Chapter Nine | Conclusion

9.01 Summary

This thesis described a method to embed pedagogy into the user interface, information architecture/navigation and content layout design process for e-learning courseware. The method was deployed and evaluated on a specific instance of e-learning courseware, an e-learning forum. This method used the concept of design patterns (Alexander et al., 1977) and used a pedagogical framework and philosophy (Goodyear, 2004) to guide the structure of the design for pedagogy pattern. Two pedagogical theories, constructivism and experiential learning theory were distilled into ‘primers’ in which design principles for e-learning were created to inform the content of the pattern. The FBS framework (Gero & Kannengiesser, 2002) was used to create a tool, the ‘pattern pack’, which aided the identification and extraction of solutions to problems from example e-learning forums, also informing the pattern content.

Alexander's pattern structure was modified in order to embed the pedagogical framework within it, allowing the pattern to integrate not only design solutions, but also pedagogical practice. This modified structure was used in the ‘pattern pack’ by a set of eight writers to create design for pedagogy patterns for an e-learning forum. The resulting patterns were evaluated to determine the best pattern based on its pedagogical content and other factors. This pattern was then used by designers and design educators in a comparative within-subjects laboratory experiment to investigate its value against a standard design pattern. ‘Think aloud’ data was captured and analysed using content analysis, which indicated a statistically significant increase in the use of pedagogical phrases. The designers also took part in structured and unstructured interviews, which were subsequently used in conjunction with the ‘think aloud’ data and the designers’ sketches, in a qualitative analysis to determine how design for pedagogy patterns modify the e-learning courseware design process. Methods of data visualisation were used to identify themes and relationships within the data.

9.01.01 Research Objectives and Research Methodology

The primary objective for this research (RO1), therefore, was to create a method for creating a design for pedagogy pattern. The first step was an examination of Alexander’s (1977) pattern language structure, which deals with architecture and town planning. Taking the same top-down (and bottom-up) approach, Alexander’s hierarchical structure was modified into a loose mapping of the e-learning domain (Figure 4-1). This formed the foundation for
creating a pedagogically-based pattern language. By creating a preliminary structure for an entire design for pedagogy pattern language, it was possible to begin to identify possible topics for a single pattern to be used, and to make the preliminary steps towards creating an entire design for pedagogy pattern language (see p. 9-5).

Embedding pedagogy into the design pattern structure was a ‘wicked’ task (Rittel & Webber, 1973). In examining the use of frameworks used in conjunction with design patterns, I decided to use the framework for pedagogical patterns in e-learning developed by Goodyear (2004), in which an overall pedagogical philosophy informed the high level pedagogies, pedagogical strategies and tactics to engage students. The problem was that when embedding Goodyear’s framework into the Alexandrian pattern structure, the pattern’s focus turned to pedagogy, rather than design. This was solved by adapting Alexander’s individual pattern structure to include pedagogical sections (Figure 4-3).

Once the structural considerations had been addressed, what remained was to create a repeatable method for integrating Goodyear’s pedagogical framework into the modified pattern structure, that is, a way for writers to consistently be able to write a design for pedagogy pattern. A preliminary method based on a text search of academic papers and existing e-learning courseware (Table 4-1) was iteratively designed and evaluated, with mixed results. The pilot pattern writers had difficulty in clarifying the task and found it difficult to create consistent design solutions based on the two pedagogical theories. The ultimate failure of the first pilot study led to the creation of the second research objective: (R02) Develop a tool that embodies the method and use this tool with a set of design pattern writers to produce design for pedagogy patterns.

The pattern method was revised (Table 5-1) using experiential learning and constructivist approaches (Figure 5-4). A tool, the ‘pattern pack’ was iteratively designed and tested with a second set of pilot pattern writing participants (Chapter Five). The ‘pattern pack’ uses a ‘hands on’ approach consistent with experiential learning theory. The pattern’s topic and problem statement were predefined: the pattern would be written for an e-learning forum. Using the Function-Behaviour-Structure (FBS) framework (Gero & Kannengiesser, 2002), and three e-learning forums, (Murty, 2009; The Open University, 2005; Vande Moere, 2009/2010), two sets of cards were developed. One set dealt with the pedagogical function of an e-learning forum, the other the design structure.

The cards were used to extract the pattern’s solution from the existing forums and to relate the pedagogy to design elements. The design cards were employed to create an information architecture hierarchy which represented one of the forums, similar to a flowchart. The pedagogy cards were then placed in the hierarchy where pedagogy was seen to be taking
place. This was photographed and the process was repeated for the remaining two forums. After reading the supporting literature and documentation, the writer used the cards to create a generic forum using only the common elements that were seen, and ideas taken from the literature that exhibited ‘best practice’. This generic forum was used to facilitate writing the design for pedagogy forum pattern (Chapter 6). At the end of the piloting process the ‘pattern pack’ comprised of the two sets of cards, a printed brochure, a set of explanatory documents and pattern templates on CD ROM, a silver case, markers, adhesive putty and blank cards.

The completion of the development of the ‘pattern pack’ satisfied the second research question (R2), which asked, ‘What is the methodology for embedding a pedagogical framework incorporating constructivist and experiential learning theories into e-learning design patterns?’

Research Objective Three (R03) was to compare the quality of the design for pedagogy patterns. To do so, the ‘pattern pack’ was tested by eight carefully chosen pattern writers, resulting in a set of eight design for pedagogy patterns. The patterns were evaluated by myself and Michael Derntl who was based in Vienna, Austria. An online assessment tool (Appendix Five) aided the evaluation of their design for pedagogy patterns, using a mixed methods approach by means of a set of evaluation factors. These evaluation factors were embodied in a quantitative Likert scale survey, correlated with a rank, a quality score (Table 6-7) and qualitative comments. The evaluation enabled one best design for pedagogy pattern to be chosen for the next stage of the research.

A textual analysis was undertaken to compare the highest ranked design for pedagogy pattern for an e-learning forum and the standard pattern for a forum (Chapter Six). The purpose of this analysis was to answer the third research question (R3) which asked: ‘Does the method improve the pedagogical quality of design patterns?’ This analysis noted that the design for pedagogy pattern placed pedagogy as the central concept for its content with a particular focus on social interaction and knowledge sharing, thus enacting elements of social constructivism within the pattern document. The standard pattern, in contrast, placed its emphasis on communication, access and information flow. These principles are important for usability, which is consistent with a ‘user-centred’ approach to design. In general the conceptual differences can be summarised: the design for pedagogy pattern takes a socio-relational approach to interaction, whereas the standard pattern takes a transactional approach. The design for pedagogy pattern writing method based on the ‘pattern pack’ improved the pedagogical quality of design patterns, affirming Research Question Three.
The next research objective (RO4) was to compare the value of the design process of the best design for pedagogy pattern against a standard design pattern for the same e-learning courseware with a set of interaction designers and design educators. This research objective addresses Research Question Four (R4), which is ‘Do pedagogically-based design patterns assist e-learning designers to be more aware of pedagogical issues when creating e-learning courseware?’

The highest ranked design for pedagogy pattern and the standard design pattern were used by a set of designers comprising nine designers from three user groups, consisting of novice interaction designers, experienced interaction designers and educators, to design an e-learning forum. The participants were asked to ‘think aloud’ as they designed, and the transcriptions were coded into five different categories: pedagogy, task analysis, navigation/information architecture, visual design and system design, and analysed using content analysis. The content analysis of the ‘think aloud’ data was subject to standard reliability checks (Chapter Seven). This involved the application of inter-coder reliability using Krippendorff’s Alpha (2007) and fatigue tests. Results from the content analysis were subjected to a 2-tailed t-test which revealed a statistically significant increase in frequency in the pedagogy category, without a significant reduction in the other categories (Figure 7-5).

The qualitative analysis (Chapter Eight) of a representative participant from each design user group revealed an overall broadening of design approach, changing the designer thinking from a focus on the designed object ‘forum’ (structure) to a more integrated consideration of the pedagogical function of the courseware, enacting the FBS framework. The e-learning forum design sketches exhibited a move from a transactional approach (standard pattern designs) to a more social/relational approach (design for pedagogy pattern designs), which supported the findings in the design for pedagogy pattern evaluation (Chapter Six). The linkages between pedagogical issues considered in the context of design elements in some cases exhibited a five-fold increase, as shown in the Phrase Wheel visualisations, indicating a tighter integration between design and pedagogical issues. These linkages were an important feature of the two reviewers’ comments in the qualitative evaluation of the eight design for pedagogy patterns in Chapter Six, as an indication of a high quality pattern. One could conclude that the increases in linkages are indicative of a higher quality of pedagogy being enacted in the design process. Design for pedagogy patterns aid the designer’s understanding of the pedagogical processes required for optimal learning outcomes, without appearing to add undue complexity to an already ‘wicked’ task (Rittel & Webber, 1973).

Users with varying levels of experience displayed a variation in the enactment of the patterns. Two out of the three novice designers created elaborate information architecture flowcharts...
when using the design for pedagogy forum, as did the most junior design educator. These three participants used both patterns as a checklist, enabling a pattern-led validation of their designs. One of the novice designers and the junior design educator used note-taking when using the standard pattern, with both creating information architecture diagrams when using the design for pedagogy pattern. Novice and experienced designers alike exhibited fewer lateral transformations than the design educators, who exhibited a greater variation and number of designs. The experienced designers exhibited the most ‘polished’ sketches, exhibiting vertical transformations. The design educators returned the most original designs when applying the patterns, appearing to consider the virtual space in their designs over the more commonly used page metaphor. Their use of this virtual space was not, however, consistent over the two patterns and appears to be an indicator of experience and not necessarily the use of the different patterns.

In examining the interplay between the content analysis results, the narrative summaries, ‘think aloud’, sketches, and visualisations, the fourth research question, ‘How do pedagogically-based design patterns assist e-learning designers to be more effective in creating e-learning courseware’ has been answered. Pedagogy is considered significantly more frequently when the designers and design educators used the design for pedagogy pattern, without a significant decrease in other design thinking. Links between pedagogy and design also occur more frequently, and the resulting designs appear to be conceived with pedagogy in mind. Design sketches move from a transactional approach to a social/relational approach in the use of the design for pedagogy pattern, while at the same time the design thinking moves from a design structure focus to one which considers pedagogical function.

9.02 Limitations of This Study and Future Research

Additional future work arising from this research could involve three discreet approaches:

1. Developing the keyword lists and categories.
2. Creating an entire design for pedagogy language for e-learning.
3. Implementing an e-learning forum designed using a design for pedagogy pattern and testing the resultant courseware with educators.

9.02.01 Developing the Keyword Lists and Categories

Methodological limitations of this study stem from the categorisation of the keywords in the ‘think aloud’ laboratory experiment. When determining whether a word is placed into one of the five different categories, (pedagogy, task analysis, navigation and information architecture, visual design and system design) difficulties can arise in the interpretation of a word’s meaning. In particular, limitations of analysis stem from ambiguity or double-
meanings of words such as ‘discussion’, although in this study both content analysis coders agreed that this word should sit in the ‘pedagogy’ category. Other ambiguous words such as ‘information’, ‘topic’, ‘questions’ and ‘answers’ when viewed in the context of an e-learning forum also presented dual meanings. For example the keyword ‘topic’ could be taken to mean a lesson topic, and therefore was pedagogical. However, it could also mean the topic of a message, which is displayed in a thread, in which case it is a visual design code. These four words were excluded from the content analysis, but these were by no means the only words which presented categorisation issues. Future research may focus on developing the keyword lists to further clarify the categories.

The five keyword categories, pedagogy, task analysis, navigation and information architecture, visual design and system design emerged using a grounded approach from an examination of the ‘think aloud’ transcriptions. However, these are not the only categories that could be examined. The FBS Framework (Gero & Kannengiesser, 2002) was used to help create two sets of cards that were used in the design for pedagogy pattern writing process. The results of the ‘think aloud’ analysis indicate a similar shift to pedagogical function (design for pedagogy pattern) over design structure (standard pattern) when comparing the use of the two patterns. An interesting aspect of future work might be the development of the behaviour part of the FBS analysis in an additional set of cards for use in the ‘pattern pack’. ‘Think aloud’ transcriptions of the design for pedagogy pattern in use could be analysed to investigate the interplay between function, behaviour and structure categories.

9.02.02 An Entire Design for Pedagogy Pattern Language for E-Learning

Another limitation of this study was that a single pattern was written and evaluated without being situated in the context of an entire pattern language. Both Goodyear (2005) and Alexander (1977) stated that the utility of a design pattern language is in the links and relationships between patterns. An individual pattern is therefore difficult to evaluate in isolation. A design for pedagogy pattern language for e-learning could inform the creation of integrated e-learning courseware, following the suggested pattern language structures outlined in Figures 4-1, 4-4 and 4-5. This integrated approach was touched upon in some of the forum designs created during this study, with the incorporation of student portfolios, rich media elements, links to learning resources and so on. It is the design of these additional multimedia elements that could benefit from treatment using design for pedagogy patterns.

9.02.03 The Pattern’s Use with Educators

One final avenue for further research would be to investigate the use of the design for pedagogy pattern for the e-learning forum with its secondary user group - educators. The
provision of the teaching strategies section in the design for pedagogy pattern served a dual purpose. One was to inform designers of how their forum would be put to use. By considering the teaching strategies while designing, which some of the participants called design principles, it was possible to integrate design elements with the pedagogical practices. The ‘think aloud’ qualitative analysis confirm this integration was taking place; the green pedagogy phrases became more apparent in the Word Cloud visualisations, and the linkages between design and pedagogy increased in the Phrase Wheel and in some cases in the Phrase Net visualisations (e.g. Designer G, Figure 8-16).

The same teaching strategies could be used by educators when co-ordinating a forum created using the highest ranked design for pedagogy pattern. In this way pedagogical theories could inform the educators of ‘best practice’ when using the e-learning forum with students. The pedagogical framework could therefore inform not just the design, but also the implementation of the courseware. Future research could investigate whether online facilitators and tutors find the pattern useful in their practice, and whether their online teaching practice becomes more pedagogically grounded when using the design for pedagogy pattern. The interplay between pedagogical practice using the design for pedagogy pattern and student learning outcomes could also be investigated.

9.02.04 Generalisability

For the purposes of this research constructivism and experiential learning theories were used, but the aspiration was to create a method which formalised a process of embedding theories into design patterns irrespective of the pedagogical framework or philosophy. The two pedagogical theories explain why a lack of interaction impedes learning, and when used in conjunction form a valuable partnership balancing descriptive and normative theories of learning. Kolb’s (1984) experiential learning cycle describes what happens when a learner learns, and Chee’s (2004) cycle explores the interactions between teaching and learning (Figure 5-4). The method created by this research is generalisable, so long as there is a designed object (structure) and a function (in this case pedagogy), and it is possible to identify areas in the structure where the function occurs (Gero & Kannengiesser, 2002). In the case of design for pedagogy patterns, theories of the functional characteristics are used to inform the structure, but theory could be embedded into either axis. In this context a pedagogical function is the explicit use of pedagogy, whereas the structure is the presence of design elements in the e-learning courseware.
9.03 Conclusion

In this research a systematic approach was taken to determine a method for the creation of design for pedagogy patterns and an examination of how design for pedagogy patterns modify the e-learning courseware design process. Expanding the field of design patterns for e-learning, this research created a generalisable method for embedding a pedagogical framework into design patterns, using two pedagogical theories and the FBS framework to inform the solutions to the pattern’s problem. Embedding pedagogy into the design pattern resulted in a statistically significant increase in the use of pedagogical phrases in all users who applied the design for pedagogy pattern in the design process for an e-learning forum. The 'think aloud' visualisations displayed a shift in emphasis from design structure (standard pattern) to pedagogical function (design for pedagogy pattern). At the same time the designs exhibited a shift in emphasis from a transactional approach to interaction design, to a socio-relational approach, which is consistent with social constructivist theory. The design for pedagogy patterns appear to enable the design process to be conceptualised with pedagogy in mind, enabling tighter relationships between pedagogical and design issues. This research has proven the utility of pedagogically-based design patterns in the creation of e-learning courseware, and there is evidence of how they contribute to the design process, at least in the case of an e-learning forum.


