) Social interaction via moderated discussion (with invited guests/speakers)

Moderated discussions may benefit from a guest "appearance". Warm the students up for the guest appearance by suggesting students research the topic beforehand (e.g. visiting websites of professional associations, or reading interviews with professionals). Organize initial discussions among the students, in which they can exchange their early theories about what counts as important within the discipline. Formulate a process that allows students access to a number of resources so that the discussion may be enriched with different views and perspectives.

Organise a professional guest who will present his or her views of how a particular field recognizes original work. The invited guest will provide a real-life aspect to students' construction of what is considered special within the discipline.

The exercise will provide students with opportunities to deepen their knowledge construction of the values of the discipline by exploring the topic in varied instances, as well as interaction with students and professionals and their perspectives of the topic.

2) Comprehension strategies

Use comprehension strategies (e.g. reading protocol, inquiry chart) to accompany reading material or watching of interview clips. Provide students with material that supports and scaffolds students' inquiry into what is considered important within a discipline.

For example, a reading protocol should prompt students with strategies they may use when trying to identify how the discipline is specialized (e.g. How does the professional describe genuine work in the discipline? Is there emphasis in the object per se? Is there emphasis in how one applies knowledge or techniques? Is there an emphasis on how one experiences the object? Is there any personal characteristics that are essential in this job?)

Use a general inquiry chart to aggregate the gathering of the various sources (interviews, publications, websites from associations, etc). Generate questions whose answers will come from converging data obtained from the various sources. This may then be used as input for discussion in a discussion forum about the topic.

Consider these other patterns:

THE ROLE OF THE TUTOR, MODERATION and LINKING PATTERN

References:

Bernstein, B. (1977). *Class, codes and control (Vol 3)*. Boston: Routledge & K. Paul.

Maton, K. (2000a). Languages of legitimation: The structuring significance for intellectual fields of strategic knowledge claims. *The British Journal of Sociology of Education*, *21*(2):

147-167.

Maton, K. (2000b). Recovering pedagogic discourse: A Bernsteinian approach to the sociology of educational knowledge, *Linguistics & Education 11*(1): 79-98.

Maton, K. (2004). The wrong kind of knower: Education, expansion and the epistemic device, in Muller, J., Davies, B., & Morais, A. (Eds.), *Reading Bernstein, Researching Bernstein.* London: Routledge, pp. 218-231.

Maton, K. (2006). On knowledge structures and knower structures. In R. Moore, M. Arnot, J. Beck and H. Daniels (Eds.), *Bernstein: Policy, Knowledge and Educational Research*, London: Routledge, pp 44-59

Conclusion

The modification of the Alexandrian pattern method allows the addition of a layer of complexity needed in the design pattern structure – that of pedagogy. This conceptual innovation makes the design of e-learning courseware simpler without losing the richness of the teaching experience. It allows each designer and teacher to work together in creating a design solution that works in harmony, with a united pedagogical philosophy, while the details of individual solutions are still left to the individual's creativity. As multiple links and design solutions are presented in an entire design pattern language, each solution will be unique and the design implementations can be rich and creative – design patterns are not formulaic.

This innovation of embedding experiential and constructivist learning theories not only into the e-learning design but also into the pedagogical practice which accompanies the courseware allows a design pattern language to address the wicked problem of e-learning design. These theories afford themselves to interaction design, and we have drawn generic design principles specific to e-learning from them.

The methodology of creating this pattern language, of using a peer-reviewed text-based research approach in addition to examining existing art, avoids the problem of repeating mistakes in implementation in a design field that is relatively new. It creates an evidence-based approach to pattern design, over current practices of "reverse engineering systems that embed good design" (Retalis et al., 2006) where "good design" is ill defined by popularity. In this way we have created a solid foundation to the pattern creation process, which can be replicated by numerous authors to generate an entire pedagogically-based pattern language for e-learning.

References

Adams, E. S., Carswell, L., Kumar, A., Meyer, J., Ellis, A., Hall, P., et al. (1996). *Interactive multimedia pedagogies: report of the working group on interactive multimedia pedagogy.* Paper presented at the Annual Joint Conference Integrating Technology into Computer Science Education, Barcelona, Spain.

Bernstein, B. (2003). *Class, codes and control* (Vol. 1 - Theoretical Studies towards a Sociology of Language). London: Routledge.

Alexander, C., Ishikawa, S., Silverstein, M., Jacobson, M., Fiksdhl-King, I., & Angel, S. (1977). *A Pattern Language.* New York: Oxford University Press.

Ardito, C., De Marsico, M., Lanzilotti, R., Levialdi, S., Roselli, T., Rossano, V., et al. (2004). *Usability of E-Learning Tools.* Paper presented at the Proceedings of the working conference on Advanced visual interfaces. DOI: 10.1145/989863.989873

Chan, P. K. (2003). *A Pattern Language for Design Development Process of a Web-based Online Course.* Unpublished Dissertation, Ohio State University, Ohio.

Chee, Y. S. (2004). Distance Education and E-Learning in the Digital Age: Critical Considerations. In T. K. Shih & P. P. Wang (Eds.), *Intelligent virtual world: Technologies and Applications in Distributed Virtual Environment* (pp. 275-294). New Jersey: London World Scientific.

Clancy, M. J., & Linn, M. C. (1999). *Patterns and Pedagogy.* Paper presented at the The proceedings for the thirtieth SIGCSE technical symposium on Computer science education, New Orleans, Louisiana, USA.

Dalgarno, B. (2002, August 2002). The Potential of 3D Virtual Learning Environments : A Constructivist Analysis, *e-Journal of Instructional Science and Technology (e-JIST)* Retrieved November 22, 2007, from http://www.doaj.org/doaj?func=abstract&id=93940&recNo=2&toc=1

Derntl, M., & Motschnig-Pitrik, R. (2004). *Patterns for blended, Person-Centered learning: strategy, concepts, experiences, and evaluation.* Paper presented at the 2004 ACM symposium on Applied computing, Session: Engineering e-learning systems (ELS) New York, NY, USA

Dewey, J. (1938). *Experience and Education*. New York: Kappa Delta Pi.

Dong, A. (2007). The enactment of design through language. *Design Studies, 28*(1), 5-19.

Fabri, M., & Gerharo, M. (2000). The Virtual Student: User Embodiment in Virtual Learning Environments. In G. Orange & D. Hobbs (Eds.), *International Perspectives on Tele-Education and Virtual Learning Environments* (pp. 32-55). Burlington, Vermont: Ashgate Publishing Ltd.

Goodyear, P. (2004, 5-8 December). *Patterns, pattern languages and educational design.* Paper presented at the Beyond the comfort zone: Proceedings of the 21st ASCILITE Conference Perth.

Goodyear, P. (2005). Educational design and networked learning: Patterns, pattern languages and design practice. *Australasian Journal of Educational Technology, 25*(1), 82-101.

Kolb, D. A. (1984). *Experiential Learning - Experience as The Source of Learning and Development*. Englewood Cliffs, New Jersey: Prentice-Hall.

Maton, K. (2000a). Languages of legitimation: The structuring significance for intellectual fields of strategic knowledge claims. *The British Journal of Sociology of Education*, *21*(2): 147-167.

Maton, K. (2000b). Recovering pedagogic discourse: A Bernsteinian approach to the sociology of educational knowledge, *Linguistics & Education 11*(1): 79-98.

Maton, K. (2004). The wrong kind of knower: Education, expansion and the epistemic device, in Muller, J., Davies, B., & Morais, A. (Eds.), *Reading Bernstein, Researching Bernstein.* London: Routledge, pp. 218-231.

Maton, K. (2006). On knowledge structures and knower structures. In R. Moore, M. Arnot, J. Beck and H. Daniels (Eds.), *Bernstein: Policy, Knowledge and Educational Research*, London: Routledge, pp 44-59.

Preece, J., Rogers, Y., & Sharp, H. (2002). *Interaction Design: beyond human-computer interaction*. New York: John Wiley & Sons, Inc.

Retalis, S., Georgiakakis, P., & Dimitriadis, Y. (2006). Eliciting design patterns for e-learning systems. *Computer Science Education, 16*(2), 105-118.

Rittel, H. W. J., & Webber, M. M. (1973). Dilemmas in a General Theory of Planning. *Policy Sciences, 4*(2), 155-166.

Van Duyne, D. K., Landay, J. A., & Hong, J. I. (2003). *The Design of Sites, Patterns, Principles, and Process for Crafting a Customer-Centered Web Experience*. Boston, MA: Pearson Education.

Vrasidas, C. (2004). *Issues of pedagogy and design in e-learning systems.* Paper presented at the Proceedings of the 2004 ACM symposium on Applied Computing, Nicosia, Cyprus.

Young, R. A., & Collin, A. (2004). Introduction: Constructivism and social constructionism in the career field *Journal of Vocational Behavior Special Issue on Constructivism, Social Constructionism and Career 64*(3), 373-388