

Patterns in education systems: Are there lessons from the enterprise domain?

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This paper describes an effort to explore ways in which educational scenarios can benefit from lessons learned in enterprise scenarios. The exploration is well suited to the conference theme of 'beyond the comfort zone' because from an enterprise perspective organisations already have a history of being rapidly dragged out of their comfort zones and can hence provide insights at many levels including opportunities, challenges, and strategies and techniques for coping, etc. For many organisations the challenge is stark, i.e., evolve rapidly from a business to an 'on demand eBusiness' or cease to be viable. That challenge requires organisations to understand and embrace evolving operational practices and the rapidly evolving technologies required to support those practices. We notice that trends and advances in enterprise practices and enterprise technologies emerge at a significantly faster rate than their equivalents in the domain of education and hence we assert that the opportunities for the domain of education to learn from this are significant. In particular we note the growing trend of adopting pattern oriented approaches for clarifying, analysing and designing technology oriented scenarios and we are exploring ways in which pattern oriented approaches can assist in helping educational scenarios to migrate beyond their current comfort zones.

Keywords: patterns in education systems, enterprise technologies, ebusiness on demand

Are there benefits for education from exploring enterprise scenarios?

In this paper we use the phrase 'developments in the enterprise domain' to refer to changes in the operational practices of modern enterprises and the eBusiness technologies used to support those evolving practices. An underlying assertion within this paper is that anyone involved with the design, development, delivery or administration of educational scenarios will either directly or indirectly be affected by developments in the enterprise domain. Many sections of this paper are about describing some of those potential effects and influences. It is an aim to observe and learn from these developments and then, either by analogy or by direct comparison, it is intended to predict or influence some of the changes that are appropriate or inevitable for educational practices and the educational technology used to support those practices.

There are many facets to this discussion and many that will by necessity be ignored in a brief conference paper. The facets that will be highlighted here include the following:

1. some challenges and opportunities that face all organisations including education providers as the drive towards eBusiness on demand gains momentum and forces organisations to rethink their core practices or face obsolescence,
2. some challenges and opportunities that arise from exploiting modern enterprise technology, and
3. some benefits of adopting a patterns oriented approach for managing complexity in the analysis and design of technology oriented scenarios.

A recurring and obvious observation that will be made in this paper is that trends and advances in enterprise practices and enterprise technologies emerge at a significantly faster rate than their equivalents in the domain of education, not least because the funding levels in each domain are vastly different. Hence we assert that the opportunities for the domain of education to learn from the enterprise domain are significant and worthy of extensive exploration.

Figure 1 and some of the context and initial observations are borrowed from (Siviter 2004). In (Siviter 2004) figure 1 was used just to provide a context for a brief commentary on Web Services in Education. Here figure 1 is used to provide a tour guide for the rest of the paper.

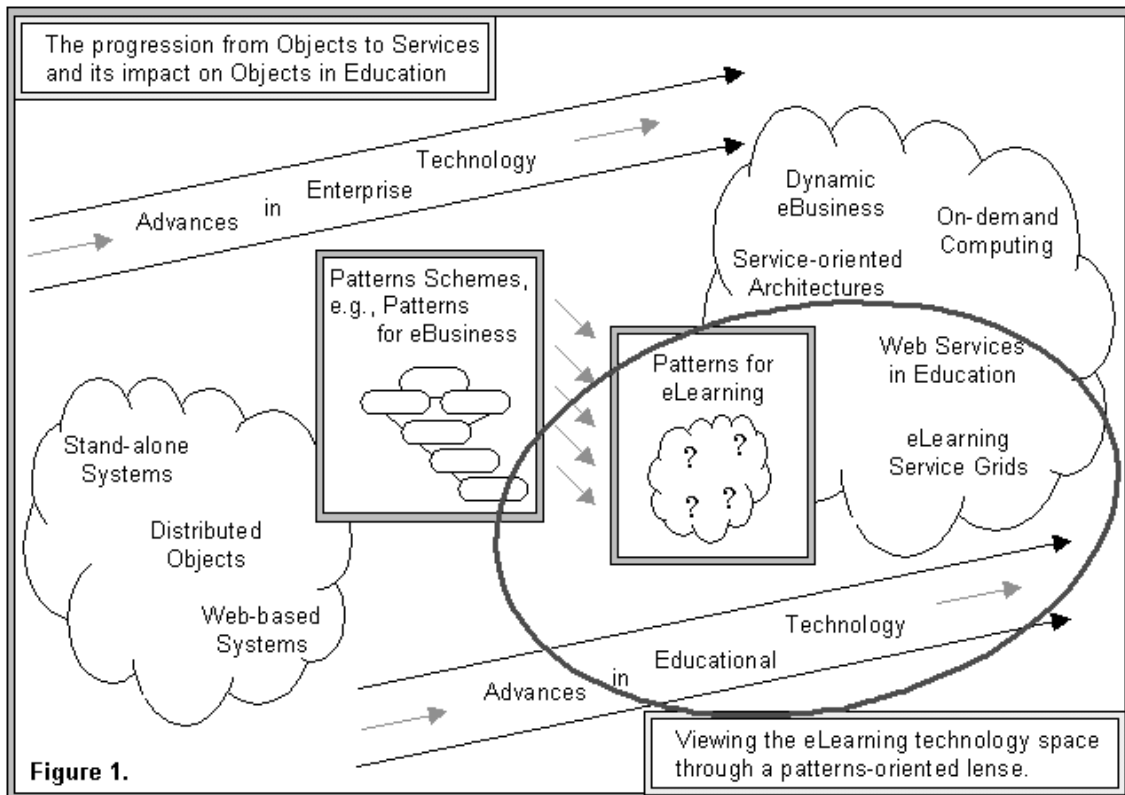


Figure 1: Advances in enterprise technology influence advances in educational technology

A tour of various concepts summarised in Figure 1

There are various interpretations of the ideas summarised in figure 1. The following paragraphs offer some of those interpretations and leave further details to be provided later in the paper.

eLearning as a (currently non-integrated) spectrum of activities

The term 'eLearning' should be seen as embracing a spectrum of activities ranging from 'eLearning:Administration', i.e., the eBusiness characteristics of eLearning, to 'eLearning:Educational Practices', i.e., technology assisted teaching and learning. See Figure 3.

This distinction between 'eLearning:Administration' and 'eLearning:Educational Practices' is alluded to by several authors, e.g., (Mitchell 2003), (Barron 2002). Although this distinction is valid for many reasons, there are also many grey areas in between these two ends of the spectrum and it should be noted that in an educational technology sense it is a goal to see integration between these conceptually separate facets of eLearning. Technologies to support the whole spectrum of eLearning activities are historically already lacking in integration. i.e., there is typically poor integration between the eBusiness technologies that support eLearning:Administration and the teaching and learning technologies that support eLearning:Educational Practices.

Patterns for eBusiness and patterns for eLearning

Figure 1 hints at how relationships might be identified between Patterns for eBusiness and Patterns for eLearning. This discussion of patterns is expanded later in this paper. Hence at this point readers are offered two equally viable routes through this paper. Either continue reading here and hence initially just note the following summarised bullet points about Patterns for eLearning or take an immediate diversion to read part two of the paper entitled 'Patterns in education systems' and subsequently return to this point in the paper. Either route is viable according to the reader's preference and/or prior knowledge of patterns.

- Patterns for eBusiness is a tried and tested successful initiative from (IBM 1999) which is exploited extensively during the analysis and design of eBusiness solutions. In the context of this paper it is also an example of an advanced well funded body of knowledge emerging from the enterprise domain; an example of something that the education domain might be able to learn from.
- Patterns for eLearning is a speculative idea to which an increasing number of researchers are starting to contribute, ourselves included. In contrast to Patterns for eBusiness, Patterns for eLearning is a poorly funded fragmented area of research lagging significantly behind its commercial counterpart.
- In formulating a Patterns for eLearning schema one would expect to find significant reusability of Patterns for eBusiness ideas in the context of Patterns for eLearning:Administration. It is much more speculative to consider whether the Patterns for eBusiness schema can contribute to formulating a Patterns for eLearning:Educational Practices schema. The drivers for optimistically pursuing this speculation include:-
 1. A desire to see a Patterns for eLearning schema that serves educational technology developments in a manner that is analogous to how the Patterns for eBusiness schema serves eBusiness developments.
 2. The ‘taken for granted’ usefulness of the Patterns for eBusiness schema for supporting developments in eLearning: Administration.
 3. A desire to see technology integration between the two main facets of eLearning (administration and educational practices). For this technology integration to be achieved it is probably a pre-requisite that a patterns schema describes the integration. i.e., the patterns will be integrated before the systems aspects of the technology are integrated.

Advances in enterprise technology and advances in educational technology

The first thing to note here is that the term ‘technology’ should not be narrowly interpreted. ‘Technology’ does not refer to just the hardware and software gadgets that most people associate with the word. Consider the historical origins of the word, e.g., from the Greek word ‘*technologia*’ meaning ‘systematic treatment of an art’. Consider current dictionary definitions including ‘a manner of accomplishing a task especially using technical processes, methods, or knowledge’ and ‘a capability given by the practical application of knowledge’. Note in these definitions the emphasis on knowledge rather than on hardware gadgets. This broader view of ‘technology’ is important here because of the assertion that advances in educational technology need to derive lessons from advances in enterprise technology and these lessons are very much broader than just an appreciation of hardware and software. For example, in the brief introduction to patterns provided above the knowledge, principles, techniques, etc, are all regarded as important aspects of the technology.

A useful elaboration to make here is to break the phrase ‘enterprise technology’ down into two phrases, ‘*technology of enterprise*’ and ‘*technology in enterprise*’. Similarly, one should think of ‘educational technology’ as embracing ‘*technology of education*’ and ‘*technology in education*’. ‘*Technology of education*’ would include things like the process of designing learning scenarios that support the provision of student driven just in time assembly and coordination of learning and teaching resources. In contrast, ‘*technology in education*’ would include things like software artefacts, e.g., your favourite learning management system or simulation tools or multimedia educational games, etc.

Therefore, in figure 1, where it says ‘Advances in Enterprise Technology’, this refers to much more than enterprise hardware, this includes the evolution of enterprise practices towards ‘Dynamic eBusiness’ or as it is also called ‘eBusiness on demand’.

Dynamic eBusiness (aka eBusiness on demand)

One could provide intuitive explanations of what terms like ‘dynamic eBusiness’ mean but in the spirit of this paper we are obliged to deliberately explore and exploit existing knowledge of these ideas that has emerged from the enterprise domain. This is especially worthwhile for the context of the conference theme ‘beyond the comfort zone’ because in today’s enterprise domain the necessity to migrate towards ‘eBusiness on demand’ is a classic example of being forced to abandon the old comfort zone or become obsolete. It must be worthwhile to examine the details of what it means to migrate towards eBusiness on demand and then ask ‘how much of this can be applied to educational scenarios?’ If approached imaginatively this question can be applied at various levels of educational scenario. Hence one can

explore what it means to take dynamic eBusiness characteristics and apply them to a university, or to a faculty, or to a department, or to the delivery of a course, etc.

Within this overview of dynamic eBusiness other terms in figure 1 (i.e., Web Services, Service Oriented Architectures, on demand Computing, and eLearning Service Grids) will also be placed into context.

IBM has defined eBusiness on demand as "an enterprise whose business processes, integrated end to end across the company and with key partners, suppliers, and customers, can respond with speed to any customer demand, market opportunity, or external threat" (IBM 2002). One can already use that definition to make potentially embarrassing comparisons with the average university department. Can a typical university department describe its educational provision as responsive, agile, dynamic, etc. Is any university department even vaguely close to offering student directed just in time educational services? It is probably more realistic to note that most university departments are barely even considering the possibilities yet alone thinking about the implementation. This is not just the age old debate about resource based approaches to learning versus face to face approaches to learning. The lack of dynamic flexibility, an inability to rapidly respond to dynamic requirements of students, is a criticism that can be aimed at our current implementations of all approaches, resource based, face to face, and blended hybrid approaches. Our willingness to find excuses for avoiding dynamic flexibility is certainly an indicator of a complacent comfort zone waiting to be challenged.

The IBM version of eBusiness on demand offers a clarification of various characteristics. At the business operating level it refers to characteristics like Responsive, Variable, Focused, and Resilient. At the level of the systems required to support dynamic eBusiness it refers to characteristics like, Integrated, Open, Virtualised, and Autonomic. These terms are further explained below. Having borrowed these terms from eBusiness on demand one can speculate on whether the characteristics they describe are valid targets for the dynamic provision of educational services and for the educational technologies that support those provisions.

The evolution towards eBusiness on demand is described by IBM as occurring in roughly three stages which they label as Stage i) Access, Stage ii) Enterprise Integration, and Stage iii) eBusiness on demand. The first stage is immediately recognisable as just 'getting onto the web', i.e., organisations provide web based access to a variety of resources for customers and eventually offer the facilities to conduct relatively simple transactions online, e.g., making bookings, paying bills, etc. One can make comparisons with a number of educational equivalents like publishing lecture notes on line and enabling students to enrol online for a course. Irrespective of whether this stage is being used for pedagogically sound practices or pedagogically bankrupt practices, it is still just an early phase of exploiting the Internet and in IBM eBusiness jargon this is called the Access stage. In educational environments we can all realise how this might be regarded as one of our current comfort zones within which we get genuine but not particularly advanced benefits from our online technology.

The second stage (overlapping to some extent with the first) is called Enterprise Integration. In this stage organisations seek to use web technologies to integrate business processes within and across enterprises. This stage involves significant integration of internal and external systems, within organisations and across organisational boundaries. Again we can make comparisons with how well education providers are faring in this stage. As a university's internal systems become better integrated, they can offer streamlined administrative processes directly to staff and students and offer significantly improved access to those processes maybe even by using campus portals, etc. It is tempting to feel satisfied that progress is being made in this area but as a note of caution most current achievements in this kind of integration are currently primitive and mostly hand crafted and destined to need a major overhaul as new approaches to integration are emerging. They are at best very temporary comfort zones. So for example if your learning management system somehow manages to collect data from your student management system and your students use the same login facilities to access the library as they use to access the learning management system you might be tempted to think you have achieved integration. In terms of eBusiness on demand however, at this stage the game has barely begun.

Stage 3 – eBusiness on demand should not be interpreted as the simple scenario where customers simply receive a service online. It is instead a description of how quickly a business can adapt its structures and processes in response to new opportunities or new threats. When an old way of doing something is no

longer appropriate, and a new way is required, how long does it take to adapt the structures and processes? When a new opportunity arises how long does it take to provide a solution? If the answer is measured in months of human design effort then this would not qualify as eBusiness on demand even if the final result was an on demand service. If on the other hand a business was sufficiently *Responsive* to identify required changes, and sufficiently *Variable* to adapt its structures and processes automatically, then it would have achieved two of the qualities deemed necessary to qualify as an on demand eBusiness. The other two qualities deemed appropriate for an on demand style of operation are *Focused*, which refers to an organisations commitment to its core competencies and its associated arrangements with strategic partners to manage related activities, and *Resilient*, which refers to an organisation's ability to provide round the clock services via processes and systems that can survive unexpected spikes in demand, or virus attacks, etc. These four characteristics Responsive, Variable, Focused, and Resilient are therefore regarded as features of an on demand eBusiness operating environment. The descriptions are at the level of operational practices. It is an interesting prospect to contemplate which aspects of educational provision might ultimately be amenable to these highly automated and fast approaches to adaptation.

A lower layer of characteristics is also described by IBM as they describe the kinds of hardware and software environments that are required to achieve an on demand operating environment. These characteristics include terms like Integrated, Open, Virtualised and Autonomic. The term 'Integrated' refers especially to horizontal integration that enables the modelling and management of processes across internal and external systems. This is the feature that is currently a major focus of attention for very many IT departments within very many organisations. The flavour of the month buzz words in this area are undoubtedly Web Services, Service Oriented Architectures and Business Process Management. Although flavour of the month (actually for a few years now) these technologies really do deserve the attention they currently receive and really do offer unprecedented opportunities for modern technology to achieve some of its overdue promises in terms of achieving integrated process management without dependencies upon specific platforms or specific operating systems and specific programming languages, i.e., they really might enable heterogeneous systems to dynamically achieve collaboration. Applications of these ideas in an educational context, i.e., Web Services and Service Oriented Architectures in Education, were briefly described in (Siviter 2004). See also (Siviter & Wheeler 2004) for an investigation of whether Educational Process Modelling might be well served by advances in tools and techniques developed for Business Process Modelling.

For a brief explanation of the other terms used to describe the systems that support eBusiness on demand (i.e., Integrated, Open, Virtualised, Autonomic): - 'Open' just refers to open standards, e.g., XML, Web Services, etc. 'Virtualised' refers to scenarios where organisations exploit computing power on demand in a manner that is analogous to using a utility like a water supply 'on tap'. Business applications designed to exploit a virtualised environment instead of a dedicated environment are less concerned with whether the computing power is supplied in-house or supplied from an outsourced grid or a combination of both. Grid computing is a technological development designed to achieve that virtualisation. Grid computing is quite literally coming online at an increasing pace (GGF 1999) and is destined to have an impact on all computer usage. In education environments we can contemplate the following equation:- Web Services in Education + Grid Computing = eLearning Service Grids. Imagine the potential if tutors and students all take for granted the use of hand held devices that can wirelessly tap into remote supercomputers.

The final term 'Autonomic' is an interesting technical feature with which IBM claim to be making substantial progress. By analogy with human systems, an autonomic system has capabilities of self diagnosis, self configuration, and self healing, all especially welcome and essential when these complex service grids become commonplace.

It should be apparent from the ambitious goals of eBusiness on demand that one of the greatest recurring challenges is that of managing complexity. The analysis, design and development challenges that accompany eBusiness on demand are immense. Even so, the deterrence of complexity does not outweigh the benefits to be gained and the evolution towards eBusiness on demand seems unstoppable. If similar trends face the education domain then we can anticipate even greater complexity. It is obvious that trends in eLearning:Administration could mirror trends in eBusiness on demand but given our spectrum of eLearning:Administration and eLearning:Educational Practices, what are the added complexities of eLearning:Educational Practices evolving towards a more dynamic model?

One of the most important techniques that has emerged to cope with complexity in a number of disciplines is a patterns oriented approach. We favour pattern oriented approaches for clarifying the complexities of eLearning scenarios. We hold the assumption that integration across the eLearning spectrum can be usefully described within 'Patterns for eLearning' schemes and that the pattern oriented descriptions can assist in implementing integrated eLearning technology.

Initiatives in several disciplines have extolled the virtues of pattern oriented approaches and several of these initiatives can contribute insights to patterns for eLearning. So, for example, while looking at eLearning:Administration we can find useful insights from the Patterns for eBusiness initiative (IBM 1999). At the other end of the eLearning spectrum, while looking at eLearning:Educational Practices, we can find useful insights from projects like (Oliver et al, 2002; PPP, 2002). There are many other examples of patterns initiatives that can be fitted into the eLearning spectrum including for example Patterns for Interaction (Borchers, 2000), Patterns for Learning Management Systems ((E-LEN Project, 2003; Avgeriou et al, 2003), Patterns for Software Design (Gamma et al, 1994), etc.

The next section of this paper provides an introduction to patterns and highlights a few of the initiatives mentioned above. The work described in this section is part of a project to investigate and consolidate ideas from any patterns oriented initiatives that may be able to contribute to a 'Patterns in Education Systems' scheme.

Patterns in education systems

The following sections of the paper explore the idea of patterns and examine their application in a number of relevant fields. Comments are made on the suitability of the patterns concept for educational contexts and suggestions made concerning the future development of patterns in education systems.

What are patterns?

A pattern is essentially a reusable solution to a re-occurring problem. Such solutions usually evolve through the learning achieved from extensive practical experience. A typical pattern description will include the pattern name, an outline of the generic problem to which the pattern applies, and a description of the solution provided by the pattern.

The modern origin of the patterns concept is attributed primarily to the work of Dr. Christopher Alexander. Whilst working at the Centre for Environmental Structure at the University of California, Alexander, along with colleagues, Ishikawa, and Silverstein, published the book "A Pattern Language". This book describes 253 patterns for use with town planning and construction design. According to Alexander, a pattern is defined as follows:

Each pattern describes a problem that 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)

The 253 patterns described by Alexander were moulded into a hierarchical system of patterns. Alexander refers to this hierarchy of patterns as a Pattern Language. A theme stressed by Alexander is that the true value of patterns stems not from their individual application but from a more synergistic use. It is suggested that the relationships between patterns within a pattern language are of as much significance as the patterns themselves.

The pattern language presented by Alexander was designed to be applied in a sequence, moving from larger (high level) patterns to smaller (low level) patterns. It was hoped that using patterns in a such a sequence would help bridge communication gaps between different disciplines.

Alexander suggests that selection of a sequence of patterns from a pattern language in turn forms a sub pattern language that is applied to a particular situation. By using different sequences of patterns different pattern languages can be generated. The pattern language selected for a particular circumstance will play a large role in defining the character of the eventual solution.

Alexander speaks to the use of a pattern language to create “poetry” or “prose”. The difference between poetry and prose is not that different languages are used, rather that the same language is used differently (Alexander et al, 1977). Creation of pattern language prose will generally result in a solution of shallow meaning, whilst creation of poetry will result in a solution whose meaning can be much deeper.

Where have patterns been used?

Since the publication of Alexander’s work in the late 1970’s the patterns concept has been adopted by a number of fields. This includes computing fields such as Software Engineering and in recent years eBusiness. The application of patterns to these areas is outlined as a means of leading into the examination of patterns within education systems.

Patterns and software engineering

In 1987, Ward Cunningham and Kent Beck, two software engineering consultants, were working on a project at the Tektronix corporation. The development group at Tektronix was having difficulty completing a design for software system. Being familiar with the works of Alexander et. al Cunningham and Beck decided to attempt to exploit the patterns concept to assist in the design. Using his expertise of the Smalltalk programming language, Cunningham produced a pattern language consisting of five (5) patterns. These patterns were aimed at allowing novice designers utilise Smalltalk’s strengths while avoiding its weaknesses (Cunningham, 2004).

This work was followed by a number of publications in the early 1990’s investigating the development of reusable object oriented software through the use of documented designs. These initial works into design documentation lead to the development of arguably the most famous set of Software Engineering patterns. In 1994, Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides (nick named the Gang of Four) published a book called “Design Patterns” (Gamma et al, 1994). This book introduces the idea of design patterns and presents a number (23) of pattern descriptions. Each of the presented patterns is classified as either a Creational Pattern, a Structural Pattern, or a Behavioural Pattern.

Whilst the documentation and use of patterns has gained widespread acceptance amongst many within software engineering, it has been suggested that patterns have not been used to their full potential in this field. In 1996, Christopher Alexander delivered a keynote presentation at the Object Oriented Programming conference in San Jose, California. During his presentation Alexander suggested that Software Engineering patterns had been used well to exchange fragmentary ideas about programming but had generally not been used in a holistic sense as his patterns concept has intended (Alexander, 1996).

Patterns and eBusiness

The Patterns for eBusiness initiative (IBM 1999) was launched by IBM in 1999. Since that time IBM has continually adjusted and revised the included patterns as changing needs emerge in industry (IBM, 2003).

The Patterns for e-Business initiative presents a framework or system of patterns (figure 2) which attempts to bridge the traditional communication gap between business requirements and technical implementation. This is in line with the approach to patterns taken by Alexander.

As figure 2 suggests, the IBM eBusiness patterns are applied to a scenario in a sequence. The sequence starts with the identification of business patterns on a Solution Overview Diagram (SOD). Examination of the relationships between each identified business pattern leads to the identification of integration patterns. From here an application pattern is selected for each business and integration pattern, providing a more refined solution description. Selection of runtime patterns refines the solution further, finally allowing the mapping of solution requirements to specific products (product mappings).

“Business Patterns are high level constructs that can be used to describe the key business purpose of a solution” (Adams et al, 2001, p.35). There are presently four (4) business patterns documented by the initiative; Self service, Collaboration, Information Aggregation, and Extended Enterprise. Integration patterns are used to combine business patterns into more powerful solutions. The initiative presents two integration patterns, Access Integration and Application Integration (Adams et al, 2001, p.54-57).

Once the appropriate business and integration patterns have been identified for a solution, an application pattern for each business and integration pattern is selected. A range of application patterns exist (currently approximately 30), each with different characteristics. IBM has devised a table of metrics to assist in the selection of the most appropriate application patterns for each circumstance. The selection of application patterns represents a necessary refinement allowing implementation to proceed (Adams et al, 2001, p.15). Further refinement is achieved through the selection of run time patterns and a process of product mappings.

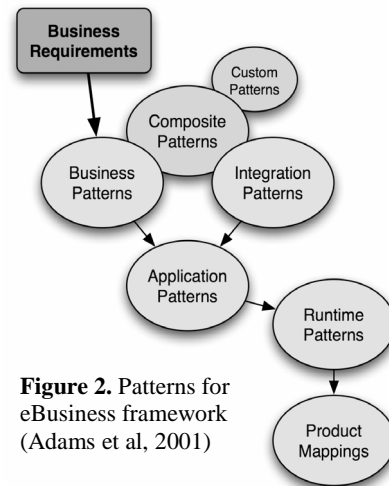


Figure 2. Patterns for eBusiness framework (Adams et al, 2001)

Patterns presented as part of the initiative are described using a standard descriptive framework which describes the pattern, the context in which the pattern can be typically found, the proposed solution, guidelines for use, benefits, limitations, and a guide to the business and technology drivers behind the patterns selection.

IBM have cited their extensive experience in development of eBusiness solutions as the basis for the patterns within the Patterns for eBusiness project. As might be expected, the patterns within the initiative tend to lead to product mappings well covered by IBM products, however the pattern language presented provides a useful illustration of patterns usage within an extensive technology area.

Patterns and education systems

There exist a number of projects that have examined or are examining the use of a patterns style appropriate to education provision.

The provision of education involves a variety of activities, ranging from administrative functions such as enrolment and attendance checking to pedagogical activities such as lecturing and group work.

It is expected that many of the existing projects examining a patterns approach to education will be able to contribute to an overall system of education patterns.

Whilst only two projects will be described in this section, they are indicative of the kind of patterns related work being completed within educational research.

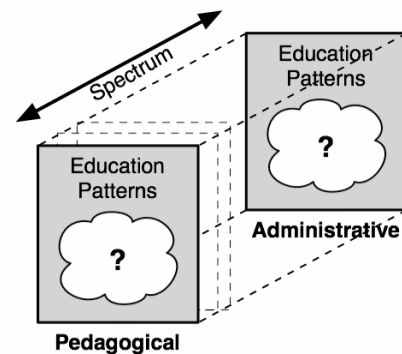


Figure 3: A spectrum of activities associated with the provision of education

The AUTC Learning Designs project

In November 2000, AUTC (Australian Universities Teaching Committee) commissioned a project aimed at identifying ‘learning designs’ that would assist in producing high quality learning experiences. With a focus on finding learning designs that involved the use of Information and Communication Technology (ICT), the project documented a number of reusable templates for creating learning designs, and a number of learning design exemplars (Oliver et al, 2002).

Each learning design presented by the AUTC project is described using a framework consisting of the tasks, resources, and supports that the learning design requires. See figure 4.

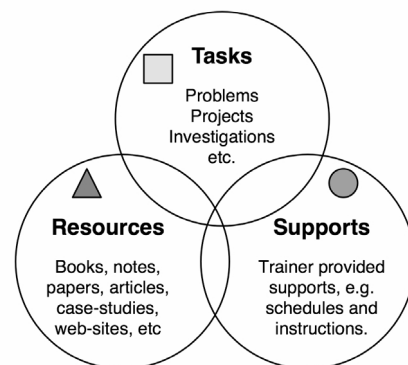


Figure 4: AUTC Learning Designs, Key Components.

Learning tasks represent the activities or the ‘journey’ learners are required to undertake. Learning resources are the artefacts available to learners aimed at supporting learning activities. Learning supports represent the support mechanisms provided by the trainer. These three components are combined into a “learning design sequence” that graphically represents the learning design.

Collections of learning designs are in effect collections of patterns. We believe that there would be benefits from seeing these patterns integrated into a broader framework of patterns in education.

The E-LEN Project

Of interest are the efforts of the E-LEN project. E-LEN represents a collaborative effort between a number of European institutions to “design patterns for e-Learning, laying the foundations for a pattern language for e-Learning” (E-LEN Project, 2003).

At present the E-LEN Project has publicly described a small number of e-Learning patterns which have been classified into four (4) categories (see figure 5). Each of the four categories has been allocated to a special interest group within the E-LEN project. Each e-Learning pattern described by E-LEN is given a rating of one (1) to three (3) that indicates its level of maturity. A rating of one indicates that the pattern is premature and still being researched. A rating of three indicates that a pattern is mature and has been accepted by E-LEN as a valid pattern.

Learning Resources & Learning Management Systems
Lifelong Learning
Collaborative Learning
Adaptive Learning

Figure 5: E-LEN Patterns classification categories

Summary and closing remarks

This paper has alluded to the fact that many enterprises are faced with the option of either evolving into ‘on demand’ eBusinesses or ceasing to be viable. Just as enterprise is continually dragged out of the comfort zone both in its operational practices and in the supporting technology, so too will education providers be driven towards more dynamic practices supported by significantly more complex technology. This inevitable movement out of the present educational comfort zone makes exploration of ways to ease this movement relevant and necessary.

Pattern oriented approaches are regarded as valuable tools for managing complexity and are established in various domains including eBusiness and software engineering. It is reasonable to assume that patterns can offer similar benefits to the education domain. The examination of patterns within education systems raises some interesting questions. For example, are the eBusiness patterns developed by IBM applicable to any aspects of education provision? To what extent can the various existing patterns initiatives in education be combined into a more holistic system of patterns for education?

An observation emphasised within this paper is that technology within the enterprise domain emerges and evolves at a faster rate than equivalent technology within the educational domain. Given this observation, it is logical for the educational domain to adopt and adapt various enterprise technologies. It can even be argued that many of the advances in eLearning technology are being driven by advances in eBusiness technology. The lag between the emergence of technology within the enterprise and educational domains provides education providers with the opportunity to learn from the successes and mistakes made in the enterprise domain. Patterns provide a useful means of encapsulating lessons learnt.

Whilst patterns have been developed and utilised in fields such as eBusiness and software engineering there presently exists a limited number of dispersed projects examining the use of patterns within education. It is hoped that a collaborative approach can be adopted by these projects, each being able to make a contribution to the development of pattern languages for various aspects of education provision. A framework of pattern languages for education might be used to facilitate the classification and organisation of the works presented by the various educational patterns projects.

Clarity and consistency of documentation quality is considered to be an important part of producing a successful pattern language. As such, pattern languages for education need to be documented clearly and consistently. Such consistency of documentation is demonstrated in the IBM patterns for eBusiness

project with what they refer to as a 'Standard Descriptive Framework'. This is considered to be one of the factors that has aided in the success of the initiative.

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