e-learning quality: becoming a level five learning organisation

Chris Manford
Mae McSporran
UNITEC
Auckland, NZ
cmanford@unitec.ac.nz

Proceedings of the 16th Annual NACCQ, Palmerston North New Zealand July, 2003 (eds) Mann, S. and Williamson, A. www.naccq.ac.nz

ABSTRACT

The effectiveness and maturity of any organisation's business processes directly affects costs and quality of the goods and services they delivery to their customers.

As education providers explore e-learning, many concerns (Institute of Higher Education Policy 2000, University of Illinois 1999) are being raised that the quality of e-learning courses may be low, leading to an adverse impact on the reputation of the education provider and a resistance by faculty (Clay 1999) to adopt computer facilitated learning. This paper suggests a possible solution to the problem of maintaining quality for education providers who are implementing e-learning solutions within a traditional face-to-face environment. Specifically it proposes a Maturity Model (MM) that can be used to measure the organisational maturity with respect to the development and delivery of e-learning solutions. Once measured against this common benchmark, organisations can use this information to gauge their progress in this area and draw comparisons between themselves and other organisations.

1. INTRODUCTION

This paper has two main objectives first to introduce a maturity model for measuring organisational maturity of e-learning and second to present data from four large educational institutions (two from Australia and from New Zealand) that is used to test the model. The maturity model described (e-learning capability maturity model) and used to model the four organisations, was developed by one of the authors. Space limitations preclude a complete description of it but this will be published shortly. The model has elements of several of the other maturity models. However, even though it was derived from many years of experience, it is still in an experimental stage and would benefit from peer review. Publishing this paper is the first step at obtaining such feedback.

Whether we like it or not education is now big business. In the 2001/2002 financial year the Australia education sector was estimated to be worth over $4 billion, the third highest for the country. In 1997/8 they invested millions in the development of e-learning capability and products by making grants available. Perhaps as a response to this, our own government is showing an interest in supporting Computer Facilitated Learning (CFL) projects. In May 2003 the Associate Minister of Tertiary Education, Steve Maharey, announced that the government is to invest $28M in e-learning for the tertiary sector. This, in addition to the $9.8M set aside in the 2002 budget. Welcome news indeed!

Whether tertiary education providers are interested in e-learning in order to gain access to this funding or as a necessity – because students expect it, or for competitive advantage – to increase student numbers, or for strategic advantage - by giving students more flexible learning options, or simply because they think e-learning has the potential to improve education, it is evident that it represents an important issue for most providers.

Many already have some experience in e-learning having implemented a variety of solutions driven mainly by early adopters. For many this 'toe in the water' approach has been quite valuable; it's enabled them to gain experience with the pedagogy and technology and work out the strengths and weaknesses should they decide to 'go for a swim'. But organisations cannot stay in a 'toe in the water' state forever and the time comes to make decisions.

Other organisations took their swimming lessons some years ago, they can articulate a clear vision for e-learning and understand the factors they need to manage to realise it. They are now helping others by adding to the rich body of knowledge and providing examples of good practice.

The approach of this paper is to summarise the E-learning Capability Maturity Model (ECM^2) and apply its Key Performance Indicators (KPIs) to four large Universities to model their development of e-learning over the period 1995 to 2002.

2. INTRODUCTION TO MATURITY MODELLING

Maturity models (MM) were used as long ago as 1943 by Maslow (cited by Gwynne 1997) who proposed one for human needs development. However all MMs have the same basic aim. The Project Management Institute (PMI) describe their OPM3 model as a "model that provides methods for developing and assessing capabilities which enhance an organization's ability to deliver projects successfully, consistently, and predictably in order to enact the strategies of the organization and improve organizational effectiveness." (PMI 2003).

Maturity models have the following characteristics and assumptions:

♦ The aspect of measurement – how long did this task take? how much did this development cost the organisation?

♦ A maturity matrix - a number of levels or stages are defined that represent improved capability and performance in particular organisational processes. Organisations proceed to the next level of maturity as they fulfil its requirements.

¨ The process maturity is institutionalised by "building an infrastructure and corporate culture that support the methods, practices and procedures of the business so that they endure after those who originally defined them have gone." (Paulk *et al.* nd).

♦ That, processes which are better defined, can lead to better products.

Just because we have models these do not guarantee success as Schmidt (2002) warns: "In a sense methodologies are like [sports] coaches – they don't magically guarantee success, but they do provide principles and practices that can lead to better solutions."

The best-known maturity model is the Software Capability Maturity Model (SW-CMM) from Carnegie Mellon University, but maturity models also exist for project management, software acquisition, data maturity, integrated product development, people capability maturity modelling, enterprise application integration, earned value management and knowledge management.

3. THE E-LEARNING CAPABILITY MATURITY MODEL (ECM^2)

The ECM^2 is still in a developmental stage and comprises five levels that show increasing maturity in e-learning for an organisation. These are:

Level 1 – Initial

This is the level that organisations enter the model. It represents immaturity. The organisational capability at this level would be described as 'ad hoc and occasionally even chaotic' (Sallis, Tate and MacDonell 1995). There are few, if any defined processes that are followed by the staff involved in e-learning. No measurements of success or failure take place. Success depends on the abilities, efforts and organisation of individuals.

Level 2 – Independent

At this level systems for the management of e-learning projects are in place. However many such systems exist within the organisation and each project operates largely independent from others. Within each area, data may be collected from projects: measurements of scope, resources needed for completion and problems in meeting commitments identified. These are used to provide a basis for estimation and planning of future projects.

Level 3 – Shared

At this level there exists sharing of expertise between areas. Processes used are codified and no longer depend primarily on individuals. Some level of group responsibility exists for the maintenance of these processes. Common training programs are implemented among the areas to ensure that development staff, teachers and managers have the skills and knowledge to do their work. These well-defined processes provide greater visibility of the solution provided.

Level 4 – Organised

The main characteristic of this level is that systems and procedures (for staff development, staff and learner support, instructional design, project management) are organisation-wide. A common database exists that stores measurements collected about each project. These metrics measure well-defined and consistent productivity and quality goals for projects. Products are of predictably high quality.

Level 5 – Learning

This level represents the learning organisation. Continuous process improvement is adopted by reviewing and updating processes through incremental advancements and by use of new technologies and better methods. The organisation has the necessary data to analyse defects and their cause and perform cost benefit analysis on new technologies and evaluate new methods. Such technology and process improvements are included as ordinary business activities.

4. KEY PERFORMANCE INDICATORS (KPIS)

The performance areas for ECM[2] fall into three categories: people, processes and technology. KPIs for levels 2 to 5 have been defined[1]. These describe the aspects of e-learning that must be present to satisfy good practice at each level.

Level 2 – Independent - the success of e-learning projects depend on the effort of individual project teams.

People

♦ **Staff and student support** is organised and provided by the project team during implementation.

♦ **Staff development** is managed by the project team during implementation.

Processes

♦ **E-learning project** m**anagement** - processes for the management of e-learning projects are adopted by project teams

♦ **Quality assurance** – methods are implemented by project teams in the development and delivery of e-learning.

♦ **Instructional design** - project teams define and adopt methods for instructional design. These are of variable quality.

♦ **Funding** for e-learning projects is usually from contestable funds.

♦ **Planning** for e-learning focuses on a number of separate projects.

Technology

♦ **Network infrastructure** - A common network infrastructure supported by the organisation.

♦ **E-learning infrastructure -** the HW/SW infrastructure for e-learning provided and managed by project teams.

Level 3 – Shared – good practice is developed through the sharing of methods and knowledge with people around you.

People

♦ **Staff and student support** is organised and provided within departments or faculties.

♦ A **Staff development** needs analysis is conducted and series of e-learning courses made available to local groups.

♦ **Reward systems** - departments or faculties recognise and reward employees' contribution to e-learning.

♦ **Specialisation** - course development regularly involves specialist staff provided by the department or faculty.

♦ **Opportunities for sharing** – such as magazines, e-fest, workshops etc, are organised for people to share their knowledge and experiences of e-learning.

Processes

♦ A common approach to **E-learning project management** is within departments or faculties.

♦ A common approach to **Quality assurance** is adopted within departments or faculties. These include initial and ongoing peer review is included for e-learning projects.

♦ A common approach to **Instructional design** is adopted and the methods used are codified by departments or faculties.

♦ **Funding** for e-learning projects is provided by departments or faculties.

♦ **Standards and performance indicators** for e-learning development and delivery are adopted by depts or faculties.

♦ **Planning** for e-learning is integrated within a department or faculty.

♦ **Reusable** – learning objects within a department or faculty are identified and an object library built.

Technology

♦ **E-learning infrastructure** - a HW/SW e-learning infrastructure is provided and managed by departments or faculties.

Level 4 – Organised - good practice is developed by the organisation as a whole.

People

♦ **Staff and student support** for e-learning is organised and provided for the organisation as a whole.

♦ A **Staff development** needs analysis is conducted and series of e-learning courses made available in the organisation.

♦ **Reward systems** - the organisation recognises and rewards employees' contribution to e-learning.

♦ **Specialisation** - course development regularly involves specialist staff these are provided by the organisation.

Processes

♦ **E-learning project management -** methods used and data are collected about projects. A database of project performance measurements is maintained within the organisation.

♦ A common approach to **quality assurance** for e-learning is adopted by the organisation.

♦ A common approach to **Instructional design** is adopted by the organisation.

♦ **Funding** for e-learning projects is part of the budgeted activities of the organisation.

♦ **Standards and performance indicators** for e-learning development and delivery are adopted by the organisation.

♦ **Planning** for e-learning is integrated at the organisational level.

♦ **Reusable** – learning objects within the organisation are identified and an single object library is built.

Technology

♦ **Integrated infrastructure** – the organisation's infrastructure includes e-learning HW/SW.

♦ **Technology change management** – awareness of new technologies and their impact on quality and productivity.

Level 5 – Learning

Processes

♦ **Continuous process improvement** – activities necessary for continuous process improvement are planned and adopted by the organisation.

♦ **Knowledge management** - knowledge gained from reviews is used to modify policy, procedures and standards.

Technology

♦ **Technology change management** - new technologies are considered and evaluated to determine their effect on quality and productivity.

♦ **Technology diffusion** – appropriate technologies are transferred into normal practice across the organisation.

5. RESULTS

The data for the results was mainly collected from interviews with three key players within each organisation. In order to triangulate these findings information (where available) was gathered from institutional records and publications both internal and external. We realise however that data gathered during interviews reflects the views of the interviewees and in spite of attempting to triangulate with data from other sources, invariably those sources reflect the opinions of the protagonists within each organisation.

By examining the charts in appendix A for the four different organisations you get a visual representation of their level of maturity. They have been identified by the country code, AU for Australia and NZ of New Zealand

You should notice that according to our analysis AU_Inst 1 is the most mature with respect to its e-learning capability. The other organisations lag behind somewhat.

6. CONCLUSIONS

In this paper we have presented a capability maturity model for e-learning and used it to show a visual representation of the e-learning capability of four large tertiary education institutions, two in Australia and two in New Zealand.

This is only a preliminary investigation with a sample is small. More data has been collected and still needs to be analysed, nevertheless we hope we have been able to show that the model is able to provide a useful visual guide and a method of comparing the e-learning maturity of the four organisations.

It may be interesting to note that the organisation shown to be most mature was able to secure funding for e-learning much sooner than most, they invested this in infrastructure but did not forget the development of processes to support sensible use of the infrastructure. They also had a champion at a high level who ensured continued financial support for this area. Being the largest organisation they were also likely to employ the largest numbers of innovators.

More details about the model will be published shortly. MM in other areas took several years to develop and required input from many practitioners and ECM^2 will be no exception. It is also likely that variations in future data may challenge the model and suggest the need for new KPI's to explain the results.

The researchers realise that modelling is not new; what is new is our attempt to explain the massive amount of data collected from four case studies using a series of KPI's in an area like education where performance indicators are notoriously difficult to isolate.

REFERENCES

Clay, M., (1999) "Development of Training and Support Programs for Distance Education Instructors" [online] http://www.westga.edu/~distance/clay23.html accessed April 3rd 2003

Gwynne, R (1997) University of Tennessee, "Maslow's Hierarchy of needs" [online] http://web.utk.edu/~gwynne/maslow.HTM accessed June 6 2003

Paulk, Curtis, Chrissis and Weber (nd) The Capability Maturity Model for Software, Software Engineering Institute, [online] http://www.sei.cmu.edu/cmm/papers/cmm.pdf accessed May 13th 2003

Project Management Institute (2003) "Organizational Project Management Maturity Model" [online] http://www.pmi.org/prod/groups/public/documents/info/pp_opm3.asp accessed May 13th 2003

Sallis, P., Tate, G. and MacDonell, S. (1995), "Software Engineering Practice, Management, Improvement." Addison-Wesley.

Schmidt, J. (Oct 2002) "The Software Ecologist", eAI Journal October 2002 pp56.

The Institute of Higher Education Policy, (April 2000) "Quality on the Line: Benchmarks for success in Internet-based Distance Education". [online] http://www.ihep.com/Pubs/PDF/Quality.pdf. accessed May 13th 2003

The Software Engineering Institute, Carnegie Mellon University (May 2003) "Capability Maturity Model® for Software (SW-CMM®)" [online] http://www.sei.cmu.edu/cmm/cmm.html, accessed June 6 2003.

University of Illinois Faculty Seminar (Dec 1999) "Teaching at an Internet Distance: the Pedagogy of Online Teaching and Learning", www.vpaa.uillinois.edu/tid/report/, accessed May 13th 2003

7 8 APPENDIX A CASE STUDIES ON ECM² (CONTINUED ON PAGE 354)

AU_Inst1		1995/6	1997/8	1999	2000	2001	2002
People	Staff Development (2-4)	L2	L3		L4		
	Staff and student support (2-4)	L2				L3	L4
	Reward systems (3-4)						L3
	Specialisation (3-4)						L3
	Opportunities for sharing (3)					L3	L3
Processes	Course Planning (2-4)	L2				L3	L4
	Quality Assurance (2-4)		L2			L3	L4
	e-learning project management (2-4)	L2				L3	
	Instructional Design (2-4)	L2			L4		
	Funding (2-4)	L2		L3			
	Standards (2-3)	L2		L3			
	Reuse (2-3)						L3
	Continuous improvement (5)						
	Knowledge management (5)						
Technology	Network Infrastructure (2)	L2					
	E-learning Infrastructure (2-3)	L2					
	Integrated Infrastructure (4)		L4				
	Change management (4-5)					L4	
	Technology diffusion (5)						

AU_Inst2		1995/6	1997/8	1999	2000	2001	2002
People	Staff Development (2-4)		L2		L3		
	Staff and student support (2-4)	L2			L3	L4	
	Reward systems (3-4)						
	Specialisation (3-4)					L3	
	Opportunities for sharing (3)					L3	
Processes	Course Planning (2-4)			L3			
	Quality Assurance (2-4)			L3			
	e-learning project management (2-4)			L3			
	Instructional Design (2-4)			L2			
	Funding (2-4)		L2	L3			
	Standards (2-3)			L2			
	Reuse (2-3)						L3
	Continuous improvement (5)						
	Knowledge management (5)						
Technology	Network Infrastructure (2)	L2					
	E-learning Infrastructure (2-3)	L2					
	Integrated Infrastructure (4)			L4			
	Change management (4-5)						L4
	Technology diffusion (5)						

The role of literacy in the IT curriculum

Dr Samuel Mann
Cindy Davies
School of Information Technology and Electrotechnology
Dr Graham McGregor
Faculty of Art and Technology
Otago Polytechnic, Dunedin, NZ
smann@tekotago.ac.nz

Proceedings of the 16th Annual NACCQ, Palmerston North New Zealand July, 2003 (eds) Mann, S. and Williamson, A. www.naccq.ac.nz

ABSTRACT

Literacy is an assumed skill in all programmes of higher learning, Information Technology is no exception. We apply language skills restrictions for foreign students, yet the complexity of requirements of programmes are poorly understood. Aspects of an Information Technology degree programme are considered in terms of their literacy requirements. The paper finds that in addition to skills required for prose, and writing in IT specific registers (user manuals, etc), we require advanced language skills as a precursor to IT skills themselves.

1. INTRODUCTION

Literacy is an assumed skill in all programmes of higher learning, written language is the central mode for daily transactions and labour and acquiring communicative competence is fundamental to all learning (Unsworth 1993). Information Technology is no exception to this. Despite this, the complexity of literacy requirements of programmes are poorly understood. There are also many calls for improved literacy yet we fail to address this in our teaching, the assumption is that tertiary level students upon entry have a minimum standard of written English and that basic English has no place in higher level courses.

There are many anecdotal claims of falling standards (Tench 2001) and a need to go "back to basics", but Unsworth (p4) argues the need for a reassessment that "goes considerably beyond the back to basics rhetoric". This paper attempts to go beyond the rhetoric and review the place of literacy, in particular, written literacy, in a degree level IT curriculum.

2. GENERAL VALUE OF LITERACY

The Ministry of Education (1994) places language (English) as "fundamental to thinking and learning, As the primary means by which we gather and communicate meaning and information, language is essential for reflecting and reasoning, and for clarifying and expressing thought in all areas of the curriculum". This involves development of processes associated with using and responding to English language purposefully and effectively through reading, writing, speaking, listening, viewing, and presenting; an understanding of the grammar and conventions of English; and so on.

Englebart and Palinsar (1991 in McNaughton), discuss the constructive approach to learning, whereby students "construct" meaning from environment. The implications here are that:

1. literacy is a cultural/social phenomenon with implications for definitions of literacy, and how instruction should take place;

2. process of literacy acquisition occurs in contextualised activity; and,

3. knowledge acquired in interaction with others.

Literacy is clearly a good thing, in addition to the effect on generally improved writing skills, what we need to do is identify the context: how does it relate to an IT curriculum - would it help if students know what verb is? how to spell receive? or be able to quote Shakespeare?

In addition to general concepts of literacy, there are specific implications for computing. The growth and spread of IT has also lead to wider definitions of literacy. Sefton-Green (1999), for example argues that – new media requires new literacies, not just IT literacy as often used (the skills to manipulate the computer), but what is critical is multimedia literacies- the ability to work across domains. Bruce (1997) produced a model of information literacy (information technology, information sources, information process, information control, knowledge construction, knowledge extension, wisdom) that is driven by cognitive space (work task, information need, etc) subject knowledge and Access (esp language). Underlying all these new literacies, the ability to read and write remains fundamental.

This paper then, aims to examine what we mean by

literacy for IT, and the context of that learning.

Literacy, as expressed in Business Communication, has a role in IT education. It is compulsory in most Information Technology (IT) degree programmes and usually includes an upper level written business communication course containing elements of style, reports, letters, memos, email and instructional documents. The overwhelming consensus in the literature is of the importance of non-technical skills also referred to as "soft skills" in information technology (IT) degree programmes. Goodwin (2002) indicated that a common criticism of IT courses is that they concentrate on the technical side of IT and that students aren't receiving the right balance, which would otherwise give graduates a head start in the work environment. Hughes (2001) describes employers wanting well-rounded candidates with excellent people skills, good oral and written communication skills and good work ethics. Research on the opinions of business executives and tertiary graduates reveal that the ability to communicate effectively in business is ranked at the top of the skills necessary for job success (McPherson, 1998, p.68).

Hartman (1989) found that the English skills students had learnt prior to their degree level were not being transferred into the context of IT. She felt that lecturers assumed that a student had already learnt to write and was able to transfer this skill to their IT study without any additional guidance.

It is clear that IT, like any subject, benefits from literacy as part of the suite of "soft skills", this includes the acquisition of communicative competence for writing about computing. Now we turn to aspects IT for which specific literacy skills are needed. These fall into two areas:

- language skills sufficiently robust for addition of a complex lexicon
- an awareness of language and skills specifics for what we expect as a baseline for teaching computing specifically

We teach calculus, not because we think it is integral to IT, but because it provides a platform for the abstract thinking and symbolic representation that we require of computing students. Literacy has the same relationship:

- we might require a high degree of language skills when we discuss the OSI model as an onion
- we describe data models in terms of quite specific language constructs
- we use pseudocode in program design
- we require a high level of language constructs in order to teach other languages, specifically, programming languages
- we use structured English in requirements determination
- we expect interaction between different forms of literacy (ie visual literacy) when we develop user interaction cases
- describe behaviours, eg Object Oriented: nouns, verbs (methods)
- case sensitivity eg JADE
- Problem statement refine to requirements (whole SDLC moving towards clarity)

In the following sections we examine some of these examples in more depth.

3. ANALYSIS

3.1 Programming

Evans and Simkin (1989) were able to explain 23% of variation in computer proficiency and concluded that "the task of finding effective predictors of computer proficiency remains unfinished". Unfortunately since then, we are little further ahead. Most success has been with maths (Gray *et al.* 1993) but language also has a role. Mayer *et al.* (1986) described three components: learning features of the language; learning to solve programming problems; and learning problem solving skills applicable to other languages – transfer. Mayer finds that it is not surprising that measures of general intelligence are related learning programming but few specific thinking skills could be identified although "pretraining in procedure comprehension (ie English) provides a foundation for learning Basic" (p609).

Byrne and Lyons (2001) for example, correlated programming skills of Irish humanities students with their scores in the Irish Leaving Certificate. They found maths gave a Pearson's correlation of .353, Science .572 and language skills of 0.088 and foreign language .199 (but all had high English score so low correlation expected). They do point to "basic similarities between learning a programming language and basic similarities to learning any language. In the coding phase of programming, attention to construction and syntax might be considered similar to language grammar skills, and creative writing skills might be considered similar to developing innovative programming skills".

McCracken *et al.* (2002) undertook a large scale study of the programming skills of computing students. Among their classifications they describe the "clueless" who fail the first stage of "abstracting the problem from a given description", or comprehension. In their findings they describe what they call 'a universal problem', that of the inability of students to successfully program even on completion of their first programming course and