Chapter One | Introduction

1.01 Motivation and Significance

The motivation for this research is to create a methodology to embed the principles and methods of instruction (pedagogy) into the core of the e-learning user interface, information architecture and content layout design process.

Good e-learning courseware design should always take learning outcomes and learners’ characteristics into consideration. The problem addressed here is more refined than this. In my professional experience, what often occurs when developing e-learning courseware is that content is written by subject matter experts (SMEs) independently from the user interface, content layout and information architecture design. Written copy is then integrated with the user interface, using content layout design and structured using information architecture and the resulting e-learning courseware is presented to students. The missing link in this process is the designer’s understanding of the pedagogical processes required for optimal learning outcomes. This research aims to make e-learning design more pedagogically grounded in terms of learning outcomes and experiences, refocusing efforts in the development of e-learning from the current emphasis on usability to teaching and learning.

Current industry practice in creating e-learning courseware certainly takes pedagogy into account; there are clear principles of instructional design being taught in tertiary design schools worldwide (University of Haifa, 2011; University of Sydney, 2011; NSI TAFE, 2011). However, when it comes to implementation, often (Lever, 2008) these principles are missed due to:

- The complex nature of these instructional design principles
- Efforts and focus on usability
- The pressures and complexity of the design process

There are calls to improve the quality of the instruction in e-learning courseware, but in practice it is often very difficult to do (Nielsen, 2001). One way of improving e-learning courseware is to embed pedagogical theories into the user interface, content layout and information architecture design process. By creating the courseware using theories on how people learn as a basis should enable the design to be focused on the same pedagogical goals and objectives as the content, thereby improving the overall quality of the instruction. A pedagogical objective is the desired result of a lesson, which may involve undertaking certain activities. A goal is broader, describing what a student should be capable of doing after the completion of the lesson (LeLoup & Ponterio, 2010).
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Many designers, content specialists and teachers, no matter how expert in their particular field, lack knowledge of not only pedagogical theories, but also of creating e-learning courseware applications (Vrasidas, 2004). Designing e-learning courseware could be classified as being a 'wicked' problem (Rittel & Webber, 1973) – one that has numerous stakeholders with conflicting perspectives. Wicked problems have multiple solutions and can be dealt with by using design patterns. By breaking a set of design problems down into integrated components, pattern languages provide a vocabulary for designers to capture and transmit the design process.

To date, design patterns for computer-mediated interaction, website design and software development have been created, but few have taken into consideration issues to do with pedagogy (Schümmer & Lukosch, 2007; Van Duyne, Landay, & Hong, 2003). Further, existing pattern languages do not explicitly state which pedagogical theories and practices are applicable to certain pattern language structures and design solutions. One such methodology based on a hierarchical design analysis model (Retalis, Georgiakakis, & Dimitriadis, 2006; Van Duyne et al., 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 prioritising usability over pedagogy is that the learning experience of the entire e-learning courseware environment may be overlooked (Preece, Rogers, & Sharp, 2002). This is likely to affect the development of the learning environment, compromising how learning materials are incorporated into the user-interface, modes of communication, collaboration spaces and so on. The e-learning courseware may well be usable, but does it achieve the pedagogical goals and objectives?

The challenge in this research was to operationalise a formal repeatable approach for embedding pedagogical theories into design patterns. The patterns developed by this research overcame a lack of pedagogical knowledge in designers by creating a method that embeds pedagogy at the core of the interface, content layout and information architecture design process in a causal way. Embedding pedagogical theories within pedagogically-based design patterns is a solution for providing a theoretical basis for e-learning design, adding to current industry practice, where the focus is on usability. These will be known as 'design for pedagogy patterns'. A design for pedagogy pattern is the name I have developed for a design pattern that addresses design issues and pedagogy within the pattern structure.

Therefore, the hypothesis for this research is:

Embedding pedagogical theories into design for pedagogy patterns, which are subsequently used in the design and development of e-learning courseware, increases
the awareness of pedagogy during the e-learning design process over generic design patterns.

Poor e-learning courseware is a symptom of a lack of pedagogical theory in e-learning design and production (Frizell, 2003b). Poor e-learning courseware often places too much emphasis on the technology aspects of e-learning, without paying attention to enhancing the knowledge aspect. This includes a lack of realisation of reusability, learner personalisation and collaboration (Teo & Gay, 2006). One symptom or type of evidence of the inattention to pedagogy in e-learning design is a lack of interaction between the participants (which includes the tutor) using e-learning courseware. E-learning courseware developers tend to replace face-to-face lectures with long text documents - useful for information, but they do not provide effective learning. Information placed on the World Wide Web is not knowledge, what is done with this information is what will make it knowledge (Teo & Gay, 2006). Interaction is the key to effective learning, interaction with the course content, with lectures, with other students and with the instructor (Kessler, Rosenblad, & Shepard, 1999). Because each student brings a different knowledge framework, learning must also be active; passive learning is likely to fail (Ben-Ari, 1998). These principles are drawn from pedagogical theory and are well known to most instructional designers, but in practice difficult to achieve in e-learning, hence the need to embed them into the design process using a design for pedagogy pattern language. Design patterns are one way to deal with the complex problem of addressing pedagogical theories in the design of e-learning courseware.

This thesis tests the claim that design patterns containing pedagogical theories improve the e-learning courseware design process. In developing this research, it became evident that a consistent methodology for the creation of design patterns does not exist in literature (Schüemaker & Lukosch, 2007; Van Duyne et al., 2003). The pattern problem definition process is outlined, using focus groups and research into existing media, but once this is completed the data is given to a pattern writer to write the pattern. The process involved in writing the pattern is unclear. This research has attempted to fill this gap by developing a method for the creation of the patterns and a tool to aid writers in this task (the ‘pattern pack’). The ‘pattern pack’ aids the complex task of embedding pedagogical theories into the design for pedagogy pattern. It uses a pedagogical framework (Goodyear, 2005) in which constructivism and experiential learning become the overriding pedagogical philosophy of the design pattern. Goodyear’s framework allows for the use of any learning theory as a pedagogical philosophy, and the method allows for alternative theories to be used, either in conjunction or instead of the two chosen for this research. These two theories were chosen because they complement each other theoretically and appear to be an appropriate choice for online interaction. This
framework allows for the design patterns to inform not only the high-level pedagogies, but also the pedagogical strategies and tactics of the learning experience.

1.02 Research Questions

This thesis addresses a principal research question and three sub-questions. In answering the three sub-questions the main research question will be also be answered. The principal research question asks:

R1: Are pedagogically-based design patterns useful for creating e-learning courseware?

This question sits at the core of this research project. My motivation for undertaking this research is to make the design of e-learning courseware more pedagogically grounded. By creating a process that embeds pedagogy into e-learning design patterns and testing its utility with designers, it will be possible to address this research question.

E-learning affords itself to the use of constructivist and experiential learning theories because these theories place an emphasis on interaction. If embedding pedagogical theories into a design patterns is useful for creating e-learning courseware, research question two asks:

R2: What is the methodology for embedding a pedagogical framework incorporating constructivist and experiential learning theories into e-learning design patterns?

One of the main tenets of constructivist learning theory is that ‘learners should be engaged in active exploration, they should be intrinsically motivated, and they should develop an understanding of a domain through challenging and enjoyable problem-solving activities’ (Bares, Zettlemoyer, & Lester, 1995, p. 76). These should be authentic real-world problems which allow the students to construct their own knowledge through cooperation with other students and by employing self-regulated learning (Loyens, Rikers, & Schmidt, 2006). The second research question addresses the issue of developing the patterns based on the two pedagogical theories into a standard and repeatable methodology.

R3: Does the method improve the pedagogical quality of design patterns?

Using the above methodology in the creation of design for pedagogical patterns should result in a measurable difference in the pedagogical quality of the resulting patterns. If the design patterns show an improved pedagogical quality, this improvement should be transmitted into the design process by means of an improvement in pedagogical thinking by designers as they use the patterns. The use of design for pedagogy patterns allows the development of standard approaches to inserting pedagogy into the user interface, content layout and information
The architecture design process of e-learning courseware, and by informing these, could lead to improved pedagogical quality in the resulting courseware over the use of generic patterns.

Currently e-learning courseware design follows standard commercial practice, commencing with stakeholder meetings, utilising paper prototyping, focus groups and ongoing usability testing though a series of development stages (Van Duyne et al., 2003). The content is informed by specialist subject matter experts who may not be expert in pedagogical practices. Interface design and information architecture is developed by the production team. Designers are often experienced in new media, but not necessarily in pedagogy and in how the needs of students differ from other users of online systems. The disadvantage of this development approach is that designers and producers are constantly struggling with different approaches to learning and teaching (Chee, 2004). By providing design for pedagogy patterns these problems in e-learning application production may be overcome by providing a fluid integration of teaching principles into the design process.

**R4:** Do pedagogically-based design patterns assist e-learning designers to be more aware of pedagogical issues when creating e-learning courseware?

The final research question aims to determine if the use of pedagogically-based design patterns aids designers in creating e-learning courseware. In answering these research questions, design for pedagogy patterns for e-learning were developed that had embedded within them both constructivist and experiential learning theories. The patterns also incorporated the pedagogical framework outlined by Goodyear (2005). Each pattern included case studies demonstrating the pattern's use. Each was written in an accessible manner, taking into consideration how the designers integrate knowledge in the pattern's design. This knowledge integration was addressed in part by using what is known as constructive language – showing how the principles within the pattern can be applied in context (Clancy & Linn, 1999). By embedding these theories of learning and Goodyear’s pedagogical framework into the patterns, the design and development of e-learning solutions were grounded in solid learning theory, rather than remaining undirected or uninformed of current pedagogical thinking.

### 1.03 Aims and Objectives

The aim of this research is:

To understand how design for pedagogy patterns modify the e-learning courseware design process.

The objectives of this research are to:
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(R01) Formulate a method for creating a design for pedagogy pattern

(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

(R03) Compare the quality of the design for pedagogy patterns

(R04) Compare the value on 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 designers and design educators

Each chapter of this thesis builds upon the previous to fulfil the research aims and objectives, and in doing so answers the four research questions.

Chapter Two outlines problems in current e-learning courseware design practices and why the industry focus on a usability-led design approach should be realigned to include pedagogy. In this chapter, design patterns are discussed as a way to provide guidance for designers, and how embedding constructivism and experiential learning theory into design patterns provides one means to achieve a more pedagogically-grounded design approach.

Chapter Three discusses the approach and methods of this research, including how the six research stages address the four research questions. Epistemological assumptions including constructivist and social constructivist perspectives on knowledge creation are discussed, along with the mixed-methods methodological approach.

Chapter Four begins to address the first research objective, in which a preliminary method for embedding pedagogical theories into the design for pedagogy patterns is created. This involves examining the theory and practice of design patterns, the use of frameworks and an adaptation of Alexander’s (1977) intra-pattern structure. The process of choosing the pattern’s topic, the forum, is also outlined in this chapter.

The ‘pattern pack’, a tool to aid the writers in the complex task of embedding pedagogical theories into the patterns, was developed to address Research Objective Two (R02). The process of developing the ‘pattern pack’ using an iterative design process that involved two pilot studies is discussed in Chapter Five.

Chapter Six discusses the use of the ‘pattern pack’ by eight pattern writing participants, resulting in eight design for pedagogy patterns for an online e-learning forum. These patterns were evaluated by two pattern researchers, using an evaluation tool, and the highest ranked pattern was chosen for inclusion in the next stage of the research. The design for pedagogy pattern for an e-learning forum was compared with a standard design pattern for a forum (Schümmer & Lukosch, 2007, p. 277), thus addressing the third research objective.
Chapter Seven addresses the fourth objective, in which the best design for pedagogy forum pattern and the standard forum design pattern were used by a sample of three different groups of designers: novice designers, experienced designers and design educators in a laboratory experiment. Each group contained three people for a total of nine subjects. The designers were videotaped using ‘think aloud’ while designing and subsequently participated in structured and unstructured interviews. The ‘think aloud’ was evaluated using content analysis techniques (Krippendorf, 1980) in order to determine the differences in approach when using the two design patterns.

Three different evaluation methods were employed to test the aim:

- Content analysis comparing the ‘think aloud’ of a standard design pattern for an online forum and the design for pedagogy forum pattern
- A qualitative evaluation of the ‘think aloud’, structured interviews and unstructured comments
- Comparison between the different designs

Chapter Eight involves the qualitative evaluation of the research data, using one user from each of the three user groups. The wireframe content layout, user interface sketches and information architecture flowcharts are placed in the context of narrative summaries of the ‘think aloud’ to contextualise the design process. Data visualisation techniques are used to highlight themes and relationships that emerge from the data.

Chapter Nine discusses conclusions, generalisability and future directions arising from this research.

The next chapter discusses the problems with current e-learning design and why a pattern-based approach is optimal when solving the wicked problem of e-learning courseware design.
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