LIFELONG LEARNING SUPPORTED BY EPORTFOLIO PROCESS

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor of Philosophy

in

Computer Science

at Massey University, Palmerston North,

New Zealand.

Yuliya Bozhko

2011

Abstract

The concept of lifelong learning is based on the principle of the self-directed pursuit of knowledge or skills that occur throughout ones life. While the concept is not new, the importance of lifelong learning skills in addition to academic and subject knowledge has been increasingly emphasised in the workplace and public policy over the last decade. Higher education institutions, and universities in particular, recognise the importance of lifelong learning and define their own strategies to promote it such as including learning attributes in their graduate profiles. Yet, at this stage, lifelong learning support provided in universities is not strong enough to meet learners' needs.

This research project explores theoretical concepts, available technical solutions and lifelong learning support needs of universities. As it is shown in the literature review, theories in this area have already been developed followed by raising awareness and attempts at universities to support lifelong learning. Currently basic level technical solutions are available, such as ePortfolio systems or accommodation of Personal Learning Environments (PLE) into university settings, but their shortcomings are hindering full adoption.

This PhD research proposes a learner-centered e-learning environment which will provide comprehensive support for lifelong learning. This environment will be built on an institutionally focused Learning Management System (LMS) and a learner focused ePortfolio system. While these systems already have some low-level connections, extensions are required to adequately support lifelong learning: students need to be in charge of their own learning progress; they need to be able to choose the environment that serves their needs best and has a smart data workflow to easily connect to their institution's environment; the approach should be streamlined for both, teachers and students.

Acknowledgements

I would like to thank...

Publications and Presentations

Peer-reviewed international conferences

Bozhko, Y., and Heinrich, E. (2011). Concept Map-Based Framework for Learner-Centered Knowledge Management in ePortfolios. In Proceedings of The 11th IEEE International Conference on Advanced Learning Technologies 2011 (pp. 160-162), Athens, Georgia, USA, 6-8 July 2011. IEEE Computer Society. doi: 10.1109/ICALT.2011.53

Bozhko, Y., and Heinrich, E. (2011). Enhancing ePortfolio Systems to Better Support Lifelong Learning in Universities: Students' Perspective. In T. Bastiaens and M. Ebner (Eds.), Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2011 (pp. 1912-1917). Lisbon, Portugal: AACE.

Bozhko, Y., and Heinrich, E. (2011). Academic Perspective on Enhancing ePortfolio Systems to Better Support Lifelong Learning in Universities. In S. Barton (Ed.), Proceedings of Global Learn Asia Pacific 2011 (pp. 137-142). Melbourne, Australia: AACE.

Bozhko, Y., and Heinrich, E. (2010). Towards a Lifelong Learning Environment in Universities. In Z. Abas et al. (Eds.), Proceedings of Global Learn Asia Pacific 2010 (pp. 2038-2043). Penang, Malaysia: AACE.

Bozhko, Y. (2010). Towards an institutional lifelong learning environment. DEANZ Conference 2010. Wellington, New Zealand.

Bozhko, Y. (2009). Lifelong learning supported by ePortfolio processes. 7th International ePortfolio Conference. London, UK.

Book chapter

Heinrich, E., and **Bozhko, Y.** (2012). The Role of Institutions in Creating Student-Focused Virtual Learning Spaces with ePortfolio Systems. In Keppell, M., Souter,

K., and Riddle, M. (Eds.), Physical and Virtual Learning Spaces in Higher Education: Concepts for the Modern Learning Environment. (pp. 119-135). IGI Global. doi:10.4018/978-1-60960-114-0.ch008

Other publications

Bozhko, Y. (2011). Concept Maps for Learner-Centered Knowledge Management in ePortfolios. 9th New Zealand Computer Science Research Student Conference (NZCSRSC) 2011. Palmerston North, New Zealand.

Bozhko, Y. (2010). Towards an Institutional Lifelong Learning Environment. 8th New Zealand Computer Science Research Student Conference (NZCSRSC) 2010. Wellington, New Zealand.

List of Abbreviations

CLI – Composite Learning Index

DSR – Design Science Research

ELLI – European Lifelong Learning Indicators

LMS – Learning Management System

OECD – Organisation for Economic Co-operation and Development

PLE – Personal Learning Environment

UNESCO – United Nations Educational, Scientific, and Cultural Organization

VLE – Virtual Learning Environment

Contents

List of Tables

List of Figures

Chapter 1

Introduction

> Learning is not a product of schooling, but
> the lifelong attempt to acquire it
>
> *Albert Einstein*

The concept of lifelong learning has become very popular over the last decade. The original idea has gone through a lot of changes, through the stages of continuing, recurrent, and adult education (Jarvis, 2004). On one hand, the lifelong learning concept has an entirely economic background, where the learners themselves are seen as tools for economic development and their needs are firmly tied to the needs of the industry (Carter, 2008, pp. 112-114). On the other hand, as stated by UNESCO, lifelong learning is a cultural policy which influences society and promotes changes (Boshier, 2000, pp. 12- 14). However, no matter which point of view is adopted, world economics, employment policy and society are changing. The importance of lifelong learning is increasing. For full participation in education, workplace, and society individuals today require well-developed lifelong learning skills, developed from the early stages of their lives (Otala, 1997).

In addition to being a subject for political and economical discussions (Bagnall, 2009), lifelong learning has been also established as a topic of interest in higher education, in particular universities (Knapper and Cropley, 2000). Based on this background of the importance of lifelong learning and the central role of universities, this research project is focused on and explores the need for lifelong learning support in universities.

In addition to being a subject for political and economical discussions (Bagnall, 2009), lifelong learning has been also established as a topic of interest in higher education, in particular universities (Knapper and Cropley, 2000). Based on this background of the importance of lifelong learning and the central role of universities, this research project

is focused on and explores the need for lifelong learning support in universities.

In addition to being a subject for political and economical discussions (Bagnall, 2009), lifelong learning has been also established as a topic of interest in higher education, in particular universities (Knapper and Cropley, 2000). Based on this background of the importance of lifelong learning and the central role of universities, this research project is focused on and explores the need for lifelong learning support in universities.

1.1 Reseach Goals

The overall aim of this research is to design and implement a learner-centered e-learning environment which will support and facilitate the lifelong learning process in universities. This environment will be built on an institutionally focused Learning Management System and a learner focused ePortfolio system, both already used in universities. A review of this field showed that these two areas are already connected, but to adequately support lifelong learning they need to better meet the requirements of both students and education providers (universities) as lifelong learning stakeholders.

1.2 Research Design

The overall aim of this research is to design and implement a learner-centered e-learning environment which will support and facilitate the lifelong learning process in universities. This environment will be built on an institutionally focused Learning Management System and a learner focused ePortfolio system, both already used in universities. A review of this field showed that these two areas are already connected, but to adequately support lifelong learning they need to better meet the requirements of both students and education providers (universities) as lifelong learning stakeholders.

1.3 Scope and Limitations

This research project has its limitations. Although technology is usually called a key driver in the educational change (Attwell, 2007), one can argue that it is not only a technical question (Schaffert and Hilzensauer, 2008). Many other changes should occur to fully implement lifelong learning in universities: changes in the way of thinking of both students and lecturers, support on the higher (department or institutional) levels, provision of technical support and trainings for staff, personal motivation of learners, etc. As technology is one of the components of fully supported lifelong learning

environment, this project is focused on technical aspects. The other aspects will stay behind the focus of this research, but state of the art, literature and theories in the area have been still comprehensively investigated.

1.4 Thesis Structure and Outline

The rest of this thesis is structures as follows:

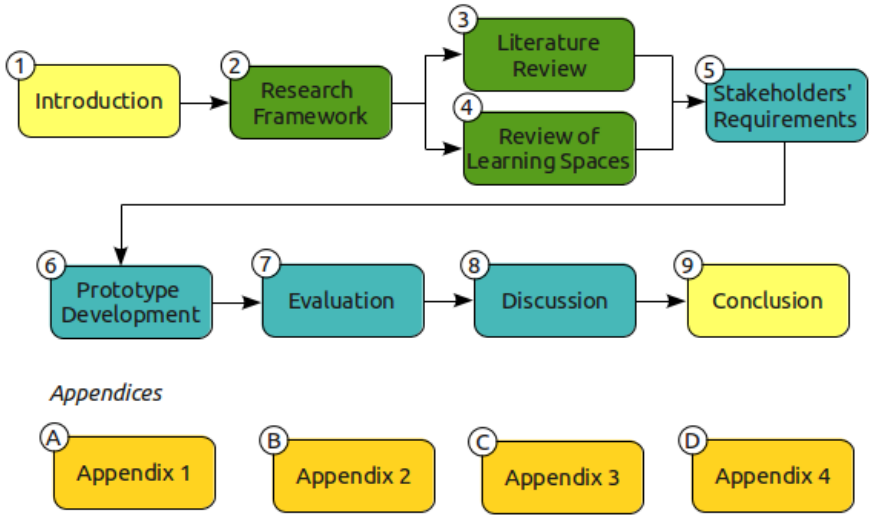

Figure 1.1: Thesis structure

Chapter 2. This chapter presents a menthodological approach employed in this reseach. Theoretical background of design science research methodology is given and the way this appoach was adopted in this project is described.

Chapter 3. This chapter focused on discussing the background of lifelong learning. Its connection to universities, the current situation in this area and the problems associated with lifelong learning in universities are shown here.

Chapter 4. This chapter explores the technical worlds of learning support. System that are curently mployed at universities are examined according to their compliance with lifelong learning support.

Chapter 5. The results of literature review (Chapter 3) and a review of learning spaces (Chapter 4) are taken to the stakeholders for analysis of their needs and requirements. Later these findings are used in developemnt of a conceptual model of an environment that can provide support for lifelong learning.

Chapter 6. Implementation process and outcomes are presented in this chapter.

Chapter 7. This chapter describes a complex evaluation design used in the research to address the questions of quality, functionality and suitability of the developed features.

Chapter 8. In this chapter the results and lessons learnt are discussed.

Chapter 9. This chapter brings conclusion of the research presented in this thesis and implications for future research.

Chapter 2

Research Framework

The main purpose of this chapter is to describe a research approach used in this study. The first section of the chapter identifies the objectives that need to be addressed in order to achieve the goal of this study, followed by the research questions in Section 2.2 raised from these objectives.

Design Science Research (DSR) methodology was adopted as the main research methodology of this study to address the research questions. This methodology emphasizes the problem-solving and performance-improving paradigms and is oriented towards creating and evaluating IT artifacts (Hevner et al., 2004). A five-stage research project framework is outlined in Section 2.3 which explains each stage of the project and the methods applied. Methodological limitations are brought to considerations in Section 2.4. This chapter concludes with the discussion of related work and projects carried out in the area of lifelong learning.

2.1 Research Objectives

Understanding how lifelong learning in universities can be effectively supported using technical solutions is an overarching goal of this research. This goal brings up a number of objectives that need to be addressed:

Objective 1. To determine student and institutional requirements for a lifelong learning environment within the university context.

Objective 2. To map these requirements against the systems already used in universities to support lifelong learning.

Objective 3. To design and implement the features required in an environment that supports lifelong learning to satisfy the defined requirements.

Objective 4. To evaluate how this environment meets the needs of all stakeholders in supporting lifelong learning.

2.2 Research Questions

Based on the objectives, this study addressed the following research questions supported by sub-questions:

RQ1: *What is the concept of lifelong learning and its connection to the universities?*

- What is the role of lifelong learning in the university context?
- What is the motivation of universities in supporting lifelong learning?
- What are the existing university policies for supporting lifelong learning?
- What are the components of lifelong learning environments in universities?
- What are the requirements for successful lifelong learning support in universities?

RQ2: *What e-tools are available to support lifelong learning within the university context?*

- What e-tools are available to support lifelong learning:
  - in general?
  - in universities?
- What are the conceptual strengths and weaknesses of these e-tools in university context?
- What is the relationship between LMS and e-tools support for lifelong learning in university context?

RQ3: *How can LMS and/or ePortfolio systems be extended to support students in a university context in lifelong learning?*

- What features are available now in these systems?
- What are the students and institutional requirements for LMS and ePortfolio to support lifelong learning?
- How can these requirements be translated and implemented into new or improved features?

RQ4: *Do this extended environment meet the needs of the stakeholders in university teaching and learning contexts?*

- How can lecturers use new features to provide students with their guidance and help them to understand lifelong learning skills?
- How can students address institutional graduate attributes and other skills using new features?
- How can new features help students track their learning progress, manage ePortfolio knowledge and content, demonstrate and share their achievements with others?

2.3 Research Approach

Finding the most efficient research approach is an important part of any research study. A properly selected approach helps to obtain answers to the research questions while working within the framework that uses methods that have been verified and tested for validity (Kumar, 2005). Multi-paradigmatic field of ICT offers a number of methodologies drawn from the variety of research philosophies (Vaishnavi and Kuechler, 2008). This study follows design science research methodology that has become popular over the last five decades as fundamentally a problem-solving approach (Cross, 1993).

2.3.1 Design Science Research Methodology

According to Peffers et al. (2008), design science research (DSR) originates from engineering and computer science where design is a component of the research process. Iivari and Venable (2009) define DSR as *a research activity that invents or builds new, innovative artifacts for solving problems or achieving improvements.* This approach is used in ICT where there is a need to extend the existing boundaries of the current systems or to address the important problems by creating new solutions and artifacts (Hevner et al., 2004). The artifacts can be described as constructs (vocabulary of a domain), methods (algorithms), models (abstractions), instantiations (prototype systems), and better theories (Hevner and Chatterjee, 2010).

Requirements for DSR contribution, defined by March and Storey (2008), include (1) identification of a problem, (2) demonstration that there are no existing adequate solutions in the area, (3) development of an innovative artifact that addresses the problem, (4) evaluation of the artifact, (5) communication of the knowledge added to the area, and (6) understanding of the implications for theory and practice.

This set of requirements closely resembles the DRS methodology process described by Peffers et al. (2008) (see Figure 2.1) and research model phases found in Vaishnavi and Kuechler (2008) (see Figure 2.2).

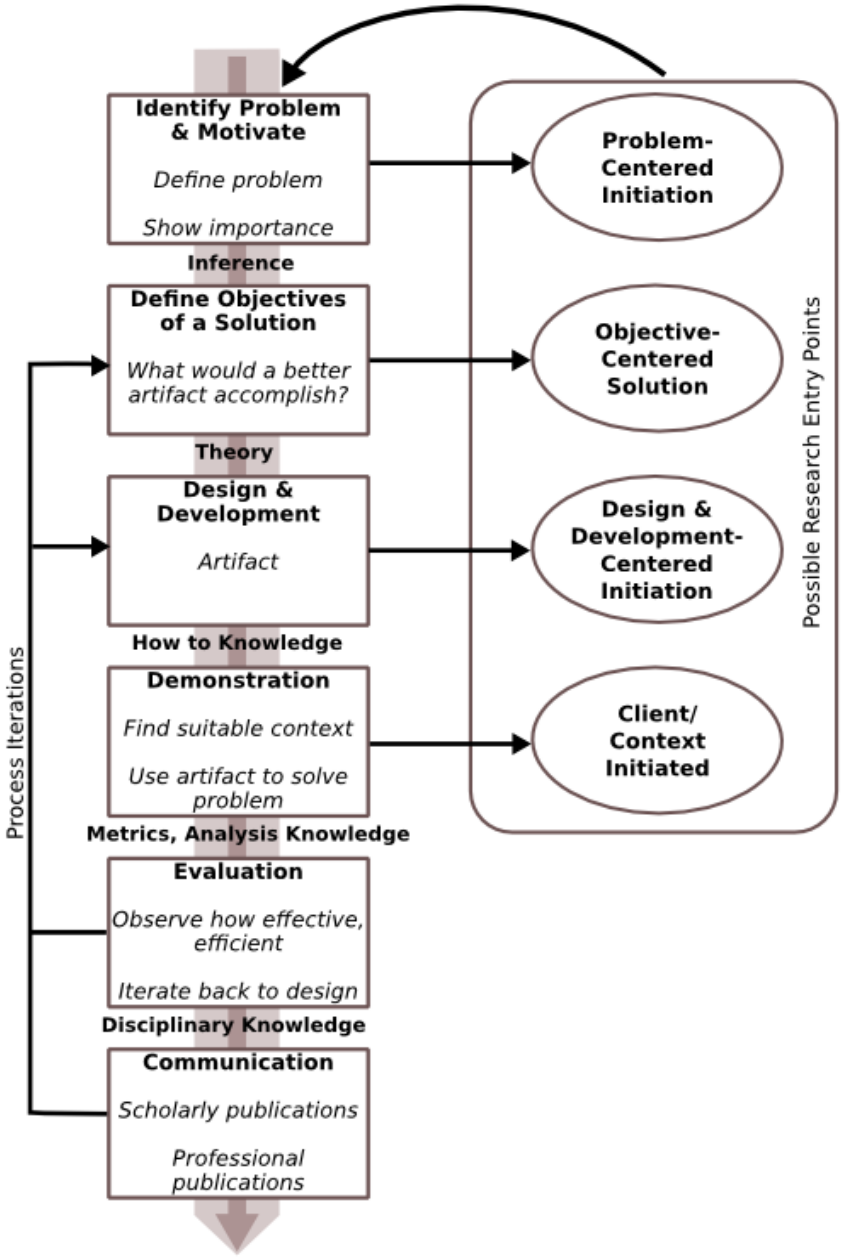

Figure 2.1: Design Science Research Methodology Process Model (Peffers et al., 2008)

All authors essentially agree on common elements. The initial stage of research is *problem identification* or awareness where a specific research problem should be stated and the importance of its solution should be justified. After the problem is identified,

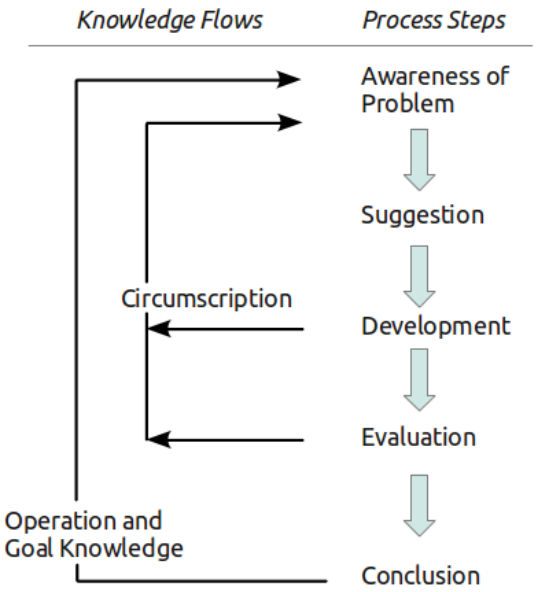

Figure 2.2: Design Science Research Cycle (Vaishnavi and Kuechler, 2008)

next step is to *suggest a solution* and define its objectives. This includes understanding the state of the problem and current available solutions, if any, and explaining how new solution is going to address the problem in a better way.

The core phase of research is *design and development*. Conceptually, this phase consists of deciding the artifact's functional requirements or its architecture and afterwards creating artifact itself. Peffers et al. (2008) note that in some cases an artifact is not necessarily a new development. It might have been already used in another research domain to solve a different problem.

Unlike Vaishnavi's research cycle where evaluation is one step of research process, Peffer's model distinguishes between *demonstration* and *evaluation* of the artifact. Demonstration is used to show that the implemented idea works, while evaluation is more formal form of measuring how well the artifact supports a solution to the problem (Peffers et al., 2008). Artifact can be evaluated from various perspectives such as performance, usability, reliability, accuracy, quality, functionality, etc.

The last stage of research is *conclusion* or *communication*. It might involve but is not limited to: discussing the problem, its importance, the novel artifact, and its effectiveness with relevant research audiences; creating scholarly publications; presenting research findings at the conferences; and writing a project report (Archer, 1984). However, if no satisfying results have been reached at this stage of the research cycle, it might as well serve as a subject for further research.

To assist beginning researches, Hevner (2004) identifies seven guidelines to follow for effective DSR:

Guidelines	Description
Guideline 1: Design as an Artifact	Research must produce a viable artifact such as a construct, a model, a method or an instantiation
Guideline 2: Problem Relevance	Research must develop technology-based solutions to important and relevant problems
Guideline 3: Design Evaluation	Proper valuation methods must be used to demonstrate artifact's quality and efficacy
Guideline 4: Research Contributions	Research must provide clear contributions to the research areas
Guideline 5: Research Rigor	Rigorous methods must be applied to construction and evaluation of the artifacts
Guideline 6: Design as a Search Process	Research must incorporate a search process to find and effective solution to the problem
Guideline 7: Communication of Research	Research must be effectively communicated to relevant audiences

Table 2.1: Design Science Research Guidelines (Hevner et al., 2004)

In contrast to Hevner, Venable (2010) argues that there is no common understanding of what kind of guidelines and standards should be used for effective DSR. However, based on analysis in the same work, the majority of respondents who are researchers and DSR practitioners agree on a few points: DSR should address important problems, have an artifact that would help to solve the problem, and have some kind of evaluation of this artifact.

2.3.2 Design Science Research Applied to This Project

The research framework in the current research is adapted from a DSR cycle established by Vaishnavi and Kuechler (2008). They identify five phases in the research model: (a) identification of a problem, (b) suggestions and objectives of a solution, (c) design and development, (d) demonstration and evaluation, and (e) conclusion and communication.

Figure 2.3 shows a research path of this project from the first to the last stage.

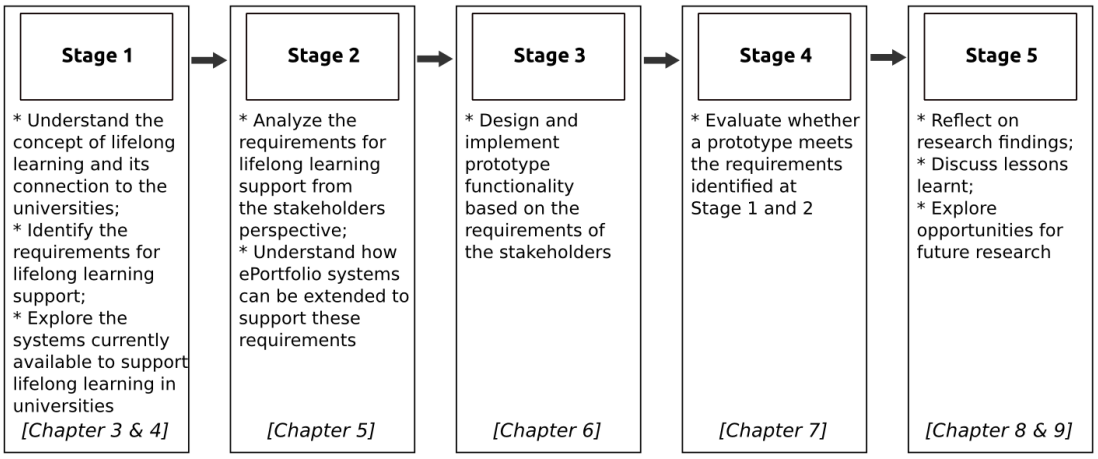

Figure 2.3: The research path

2.3.2.1 Stage 1. Problem Identification and Motivation

Any research project can be started either from the gap in the literature or when a problem that is worth solving exists (Bourner, 2002). Previous experience and observations of the existing problems in the field of study formed the background for this research. To define the main research topic, preliminary investigations were made as part of the field of study review. The problem identified in the current research is the difficulty in supporting students lifelong learning in universities. Defining the research topic led to the research questions and objectives development which, in turn, formed the direction and focus of this project.

2.3.2.2 Stage 2. Objectives of a Solution

To answer the research question on the concept of lifelong learning and what kind of environment can support it, it is important to develop understanding of current theories and practices of lifelong learning support. A comprehensive literature review and a review of the learning spaces was undertaken to address these questions.

However, this research did not rely on a literature review alone. A set of interviews with the stakeholders were organized to support literature findings and identify the gaps that exist in current ePortfolio systems. Interviewees were offered to look at the ePortfolio system from the lifelong learning perspective and offer their solutions for supporting guiding principles and recommendations for successful lifelong learning discovered in the literature.

Interviews were audio recorded, transcribed and analyzed. The results were compiled into a set of formal software requirements specification to be implemented in a system

prototype for the future evaluations.

2.3.2.3 Stage 3. Design and Development

In the development phase, the results of the literature review, interviews and requirements analysis were used to create a conceptual model of an ePortfolio-supported environment that can facilitate students in lifelong learning and be compatible with university needs.

A functionality, based on this model, was implemented in a prototype ePortfolio system. As the requirements specification was too large for the project of such size and relatively short timeline, only priority requirements were implemented. The requirements were prioritized according to the feedback given by the interviews participants at the initial stages of the project. Due to this, a number of requirements related to a better integration of the ePortfolio systems with LMS and usability improvements were left behind. Although these requirements were not implemented, they were still included into the conceptual model.

Prototyping followed established software engineering practices that interleaved coding and revision, forming iterative development cycles, as it shown at 2.4.

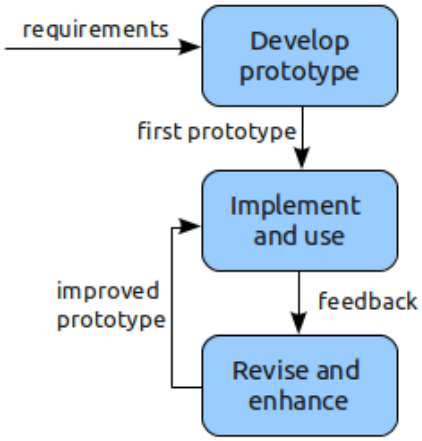

Figure 2.4: Prototyping based on Sommerville (2007, p. 411)

After each iteration was completed, the prototype was taken back to the stakeholders for feedback. This was necessary to understand what changes were required and to design further improvements.

Mahara ePortfolio system was used as an initial base system for the prototype. There

is a number of reasons why this system was selected. Mahara is a trusted and widely-used in universities (and at Massey University in particular) solution with a large community support. This system is open source which makes it easy to access and allows modifications like adding new features and changing the existing ones. Mahara is a *typical* representative of its category and provides all commonly available features. At the same time it is a leading edge system developed by using latest web technologies and programming practice.

2.3.2.4 Stage 4. Demonstration and Evaluation

Do I need to write more about cases selection process, sample size, etc., or should it go to the actual evaluation chapter?

It is important for evaluation to be treated not as an isolated process, but as a part of design process (Cleven et al., 2009). Although, the prototype was reviewed by the stakeholders after every development cycle, a complex evaluation of the overall concept was still required.

Due to the context of this research – lifelong learning perspective, – time and resources constraints, and an extended ePortfolio system being a functional prototype, it was not feasible to conduct evaluations in the real world settings. However, it was possible to develop a number of studies that looked into the specific aspects of lifelong learning support and evaluated how well developed features satisfy the requirements identified earlier by the stakeholders.

As a result, features implemented in the prototype were evaluated from three different perspectives:

- Demonstrations of the prototype and its extended functionality were used for exploratory evaluation with the lecturers. The aim was to explore how the lecturers can integrate new features into their teaching to provide students with guidance and help them to understand lifelong learning skills.
- A set of experiments with various groups of undergraduate students was undertaken to understand how added functionality can help them to address institutional graduate attributes and lifelong learning skills. Three groups with different levels of knowledge of lifelong learning skills and experience of using ePortfolio systems were involved in the experiments.
- Case studies were used to evaluate prototype from the mature students perspective. This approach was selected due to its internal and external validity, control

and in-depth examination of each case (Yin, 2009). Participant with a different study background had access to the prototype for an extended trial period of time and were able to get a better look at the new features. At the end of the trial period, each participant was interviewed and gave their feedback on the features they had used.

2.3.2.5 Stage 5. Conclusion and Communication

Where possible the results of the various stages of this research project were documented and submitted for publications and conference presentations. Full list of publications can be found in Publications and Presentations section of this thesis.

2.4 Methodological Limitations

Not sure what can be considered a limitation. The list contains only the ones I could think of...

Any study and its findings should be weighed against methodological limitations. Acknowledging limitations is important for scientific progress as they might help to understand how research can be improved in the future (Ioannidis, 2007). Although, literature does not explicitly describe limitations of DSR methodology, they can still be derived from the limitations of the methods used at each stage of the study. Therefore, the limitations considered in this research included:

Sample size: Sample size for Stage 2 was relatively small due to the participants profile requirements. As well, snowballing sampling technique was used to find suitable student participants which might have influences the outcomes of this stage.

Prototyping: Evaluated system was a prototype based on open source ePortfolio system Mahara which might have led to biased feedback as some participant were familiar with the system and already had their opinion about it.

Evaluation: Due to the nature and scale of this research project, its time and resources constraints, evaluation was not conducted in the real world settings. Instead, a set of case studies, experiments and exploratory evaluations have been undertaken.

More detailed discussion of the limitations can be found further in the relevant chapters of this thesis.

2.5 Related Work

As the field of lifelong learning became popular, there were a number of studies aimed to explore lifelong learning support in various contexts. To date, research similar to this project has not been identified, although projects found were a valuable source of information and examples of previous research experience.

- Lifelong Learning in London for All[1] (L4All): This project is focused on developing of lifelong learning system to support independent learners (particularly those 16+ learners who traditionally have not participated in higher education) by recording their learning pathways. This project aimed to provide lifelong learners in the London region with access to information and resources that facilitates their progression from secondary education to further education or from secondary education directly to higher education (de Freitas et al., 2006);

- The Regional Interoperability Project on Progression for Lifelong Learning[2] (RIPPLL): This project was going to establish a model of cross-sector collaboration in personal development planning technology in the UK. The aim was to make all the major existing electronic systems interoperable for study-based progress files that are used in further and higher education to provide an easier transition process from school to further education (Hartnell-Young et al., 2006);

- ELGG-Moodle: In autumn 2006 Klagenfurt University, Austria was piloting the project aimed to integrated Moodle LMS and ELGG platform. This integration was used for professional development for all academic staff. Project outcomes provided integration between systems such as single login and file transfer (Attwell, 2007).

- Accessible Lifelong Learning for Higher Education[3] (EU4ALL): A project started in 2006 and aimed to develop components and services for universities to make learning more accessible for both the students with functional diversity and the elderly. This project looked into providing a better access to the electronic content and educational resources in higher education using a framework or a set of free tools that support mobile learning, audio recording transcription, DAISY digital books and other adaptations of contents based on the student's needs and preferences.

[1] http://www.lkl.ac.uk/research/l4all.html
[2] http://www.nottingham.ac.uk/rippll
[3] http://www.eu4all-project.eu

- An ePortfolio based Pedagogy for Small to Medium-sized Enterprises[4] (ePPSME): Finished in 2011, this project provided higher education sector with reusable models for an ePortfolio-based pedagogy for work-based learners. This pedagogy addresses the needs of learners with shortage of time, previous informal learning experience, need for flexible delivery and quality of learning, and opportunities to record achievements (Felce, 2011).

2.6 Summary

To address the objectives and research questions stated at the begining of the chapter, this research project follows DSR methodology. DSR is a problem solving approach that focuses on development and evaluation of innovative IT artifacts. This chapter outlined a five-stage research framework used in this work with each stage explained.

The next chapter will explore the literature to understand the concept of lifelong learning and the requirements for its effifcient support. It will provide a background for the further theory development of this research.

[4] http://www.wlv.ac.uk/ePPSME

Chapter 3

Literature Review - Lifelong Learning

In order to answer the first research question, it is important to establish a basic understanding of the main concepts used in this work. Although, underlying concepts can be found primarily in the domain of education, they make a good starting point for a discussion.

This chapter introduces the key concept of lifelong learning that will be in focus throughout the thesis. First, the origins of the term of *lifelong learning* and related concepts are discussed in Section 3.2. The crucial differences between these concepts and how they transformed over time, driven by changing society and economics, are explored. Second, through the increasing focus on lifelong learning skills in the world of work and in higher education, Section 3.3 shows the need for lifelong learning support in universities. Universities are in the center of this discussion as they provide the necessary organizational framework, theoretical principles and practical experience for lifelong learning (Knapper and Cropley, 2000), which can be seen in the role and influence of the universities in the educational systems of most countries as the "keepers of the intellectual traditions of a nation" (Longworth, 2003, p. 96). Third, in Section 3.4 the general needs for successful lifelong learning are outlined. While no explicit requirements have been found in the literature, commonly accepted recommendations and guidelines were discovered in various sources that will be used as a background for further exploration in Chapter 5.

3.1 Literature Review Process

The literature review on lifelong learning (Chapter 3) and a review of institutional and open learning spaces (Chapter 4) that provide and support background for this thesis were conducted by systematically locating and reviewing books, journals and conference proceedings in the area of research. The main methods to identify relevant literature were recommendations of domain experts and a library search. Relevant articles were identified by reading titles and abstracts of selected journal articles and papers in conference proceedings. Where possible the latest ten years of issues of the following journals were looked through: "British Journal of Educational Technology", "International Journal of Lifelong Education", "European Journal of Education", "Lifelong Learning in Europe", "International Journal of Emerging Technologies in Learning", "New Zealand Journal of Adult Learning", "Journal of Computer Assisted Learning", "European Journal of Engineering Education", and "International Journal of ePortfolio".

In addition, a keyword search was carried out on the Internet and academic resources (such as Education Research Complete[1], Academic Search Premier[2], Directory of Open Access Journals[3], Google Scholar[4]) to cover conference publications not available in the library. The following keywords and combinations of keywords were used in the search: "lifelong learning", "life-long learning", "e-learning", "ePortfolio", "e-portfolio", "electronic portfolio", "Web 2.0", "learning environment", and "learning technology".

This review helped to discover previous work in the area (described in Section 2.5), explore methods that could be applied to this research, increase the depth and breadth of knowledge of the field, and identify domain experts and other people working in the same field who could be valuable to contact. Besides finding relevant information in the literature, it was also important to identify the gaps that currently exist (more detailed discussion can be found in Chapter 4). It will be shown further that these gaps are based on a lack of connection between the areas of lifelong learning theories and learning technology. While a lot of effort is put into developing theories and producing systems that support education and learning, little substantial work exists on combining these two areas.

As a continuous process, the literature review for this research was updated by actively acquiring and reading the relevant articles emerging in the literature.

[1] http://www.ebscohost.com/academic/education-research-complete
[2] http://www.ebscohost.com/academic/academic-search-premier
[3] http://www.doaj.org
[4] http://scholar.google.com

3.2 The General Concept of Lifelong Learning

3.2.1 Terms and Definitions

The European Commission (2000) defined lifelong learning as:

> *All learning activity undertaken throughout life, with the aim of improving knowledge, skills and competencies within a personal, civic, social and/or employment-related perspective.*

However, it is not as simple as it looks: the concept of lifelong learning consists of a variety of meanings, models and ideas. Such terms as *lifelong learning*, *lifelong education*, *adult education*, *recurrent education*, *continuing education*, and *further education* create a set of related, yet different concepts (Hager, 2011).

Continuing education (also referred to as *adult education*) was introduced in the late 1970s and early 1980s. There was no common definition of this term, but in some sources (Jarvis, 2004) it was described as all learning activities which could be undertaken after compulsory schooling is finished. Figure 3.1 compares the main concepts in education according to the time spent by individuals learning/studying across their lifespan. As can be seen, continuing education was usually part-time and occurred less frequently than other forms of education.

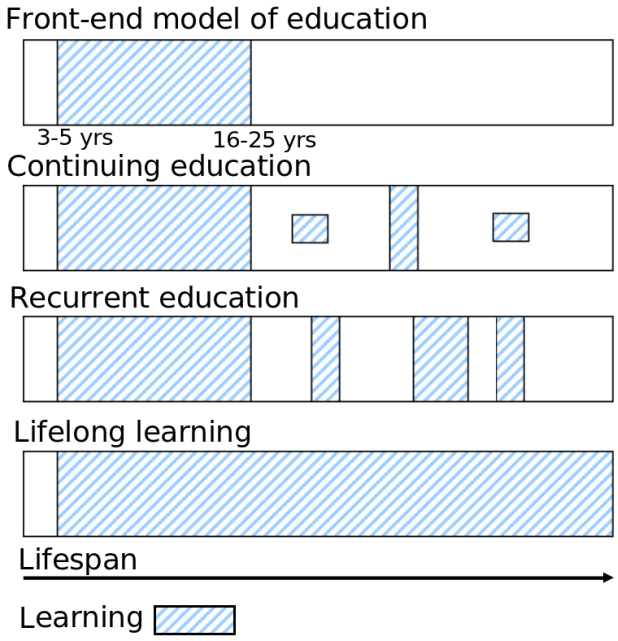

Figure 3.1: Changing concepts of learning (Jarvis, 2004)

The term *recurrent education* was widely used by OECD until the 1980s (Jarvis, 2004). Unlike intermittent continuing education, its idea was in allowing adults to spend full time studying in formal education sector doing on-the-job trainings or post-compulsory education of any kind. Arguably, this main feature of the right for full time study made the concept of recurrent education disappear from the governments' educational agendas: it was too expensive and difficult to support this policy.

Rejecting the concepts of recurrent and continuing education played an important role in development of the new educational models. While they had different underlying philosophy, they both recognized the fact that acquisition of knowledge should be a lifelong process, from "cradle to grave" (Hargreaves, 2004).

The origin of the term *lifelong learning* goes back to the early 20th century and is contributed to by John Dewey (2004). From his perspective, lifelong learning had to be centered on the individual's ability to take an active role in democratic society. He saw education as a learning process which was influenced by the growth of the individual and society, both interlinked. Dewey's key to lifelong learning was in developing active learning, enabling the individual to reflect and change throughout life, emphasizing that non-formal education was as important as formal education.

The concept of *lifelong education* was discovered in 1972 after Edgar Faure's Report "Learning to Be" for UNESCO. The concept described in this report was announced to be the leading one for the reform in education. Faure's Report used four principles for the lifelong education architecture (Faure et al., 1972): vertical integration (education should occur throughout one's life); horizontal integration (acceptance of non-formal and formal education); the democratization of education (more widespread involvement of learners); and learning society (restructuring of educational system). However, according to Hager's (2011) analysis, UNESCO's concept of *lifelong education* puts the emphasis on formal education as the only sufficient and relevant form of learning to provide actual *education*.

3.2.2 Paradigm Shift and Lifelong Learning Today

Almost 40 years after the idea of this lifelong education was introduced, many governments rediscovered not lifelong education, but lifelong learning (Boshier, 2000). This shift was not only semantic, but also substantive, which showed that lifelong learning and lifelong education are not the same: lifelong education aimed to develop more humane individuals and communities, while lifelong learning's goal was in retaining and gaining new skills that would help individuals adapt to rapid changes in their workplace

(Medel-Añonuevo et al., 2001). Lifelong learning is based on the notion of the individual learner as a consumer. And as a result if consumers decide not to take advantage of all the opportunities they have – then it is their fault. Therefore, being constructed as individual activity, learning depends entirely on personal motivation. Unlike learning, education is a provided service (Boshier, 2000) that requires someone to be responsible for providing resources, developing policies, etc. The emphasis on *learning* rather than *education* is significant (Tuijnman and Boström, 2002), as it moves focus from the institutions onto the individual. Although, it does not mean that institutions and governments play no role whatsoever. Their role is rather transformed into investment in individuals and creating conditions for them to take charge of their learning (Chen, 2009).

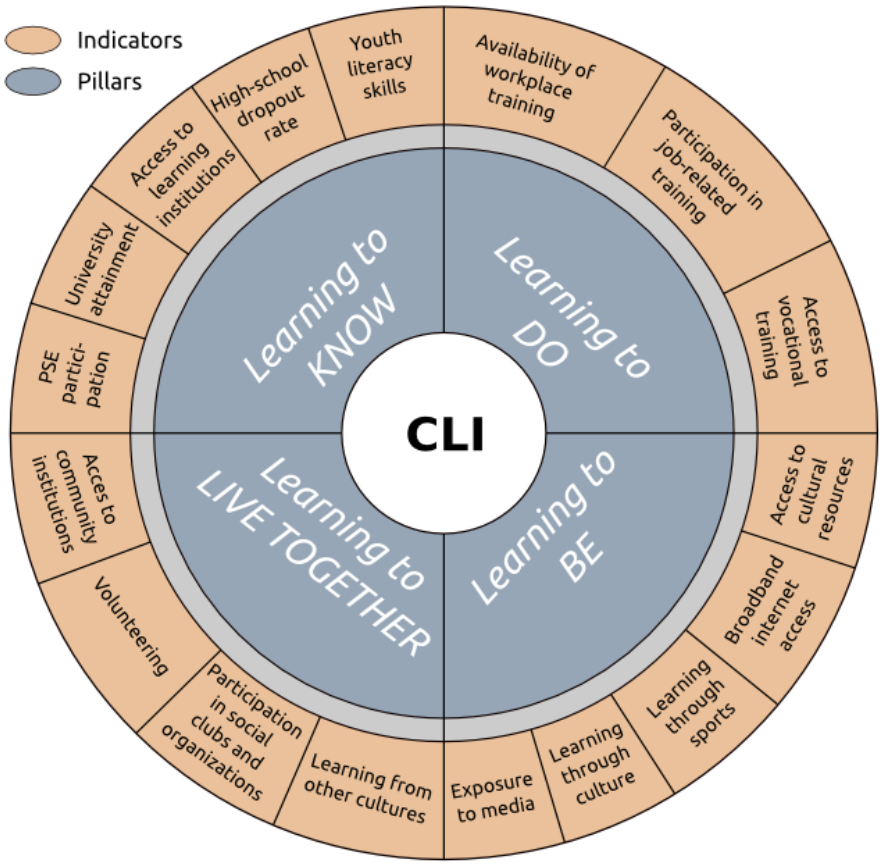

Figure 3.2: The 2010 Composite Learning Index of Canada (Canadian Council on Learning, 2011)

Over the last decade, lifelong learning support has become a part of official government policy in a number of countries around the world. As an example, European Commission established a budget of nearly 7 billion Euro for the period of 2007-2013 for 'Lifelong learning programme' which aims to support education and training at school,

college, university, in the workplace and in the community across Europe (EACEA, 2009). In New Zealand a number of governmental documents (New Zealand Ministry of Education, 2008) now mention the "success of all New Zealanders through lifelong learning". As a result, the national tertiary education system of the country has been transformed to support lifelong learning ideals (Benseman, 2006).

In 2006, the Canadian Council on Learning developed the 17 indicators and 26 specific measures (Figure 3.2) called Composite Learning Index (CLI) that are used to calculate annual progress in lifelong learning in the country (Canadian Council on Learning, 2011). Using CLI, Canadian government expects to draw attention to the benefits of lifelong learning and demonstrate learning opportunities that occur outside of classroom settings. In August 2010 the European Union adopted this Index as European Lifelong Learning Indicators (ELLI). Similar to CLI, ELLI were using UNESCO approach of four pillars of learning: Learning to Know, Learning to Do, Learning to Be, and Learning to Live Together (ELLI Development Team, 2010).

3.2.3 Components and Attributes of Lifelong Learning

In terms of purposeful learning activities lifelong learning consists of the following components (Longworth, 2003; Tuijnman and Boström, 2002):

- Formal learning – institutionally graded, and hierarchically structured system, often leads to qualification;
- Non-formal learning – organized systematic educational activity external to formal education;
- Informal learning – planned or not planned, but conscious learning from the experience;
- Incidental learning – not intentional, an accompaniment to everyday life, learning during the action.

Some researchers (Longworth, 2003) recognize only two categories of lifelong learning, formal and non-formal, leaving informal and incidental parts of it as the elements of non-formal learning. Boshier (2000) states that the current reality is such that the formal and non-formal categories of lifelong learning are like "two parallel railway lines. Both cross the landscape but never touch" (p. 11), explaining this way that formal setting have practically nothing to do with non-formal.

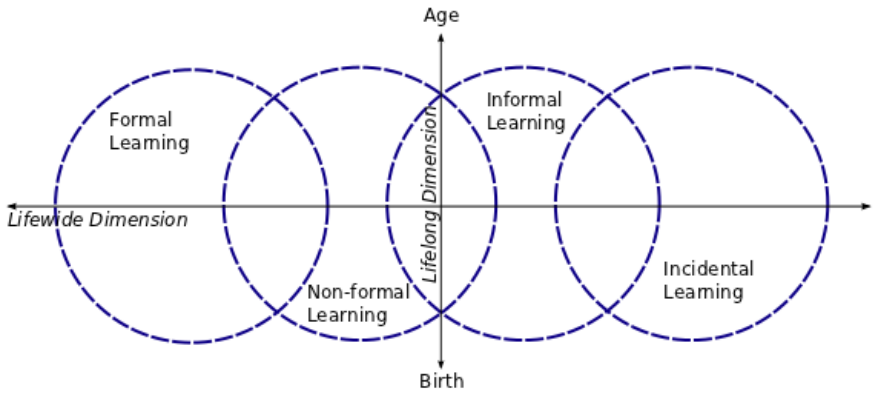

Figure 3.3: Framework for Lifelong Learning (based on Divjak et al., 2004, p. 11)

From another perspective, lifelong learning encompasses the elements of self-direction, long-term and life-wide learning (Schuetze and Casey, 2006). Rubenson (2002) called these *three fundamental attributes of lifelong learning* :

- Lifelong – means everything from cradle to grave;
- Life-wide – takes place outside the formal education system;
- Self-directed – is guided by the learners themselves and does not limit itself to education.

Weert and Kendall (2004) gathered other essential characteristics of lifelong learning:

- Most of lifelong learning occurs outside of the classroom and is not triggered by textbooks;
- The driving force in lifelong learning is self-motivation and active participation of learners;
- Lifelong learning involves interactions, groups, community learning and other social activities;
- Solving artificial tasks does not matter in lifelong learning. Achievements in real-life situations, measured by common standards, are important;
- Lifelong learning is learner-centred and aims for personal achievements;
- Lifelong learners should maintain an achievements portfolio.

These characteristics describe lifelong learning as demand-driven, flexible, social and personal at the same time.

Over recent years the skills that provide lifelong learning ability were identified. They include: solving problems, critical thinking, utilizing technology, and information literacy; working with others in teams, communication skills, leadership and social interaction skills; self-management; collecting, analyzing and organizing information; planning and organizing activities; cultural awareness and understanding (Brooks and Everett, 2008; Heinrich et al., 2007; Otala, 1997; Pitman and Broomhall, 2009).

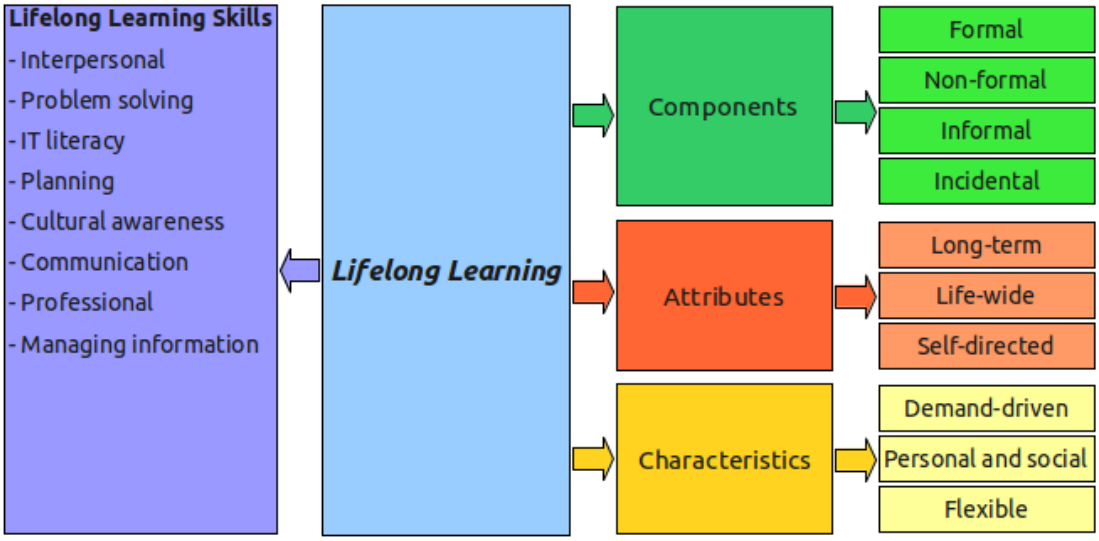

Figure 3.4: Lifelong Learning Dimensions

Figure 3.4 summarizes all concepts mentioned in this section. Hereinafter, any further reference to lifelong learning will be made in terms of these concepts.

3.3 Lifelong Learning in Universities[5]

As lifelong learning includes the concepts of *life-long*, *self-directed* and *life-wide* learning, it has following significant implications. As already mentioned above, *life-long* means the full life span of an individual. From the institutional view, it starts when students are enrolled in the university and finishes when they graduate. *Self-directed* learning in academic environment is based on being an active, highly-motivated student acquiring and enhancing new skills and knowledge. The *life-wide* component of

[5]This section was adopted from the section originally published as part of Chapter 8 "The Role of Institutions in Creating Student-Focused Virtual Learning Spaces with ePortfolio Systems" of the book "Physical and Virtual Learning Spaces in Higher Education: Concepts for the Modern Learning Environment". Full reference can be found in Publications section.

learning implies that learning can and should not occur only through formal university study, as personal and professional development takes place in many contexts. Attwell (2007) considers the fact that everyday non-formal types of learning are not connected to institutional formal education to be the major issue of modern learning, which can make students see their study at university as "something irrelevant to their identities" (p. 4). For successful lifelong learning, progress of the achievements should be recorded and maintained over a long period and across various sources, formal as well as non-formal (Kay, 2008).

The importance of lifelong learning skills in addition to academic and subject knowledge has been increasingly emphasized in the workplace and public policy (Morgan-Klein and Osborne, 2007; Sutherland and Crowther, 2006). Individuals today need to continue to update and upgrade their skills and knowledge even after completing formal education in order to survive in the changing world. Otala (1997) states that required flexibility and adaptability to these rapid changes are gained through "better developed learning skills and the right attitudes that help individuals quickly and easily learn new things" (p. 456). Therefore, current students need to "possess something more than skills which grow obsolete as technology advances" (Field and Leicester, 2003, p. 195).

Higher education institutions have responded to the need for lifelong learning skills by defining their own strategies to promote lifelong learning. Many institutions in Europe, the United States, Australia and New Zealand now explicitly express the lifelong learning characteristics they strive for in their graduates (Scanlon, 2006). Australian universities, such as Curtin University, have made policy declarations committing to graduate attributes across their programmes (Curtin University, 2006). The College of Sciences of Massey University has formulated a draft lifelong learning policy (Massey University, 2008) that expresses values, support and expectations in regards to lifelong learning. Graduate profiles, naming lifelong learning skills such as critical thinking, effective communication, teamwork and leadership have been established for many degree programme (Davies and LeMahieu, 2003; McAlister and Alexander, 2003). The accreditation criteria for engineering degrees now refer to and demand soft skills (Aller et al., 2005; Muffo, 2001). The need for a holistic education and the development of students beyond technical competency is requested (Brakke and Brown, 2002; Davies and LeMahieu, 2003; Dowling, 2006; Fallows, 2003; Grabowski, 2004; Hernon, 2006).

In order to enact policy academics need to incorporate development opportunities for these skills into their teaching and learning designs. While individual academics succeed in doing so by using techniques such as group work, reflective journals and authentic assessment (Clarke, 2003; Lombardi, 2008), universities are far from achieving the required levels of lifelong learning skills in their graduates.

The possible explanation of this might be that while graduate profiles express graduate attributes and lifelong learning skills, the individual courses making up the degrees have not been adjusted accordingly (Hughes and Barrie, 2010). One consequence of this is that students are not presented with a coherent picture across their courses and that it is too easy to disregard the messages given in single courses. Some academics may lack awareness, skills and support to fully incorporate the development of lifelong learning skills into their teaching. Academics who do not consciously practice their own lifelong learning skills development will find it difficult to lead and to inspire their students (Linden and Patrinos, 2003). Yet, students need guidance in developing lifelong learning skills (Leone, 2010), both to recognise their importance and to acquire knowledge on *how to* study (Medel-Añonuevo et al., 2001). The currently dominant academic systems are in conflict with the characteristics of lifelong learning skills. Instead of supporting the needs of learning to be self-directed, life-wide and lifelong, these systems are assessment-driven and focus on course content and duration.

3.4 Requirements for Successful Lifelong Learning

Based on considerations outlined earlier in this chapter, this section brings together the requirements for provision of successful lifelong learning support for students. While no explicit set of requirements has been found, the literature identifies a number of guidelines and recommendations that have to be satisfied in order to achieve successful lifelong learning support in universities:

- Universities should provide support for all aspects of lifelong learning (formal, informal, non-formal, incidental) (Smidt and Sursock, 2011);
- Students need guidance on various levels (Leone, 2010);
- Lecturers should be an active facilitators and promote involving learning experiences (Leone, 2010);
- Learning materials should be organized in the way that would help students learn how they learn (Medel-Añonuevo et al., 2001);
- Communication and collaboration are essential parts of learning process (Schaffert and Hilzensauer, 2008);
- Learning progress should be recorded from various sources and maintained over a long period of time (Kay, 2008);

- Students need to be aware of their personal achievements (Schuetze and Casey, 2006);
- Students should develop understanding and confidence in their knowledge and be able to address higher-order skills (graduate attributes in university context) (Hart et al., 1999);
- Students should be able to evaluate and reflect on their own performance and learning progress (Mourtos, 2003).

These theoretical recommendations will be used to guide further exploration of how lifelong learning can be supported using technical solutions available in universities.

3.5 Summary

Following from the discussions in this chapter, it is important to emphasize the following key points: lifelong learning plays an important role in current global economics and society; lifelong learning skills have become a fundamental part of personal development; governments and educational institutions, universities in particular, are attempting to promote and support lifelong learning; at this stage, lifelong learning support currently provided in universities is not sufficient to satisfy the needs of students as lifelong learners.

In order to support this argument, the next chapter will review the world of learning spaces that are currently used in universities and outside of educational sector to support various learning activities. The connection and gap that exists between these systems from the lifelong learning perspective will be thoroughly explored.

Chapter 4

Review of Institutional and Open Learning Spaces

In the previous chapter it was shown that many factors need to combine to fully support lifelong learning at universities: changes in the way of thinking of both students and lecturers, support at the department or institutional levels, provision of training for staff, and personal motivation of learners. This chapter looks at lifelong learning support from another angle, such as technical support. It reviews the area of technology and systems available for supporting various aspects of learning, and examines how availability of a suitable e-learning environment can possibly aid to the lifelong learning support required by students in universities.

The virtual learning spaces of universities are dominated by Learning Management Systems (LMS) supporting course-related work. LMSs are often closed systems that require user accounts and access permissions to the learning space. These closed systems contrast to open learning spaces provided by Web 2.0, and social networking tools in particular, which are characterised by open access allowing individuals to participate under their own direction in contributing information. Social networking includes sharing, exchanging and reflecting which provides benefits for learning.

To understand the barriers and issues of utilising closed and open learning spaces within the university environment, this chapter first explores the currently dominant LMSs and then contrasts them with the Web 2.0 virtual social spaces. Finally, it introduces an ePortfolios and ePortfolio systems as a potential solution that can help to close the gap that exists between the learning environments. ePortfolio characteristics as well as strength and weaknesses of selected ePortfolio systems are reviewed. This chapter concludes with an analysis investigating whether currently ePortfolio as a system is

mature enough to be a part of the environment that provides comprehensive support for lifelong learning.

4.1 Learning Management Systems

Higher education institutions, universities in particular, have fully embraced computer systems to support teaching and learning. According to a survey conducted by the OECD Centre for Educational Research and Innovation encompassing universities in 13 countries 89% of responding universities were using LMS institution-wide (OECD, 2005). The American Society for Training and Development published the results of their 2009 *Learning Circuits* survey according to which 91% of their respondents are using some kind of LMS in their organization or institution (Ellis, 2009). Further indications of uptake can be seen when visiting institutional websites, looking at user statistics provided by system suppliers such as Moodle[1] or Sakai[2], or by following discussions in the academic literature (Browne et al., 2006; Collis and De Boer, 2004).

According to Chapman (2009), there is no common definition of a Learning Management System. A comprehensive description of LMS provided by Watson (2007) states that it is a technology that can handle all aspects of the learning process such as: delivering and managing learning content; assessing learning of individuals and groups; tracking the progress towards meeting learning goals; and collecting and presenting data for controlling the learning process in institution or organization through virtual classroom or instructor-led courses.

The systems are referred to as Virtual Learning Environments, Course Management Systems or Learning Management Systems (LMS), the term used in this thesis. A number of on-line information and communication tools are usually integrated in such an environment into a single virtual location (Morgan-Klein and Osborne, 2007) providing users with an access to teaching and learning materials, such as lecture slides or exercises. A virtual space of LMS is shared by staff and students of a particular course. This space forms a platform for course discussions and facilitate assessment, both via on-line testing and for submission and return of assignments.

The use of LMS in universities is characterised by a strong institutional focus (Siemens, 2004). Access to the LMS depends on current enrolment with the institution and is organised around course structures. This means students have access to only the courses they are enrolled in or cohort based courses (e.g. doctoral students community) and only for the duration of these courses. The learning spaces for the different courses a

[1] `http://moodle.org/sites`
[2] `http://sakaiproject.org/community-home`

student is enrolled in are separate. LMS is based on a hierarchy of user access rights. The lecturer in charge determines the tool-set for their course and sets the parameters that define the involvement of the students. The lecturer has access to all information stored for their course in the LMS, leaving no or only very limited private space for the student. The content and use of the LMS is focused fully on the course requirements. As a course-focused virtual learning space, LMS make a huge contribution to the delivery of both face-to-face and distance courses in today's universities.

4.2 Web 2.0 and Social Virtual Spaces

Outside the higher education sector, in the open Internet domain, the Web 2.0 social networking tools have been firmly established. Tools are available for the sharing of images, photos and video clips. Individuals can communicate with others in synchronous and asynchronous forms, and in access-protected as well as open formats. Individuals can consume information on the widest possible range of topics and can as well contribute. Web 2.0 is characterised by open access, availability to anyone who has an Internet connection, and with the level and kind of participation determined solely by the individual. With freedom comes responsibility, and the responsibilities for taking up opportunities as well as for *safe* conduct in the Web 2.0 space lie with the individual.

Figure 4.1: Web 2.0 Landscape (Dawson, 2007)

Web 2.0 plays an important role in today's society and is used for social and commercial

purposes. Examples from a variety of areas show the popularity and impact of Web 2.0: virtual sports leagues attract millions of participants (Holahan, 2006); politicians use blogs and podcasts in fighting for voters (Capell, 2006); business model is changing trying to adopt Web 2.0 characteristics (Wirtz et al., 2010); communication with customers are used to increase revenue (Havenstein, 2007a); communication pathways in research communities are changing (Ashling, 2007); Web 2.0 portals are used in health care to increase access to and enrich the quality of the information available (Görlitz et al., 2010; Metzger and Flanagin, 2011); video-blogging facilitates new ways of sharing (Library Technology Reports, 2007); the music industry is being transformed (Holahan, 2007); genealogy research has become accessible to the public (MacMillan, 2007); hotel industry is adopting Web 2.0 technologies to enhance customers' travel information and simplify access to the booking engines (Leung et al., 2011).

Certainly, not all uses of Web 2.0 are linked to learning, especially when thinking of the university context. But, in light of the lifelong learning skills expected from today's higher education graduates, the potential of Web 2.0 for supporting learning becomes obvious (Tian et al., 2011). This potential is confirmed by research studies that investigate the links between the two areas: Churchill (2009) examines the use of blogs in support of learning; Wheeler, Yeomans and Wheeler (2008) look at student-generated content using wikis; Boulos and Wheeler (2007) investigate Web 2.0 tools for social communication in a learning context; Klamma and his team (2007) analyse a potential use of social software for collaboration and informal learning. Yet, when designing education that integrates Web 2.0 technologies the skill levels of students have to be considered. While it is widely assumed that today's student generation is Internet savvy, it has to be acknowledged that quite a number of students have limited Web 2.0 skills. They are either not familiar with the technologies, or have only basic level skills (Kennedy et al., 2008).

4.3 Gap Between Learning Environments

Students in universities have access to both environments, the institutionally focused LMS and the individually focused Web 2.0. On large, these two virtual worlds remain separate, both in the students' and the institutions' minds, with a distinction being made between *serious learning* and *play* (Freire, 2008). Many students cannot transfer their technology skills employed in a social Web 2.0 context into academic learning, which is both a motivational and a skill transfer issue (Katz, 2005). The information technology sections of universities draw a clear line between institutionally provided, controlled and supported LMS services and the *wild west* of the Web (Havenstein,

2007b). While they cannot effectively restrict access to Web 2.0 tools, they can deny institutional support and responsibility for quality of service. Educational researchers and individual academics have identified the potential of social networking tools for teaching and learning. This has led to the incorporation of open access Web 2.0 tools into some courses in universities, as it has been illustrated earlier in this chapter.

In response to the popularity of Web 2.0 tools and their potential for learning, LMS system providers have started to integrate social networking functionality into their systems (as can be found in functional specifications of system vendors). Discussion forums, blogs and wikis have been added to the tool-sets of LMS. Yet, the important Web 2.0 characteristic of open access has been removed as these tools have been bound into the institutional LMS framework. Access is linked to course enrolment and under institutional control. Student-generated content is accessible to the lecturers in charge and tool use is directed by relevance to the respective course. The value for teaching and learning remains, but learning is limited to the boundaries of course content and purpose (Mott, 2010).

Facebook and Blackboard LMS can serve as an example that the gap between these environments is wide and not easily bridged. An integrated application using the Facebook social networking platform was included into the Blackboard Learn software. Blackboard Inc. believed that such an approach would enable students to stay connected, not only inside their classroom, but also outside (Blackboard Inc., 2009). However, reviewing users' feedback on the Web (as can be found by searching for the keywords *Blackboard*, *Facebook* and *integration*) shows that this integration approach was not accepted by the learner community. Users were concerned about application security and the privacy of information stored in this social networking environment. A number of students hesitated conducting their social communication in such close proximity to their classroom work.

Considerations outlined in this section bring up a need for a virtual space that has to meet the requirements for successful lifelong learning (based on Chapter 3 recommendations) and facilite the development of lifelong learning skills. This space has to be integrated within universities and accepted by student learners. It has to bridge institutional and personal learning. The virtual space has to be safe, secure and provide students with a long-term access. It should also facilitate both formal and informal learning and allow for social networking and for collaboration. Such space needs to put students in charge of their learning and offer them privacy for exploration, however still allow for guidance from the lecturers. It should allow students to continue learning informally even upon completing the formal courses (and losing access to the LMS artifacts). This space has to provide a long-term accessible, safe repository for storing

artifacts demonstrating achievements. It needs to be a *professional* space that remains uncluttered from purely social communication.

Taking into account all these requirements, the next section introduces ePortfolio as a part of university's learning environment that has potential to provide support for lifelong learning.

4.4 ePortfolio

For a long time physical portfolios have been used by artists as presentation tools to collect, organize and showcase their artwork. The aim was to convince potential customers of the artists' competence. Starting from two decades ago portfolios were adopted by educators to assess the quality of teaching (van Tartwijk J. and Driessen, 2004). Since then portfolios have been used for many different purposes and as a consequence portfolio types such as showcase, development and assessment have been defined.

Electronic portfolios or ePortfolios are a digital representation of physical portfolios. The EDUCAUSE National Learning Infrastructure Initiative (NLII)[3] (cited by IMS Global Learning Consortium, 2005) defines ePortfolio as:

> *ePortfolio is a collection of authentic and diverse evidence, drawn from a larger archive, that represents what a person or organization has learned over time, on which the person or organization has reflected, designed for presentation to one or more audiences for a particular rhetorical purpose.*

4.4.1 Characteristics of Portfolios and ePortfolio Systems

The term portfolio is used in many different ways. As it was already mentioned, an important distinction can be made along the lines of purpose of a portfolio, namely for development, showcase, assessment or competences (van Tartwijk J. and Driessen, 2004).

Development portfolios or repositories support the learning and development of a learner over a period of time. They contain material and artifacts related to learning, reflections and feedback. It is important that the material stored in these repositories is private to the learner. It is up to the learner to decide when and what to share with

[3] `http://www.educause.edu`

whom. The learner needs to reflect on the material collected and on his/her development in relationship to criteria or skills. The giving and receiving of feedback are important aspects of the learning processes around development portfolios.

Showcase portfolios tend to display examples of learner's best work. These presentations contain reflection and supporting evidence. They are composed for a specific purpose and audience, e.g. a review committee, potential employer or sponsor.

Portfolios are often linked to assessment. Type of portfolio and type of assessment have to be carefully adjusted to each other. Assessment portfolios demonstrate learner's competencies and skills in well-defined areas. They can be used for both formative and summative assessment. For formative assessment the learner documents work and reflects on it, the assessor provides feedback that assists the learner in future development. Summative assessment requires predefined criteria of what is to be assessed allowing the learner to organize work examples according to these criteria. In the design of the assessment approach one has to be very careful to specify clearly what is to be assessed: subject specific work, reflections, lifelong learning skills, or presentation.

Portfolios for competences combine elements of both development and showcase portfolios and are, to a certain degree, linked to assessment. In professional areas, like health services, teacher education or engineering, the accreditation of graduates and the continuing accreditation of professionals are often linked to the demonstration of competencies. Portfolios have proven to be excellent tools for this process. The candidate collects evidence, reflects on their practice and might invite feedback, all processes covered by portfolio approaches. The accreditation occurs based on the information provided in the portfolio.

From organizational perspective, Lorenzo and Ittelson (2005) distinguish three major types of portfolios: student, teaching and institutional portfolio.

Despite these variations, there are several key processes included in most if not all portfolio work, as is displayed in Figure 4.2.

Similarly, Cambridge (2010) emphasized the importance of the following activities in portfolio process:

- Capture – collecting/gathering information and evidence from various sources;
- Management – aggregating captured evidence, sorting, indexing, ensuring accessibility over time;
- Reflection – making sense of evidence, understanding own experience and achievements;

Figure 4.2: ePortfolio key processes (Malloff, 2010)

- Composition – linking up the components together and making them available to others;
- Analysis – understanding if additional evidence is needed, reflecting on feedback, keeping up dialog with others.

While portfolio work can be conducted without the help of electronic systems, such systems assist with many tasks around document collection, recording of information, sorting through data and communicating with others. According to Tosun and Baris's (2011) research, ePortfolio compared to portfolio has valuable extra features such as: a wider context and serving different groups; archiving; cooperation and reorganization; publication and link building. Many systems, from general Web tools to specialised applications, can be used to support portfolio work. A comprehensive overview can be found at Helen Barrett's ePortfolio web-site (Barrett, 2008). This section focuses on systems specialised for portfolio work.

ePortfolio systems are centered around the individual and their needs. They provide the individual with a space for storing documents of any electronic format. In this space the user creates a repository of artifacts related to all aspects of their learning and professional development. There are tools for reflection, commonly in form of blogs. In contrast to open Web 2.0 systems, access to both files and reflections is by default set to the individual. There is no hierarchy between users in which one higher-level user could see the work of a lower-level user. The individual can select to share their work with others and has full control over whom to share with, for which period of

time. ePortfolio systems provide easy to use tools for constructing presentations that combine artifacts and reflections and that can voluntarily be shared with others. The systems allow each individual to form groups and identify partners for exchange. To a varying degree the ePortfolio systems incorporate guidance towards reflection and self-directed learning. ePortfolio systems provide a set of features that in combination are well suited to support lifelong learning. Each of the features looked at separately can be found in other computer systems or Web 2.0, but their combination within one system makes ePortfolio systems so valuable.

4.4.2 ePortfolio Systems Overview

The following sections explore the features and functionality of various ePortfolio systems. These specific systems were chosen for their level of success in learning communities and current development status. Four proprietary (PebblePad, BlackBoard ePortfolio, Desire2Learn, eFolio) and two open-source (Mahara, ELGG) systems are reviewed and analysed. Where possible, proprietary systems were reviewed by accessing demonstration web sites. In case demonstration web sites were not available, the systems were reviewed by analysing user or administrator documentation, video demonstrations, attending demonstration seminars, and external reviews.

It is important to note here that this section is not aiming to find the best system, but rather to evaluate ePortfolio systems that are currently available and successful. Examining strengths and weaknesses of these systems can provide a better foundation for understanding and development of an ePortfolio aided environment that could support lifelong learning.

4.4.2.1 PebblePad

PebblePad[4] is a proprietary web-based ePortfolio system. However, its designers tend to call it not just an ePortfolio system, but Personal Learning System that can be used in a variety of learning contexts (Pebble Learning Ltd, 2010). The system is popular and primarily used in the UK Higher Education sector and has been involved in a number of JISC funded ePortfolio research projects including ePistle[5] and File-Pass[6].

According to the PebblePad technical specification, the back-end of the system requires Windows and SQL Servers to run. The front-end uses Flash, which can create a challenge for the web application's accessibility, usability and performance. To function,

[4] http://www.pebblepad.co.uk
[5] http://www.jisc.ac.uk/whatwedo/programmes/edistributed/epistle
[6] http://www.jisc.ac.uk/whatwedo/programmes/edistributed/filepass

Flash-based applications require plugin which in turns might cause many standard browser features not perform as the user would expect or may even cause a browser crash. Flash applications do not work on many mobile and portable devices. In addition, because Flash applications are compiled into binary files, screen readers used on web sites with support of sight impaired cannot read them resulting in poor accessibility.

PebblePad has a customizable user interface which includes user-defined size and style of text and background colours. Institutions can have their own interface that fits in with the institutional branding.

Items stored in PebblePad repository are called assets. There are thirteen asset types that are subdivided into three core types, such as: uploaded files, single assets and aggregating assets. Creation of some assets can be guided by step-by-step wizard. Assets can be shared with others, inside or outside of an institution, for a certain period of time through user-defined permissions. If a person, who needs to see an asset, is not a part of PebblePad community, a temporary username and password will be automatically created allowing them to view a shared asset. Assets allow for setting up a wide range of permissions, which can include commenting and copying rights, collaboration and re-sharing of a shared asset with a third party.

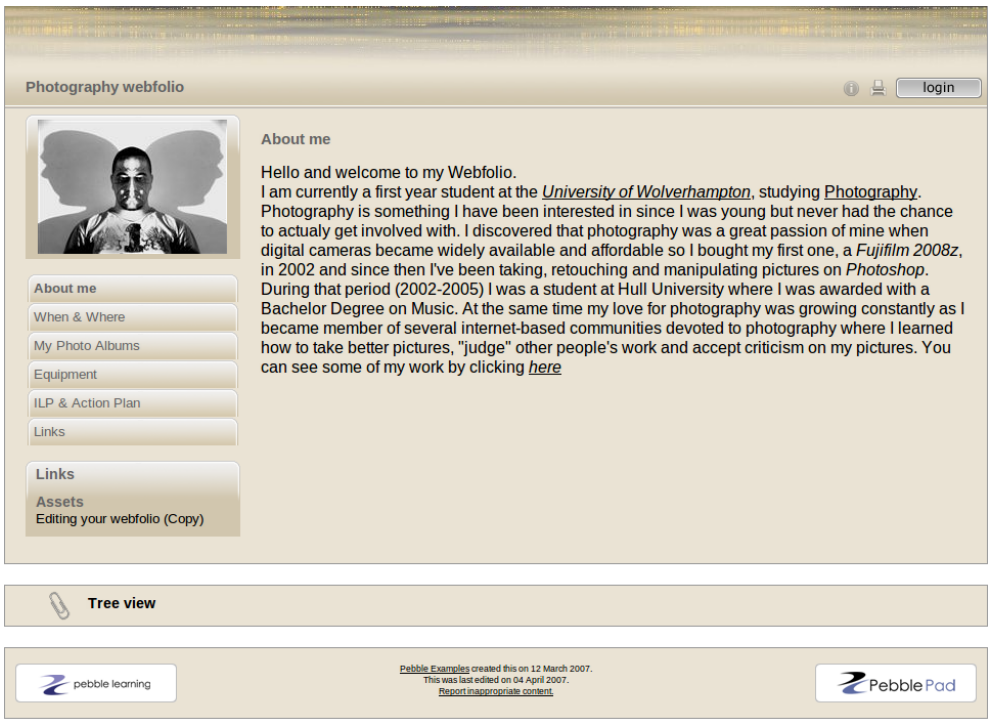

Figure 4.3: PebblePad ePortfolio system example (Pebble Learning Ltd, 2011)

However, despite these features, working with assets in PebblePad has its disadvantages.

The way the system's repository is structured, asset tracking and finding in PebblePad is noted to be not user-friendly (Overton, 2009). Due to poor asset management, users can end up deleting files and breaking links between assets, or forgetting to update the hyperlinks of the changed assets, which results in missing files for someone who is viewing the asset. Users cannot upload files larger than 10MB.

PebblePad has an interface with the Moodle LMS that allows ePortfolio users to have single sing-on with LMS and also export items from Moodle to their ePortfolio. The system supports Leap2a and IMS eP as well as import from any RSS or Atom compliant system. According to vendors website, as for the middle of 2011, the price of PebblePad adoption ranged from 14,95GBP for individual accounts hosted by the company to 1GBP per user for the largest customers hosting the system themselves. After graduation from the sponsoring institution, students can get a free 12-month personal account managed by Pebble Learning.

4.4.2.2 Mahara

Mahara[7] is an open source ePortfolio system started in 2006 funded by New Zealand Tertiary Education Commission. The system is a standalone web application and does not require any kind of LMS or another system installed. Its modular and extensible architecture that resembles the architecture of Moodle LMS. This can be explained by the fact that developer community of Mahara is deeply involved in the Moodle community. The system is claimed to be highly 'pluggable' which allows adding various Web 2.0 web services and establish interoperability with other systems (Mahara Governance Group, 2011).

Mahara functionality includes a number of standard ePortfolio features like file repository, reflection tools in form of blogs, presentation and sharing tools as well as elements of social networking like friends lists, forums, message board and e-mail. Mahara has internal résumé builder which allows users to create their digital CV with various information options. Sharing is done through pages which are called 'views'. Users can create single views or collections of views and fill them with artifacts from their ePortfolio repository. Views can be created from scratch as well as from a template developed by another user.

A group portfolio is available for collaboration purposes. Compared to personal accounts, groups have functionality limited to creating and maintaining pages (views), forums and file repository.

[7] `http://mahara.org`

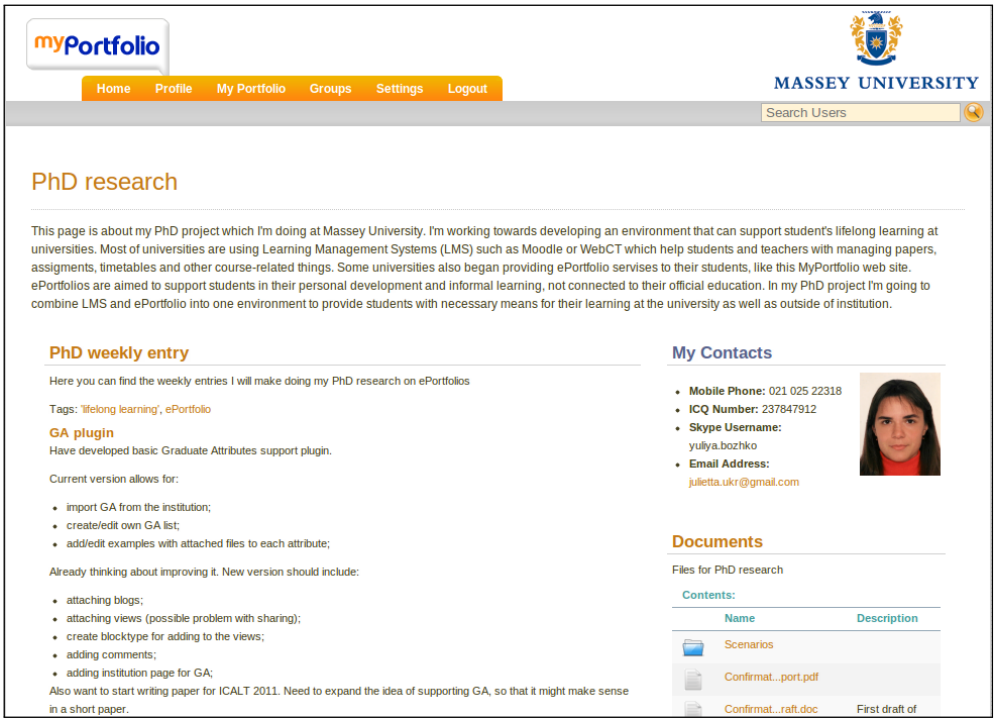

Figure 4.4: Mahara ePortfolio 1.3 example

As it became popular in ePortfolio systems throughout the recent years (Waters, 2009), Mahara comes with a user-to-user permissions control. Users can set up three levels of access to parts of their ePortfolios (private, individual and public) which defines what items and information others can see. Currently the Mahara system does allow sharing views with others or making them public, but giving feedback is restricted to registered users.

Mahara supports a complete LEAP2A interoperability which allows to import portfolio content to Mahara and export to another ePortfolio system, provided that this interoperability standard is implemented at the other side. In addition, export in form of static HTML pages is supported.

The latest version of Mahara supports single sign-on with Moodle, which means that users can log on to both systems using only one account. Unofficial plugins developed by the community allow for submitting views as assignments to Moodle. However, this functionality is not included in official release. The road-map of Moodle 2.0 included a repository plugin for Mahara that would allow direct export of artifacts from LMS to ePortfolio. Meanwhile, Moodle 2.1.1 release still does not support this functionality.

4.4.2.3 ELGG

ELGG[8] is an open source social networking and social publishing platform started in 2004 and released under the GNU Public License v2. It was originally aimed at higher education, but is currently used in many contexts from business to sport. Developers of ELGG call it a *social engine to empower social environment.*

Most the end-user functionality comes from plugins which can be loaded into system. This review examines a standard installation. ELGG is supported by an extensive community which has contributed a large number of plugins. In general, most of these plugins are aimed at supporting social networking.

Features available in the standard platform installation include user management and administration, social networking components (like friends list and "the wire"), blogging, message board, file repository, private messaging, pages, and bookmarks. Additional components can be installed by administrator as plugins and can be used within the entire system.

In ELGG, each account has a profile page which links to all available artifacts created by the user through adding or removing widgets. Except for the profile page, there is no standard way of aggregating artifacts for presentation. The profile page is as well the main option for showcasing as users cannot have multiple ePortfolios.

Unlike other ePortfolio systems, ELGG has a quite limited choice of permissions. Artifacts in the system can be either private/public, or shared with friends or logged-in users. There is no way of having multiple permission settings or user-to-user permissions for artifacts.

Similar to Mahara ePortfolio system, ELGG has groups for collaboration. Groups have the same system components (e.g. blogs, pages, files) as single profiles, and these options can be set up or removed at any time.

ELGG has no reporting system for users which would show a number of page visits, file downloas, etc. However, minor reporting functionality is available for administrative purposes.

In 2007, interoperability between ELGG and the open source LMS Moodle was established for single sign-on and courses integration. However, since Moodle 1.9 there is no news on plugin updates. Information has been found on the Internet about a proprietary plugin being developed for ELGG-Moodle integration, although no up-to-date documentation is currently available that would describe this plugin.

[8] `http://elgg.org`

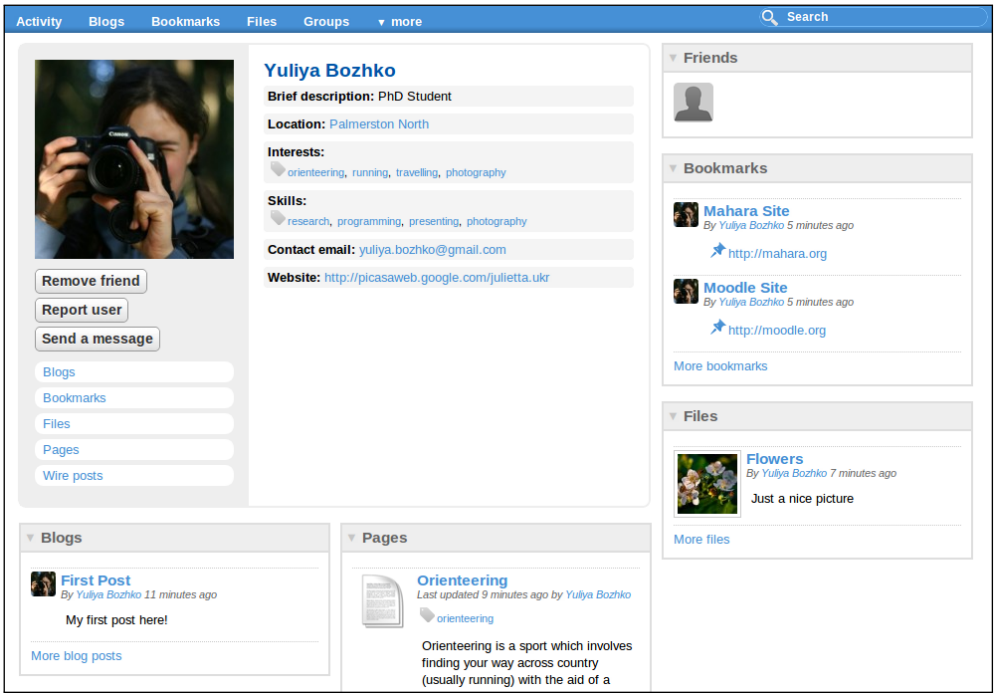

Figure 4.5: ELGG 1.8 example

4.4.2.4 BlackBoard ePortfolio

After BlackBoard[9] took over WebCT in February 2006, this popular LMS provider developed an ePortfolio toolkit the most recent release of which is currently a part of BlackBoard Learn 9.1. This ePortfolio system is designed as an add-on to the LMS environment and can not be used as a stand-alone product. On one hand, it means that all users must have BlackBoard LMS account to be able to access ePortfolio. On the other hand, it gives some advantages which other ePortfolio systems might lack, such as single sign-on with LMS, direct import of graded materials from Blackboard courses and links to course goals and objectives.

BlackBoard ePortfolio is available in Basic and Personal Portfolio versions. Basic Portfolio has an ePortfolio set-up wizard for learners who need guidance. However, it is largely dependent on functionality available in LMS. Without activation of various features, the repository might be restricted to text and hyperlinks only. Personal Portfolio provides more flexibility and functionality. Therefore, this version will be reviewed further as BlackBoard ePortfolio.

In the system, ePortfolio owners have control over the content, access, layout and style of their portfolio. ePortfolios can be created from available templates predefined by an

[9] `http://www.blackboard.com/`

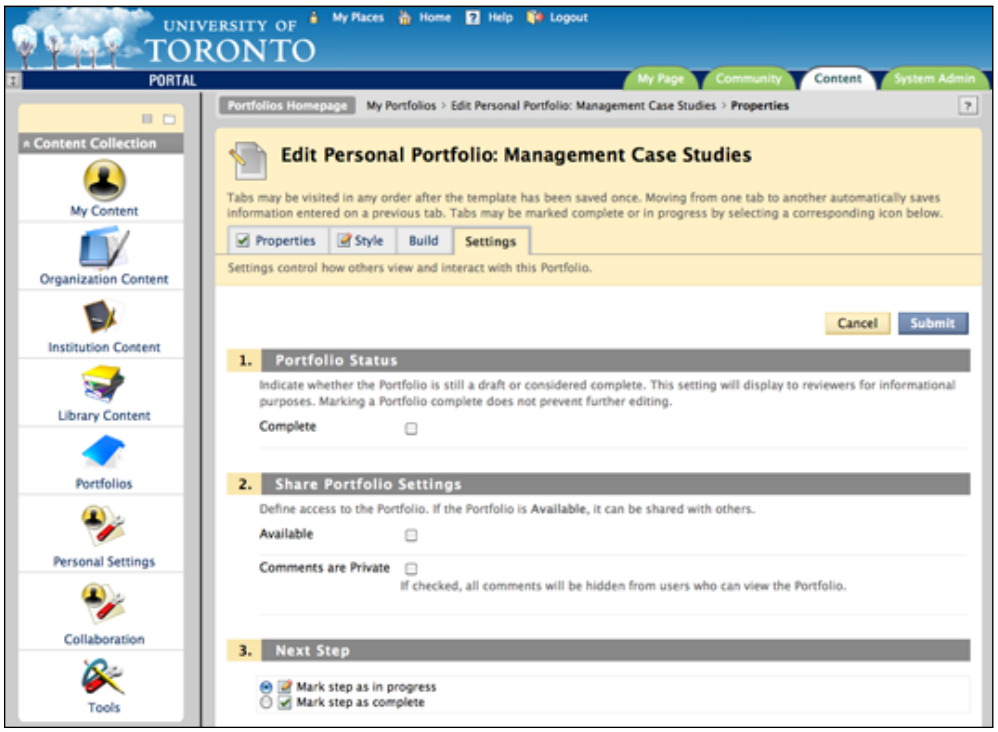

Figure 4.6: BlackBoard ePortfolio example (University of Toronto, 2010)

administrator or a lecturer, or they can be created from scratch. A variety of video, audio and text file types is supported as well as an HTML editor for creating pages. Reflections are facilitated in form of blogs or threaded topics. Content is separated from portfolios which allows reuse of the artifacts. It has been reported that because of this separation artifact management is not intuitive and might be too complex for students for effective use of tools (Clark and Neumann, 2009). In addition, portfolios can be linked to learning objectives defined by lecturers, administrators or learners themselves.

When necessary, BlackBoard ePortfolio can be shared with people inside the institutional community through system username, groups and courses as well as outside – via email or creating a guest account which is by default active for 30 days. However, availability of these sharing options is set up by system administrator who can allow or restrict any of these options. Depending on access level, users can leave their feedback in form of comments. Comments cannot be attached to individual artifacts and are stored within single pages of ePortfolio. BlackBoard ePortfolio system has a basic reporting system where users can enable tracking, and gather basic data about views of their portfolios. At the completion of studies ePortfolio can be downloaded and saved as HTML in a ZIP archive.

Overall, BlackBoard ePortfolio is good for creating portfolio of student course or program work and for linking to a course of study (University of Toronto, 2010).

According to Sweat-Guy and Buzzetto-More (2007), the cost of 12 months license for BlackBoard ePortfolio in 2006-2007 was 20,900USD which did not include the cost of prior purchase and adoption of LMS. To date, no information was found on current development status and future releases.

4.4.2.5 Desire2Learn

Desire2Learn[10] ePortfolio is a proprietary ePortfolio system developed by Desire2Learn Incorporated. It can be deployed as a standalone application or as a part of a Desire2Learn Learning Environment. As a result of close working relationship of the developing company with Microsoft, this ePortfolio system, as well as all Desire2Learn software, is built on Microsoft technologies, such as SQL Server and Windows Server (AAEEBL, 2011a).

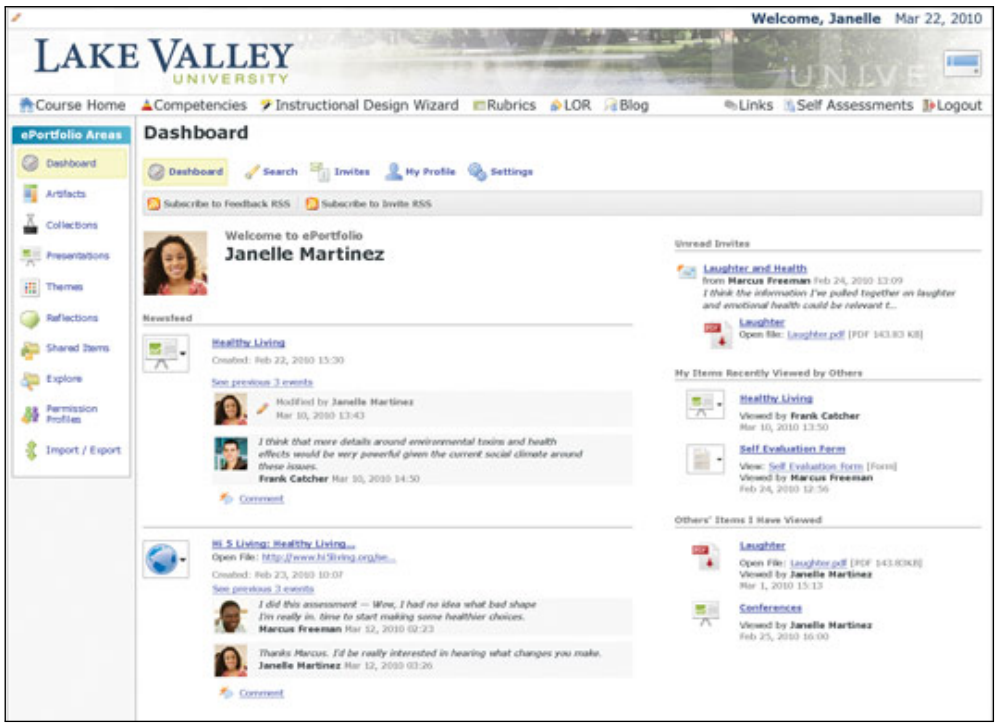

Figure 4.7: Desire2Learn ePortfolio example (Desire2Learn Incorporated, 2011)

Most artifacts can be uploaded to the system from external resources. Some of them, such as HTML files, can be created within the environment. This also includes creating audio recordings which is a unique functionality compared to other ePortfolio systems.

[10] `http://www.desire2learn.com`

Currently, Desire2Learn developers are looking into adding support for creating of video records.

There is a standard for ePortfolio systems range of functionality associated with artifacts: they can be grouped, shared with others, commented on, assessed directly or submitted as an assignment. Assessment results, such as grades, competencies or quiz details, can be saved as ePortfolio artifacts as well.

In addition to individual artifacts, other types of items in the ePortfolio system are collections, presentations, reflections and forms. Collections are used to group artifacts and can be created manually or automatically based on a defined tag set. Forms provide a way of developing artifacts with standard field types. This can be used for creating templates for evaluations, resumes, or self-evaluation. Presentations are personal web sites that present a set of artifacts in an organized way allowing users to choose theme, set up layout and manage content. Reflections are a separate form of the artifacts. They can be associated with artifacts or presentations and can be a part of collection or presentation.

Feedback can be applied to individual artifacts, collections, reflections or entire presentations. If needed, evaluators can review all comments made by peers. Users can add assessment rubrics to artifacts that require specific type of evaluation. More comprehensive assessment features are available via integration with other Desire2Learn LMS tools.

Desire2Learn ePortfolio has reporting capabilities for administrators and teachers which support tracking usage and accessing detailed information on competency achievement by students. Minor reporting is available to users in form of presentations access logs.

Any part or an entire ePortfolio contents can be imported or exported using either XML, or HTML format. XML is a native format of the system and allows to import ePortfolio to another Desire2Learn ePortfolio system instance.

No estimate cost of the Desire2Learn ePortfolio was discovered as vendors do not disclose pricing information, explaining that each case is unique to each institution.

4.4.2.6 eFolio

The eFolio[11] system is a software service hosted and maintained by Avenet Web Solutions. Developed in 2001 together with the University of Minnesota, eFolio currently has a large user base, the biggest of which are eFolioMinnesota[12] (over 60,000 active

[11] `http://www.avenetefolio.com`
[12] `http://www.efoliominnesota.com`

users) and eFolioWorld[13] (over 34,000 active users) (AAEEBL, 2011b). Being said that eFolio is a hosted service, it is still possible to get self-hosted solutions for very large implementations.

Figure 4.8: eFolio system example (EFolioMinnesota, 2011)

Every account in eFolio can have multiple portfolios which are organized as sites. When users start creating a site, they can use a wizard under the "To Do" category for filling the pages with the relevant content. The latest version of the system has a drag and drop site management interface which makes it easy to create sites and pages. eFolio comes with a number of build-in display and style formats. However, according to the comments (AAEEBL, 2011b), the system does not provide as much page layout flexibility as some users would expect.

Everything saved in eFolio is located in the "My Content" category. Currently, its standard storage capacity is 50MB per user, but this limit can be negotiated. My

[13] `http://www.efolioworld.com`

Content groups items by data types such as artifacts, courses taken, goals, images, URLs, employment, etc. As well, users can add (create) the items on a fly while building their sites. Users can set up content properties and formatting, add other content related to the item and write multiple reflections.

All sites are by default private, but can be set to public once finished. Underage user sites are always private by default and cannot be made public. Instead, owners can invite a specific person to review their site. Access to the web site is granted through creating visitors. Each visitor gets an email with login details if the site is private or site URL if it is public. Even users who already have accounts in the system get a visitor account for each specific site access. Visitors can leave feedback to any item with feedback properties set up. Depending on these properties, feedback can be in the form of Likert scale, question/answer or free-form text.

eFolio does not provide collaboration functionality and all web sites in the system are personal. For assessment purposes eFolio has questionnaires of various types which students can use to address assessment criteria.

eFolio supports the IMS ePortfolio standard which allows users to import/export their ePortfolio content. The system can be integrated with the Moodle LMS. However, no detailed information was found on what kind of integration this is.

After graduating or leaving a sponsoring institution, users can continue using their eFolio for an annual fee of 15USD. Prices for institutions depend on numbers of users, and can range between 15USD - 4USD per user (AAEEBL, 2011b).

4.4.3 ePortfolio Systems in Light of Lifelong Learning

Considering that the expectation around ePortfolio systems is that these systems support lifelong learning, the question is whether they are doing it effectively in light of the recommendations discovered in the literature. Due to the fact that the literature provides only highly conceptual recommendations, it is difficult to translate these into formal requirements. Therefore, assessment whether these recommendations are met by the features implemented in the systems turns into a challenging task. In this case, bringing these recommendations to the practical level is an important step towards a better understanding of what is expected from the environment that can support lifelong learning. One can argue that the majority of these recommendations cannot be addressed by just providing an improved system (Schaffert and Hilzensauer, 2008). However, from another perspective, a better system might aid to supporting various important aspects of learning that usually stay outside of focus of many learning environments.

Although, no prior research was discovered that would look at the ePortfolio systems from the lifelong learning perspective, there is a number of issues known among the ePortfolio community that might be relevant to lifelong learning support. For example, current ePortfolio systems have difficulty helping students to link knowledge to practical experience which is an important part of understanding one's personal progress and achievements (Chou and Chen, 2009). Interoperability between different ePortfolio systems as well as other learning systems is quite poor despite of the existing standards (Clark, 2011). Assuming that ePortfolios are lifelong, they are supposed to cope with large amounts of data (Butler, 2010). However, practice shows that current systems can barely offer efficient methods for managing data repository to users who have been using them extensively for just a couple of years. There are also issues of ethics, privacy and intellectual property where ePortfolio users need to decide who owns the data and how it can be used (Challis, 2005).

The problems mentioned here are just some examples that are not likely to draw a complete picture. To get a deeper insight into ePortfolio issues and understand what improvements are required for ePortfolio systems to fulfil the promise of efficient lifelong learning support, a deeper analysis of the area is required.

4.5 Summary

Based on the deliberations outlined in this chapter, additional technical requirements can be considered along with the recommendations for successful lifelong learning support, such as:

- A good virtual learning environment should facilitate the development of lifelong learning skills;
- It should fit with university needs;
- It has to be accepted by student learners;
- It should create a bridge between institutional and personal learning.

ePortfolio system seems to fit well into this picture. It brings a balance into the world of learning environments, and has potential of closing the gap the exists between LMS and Web 2.0. Reviewing ePortfolio systems showed that the systems currently available world-wide offer a range of opportunities for lifelong learning. Each system comes with commonly valuable functionality that promises support for important aspects of learning. However, are they mature enough to be a part of the environment that

provides comprehensive support for lifelong learning? Previous section discussed that current ePortfolio systems might still lack some elements important for lifelong learning. To support this hypothesis, the next chapter will explore the needs for lifelong learning supported by ePortfolio system based on the major stakeholders perspective. University students and lecturers have been interviewed to get their insight on the requirements and to understand whether these comply with the literature review findings.

Chapter 5

Stakeholders Requirements for Lifelong Learning Support in Universities

5.1 Lecturers' Perspective on Lifelong Learning Support

5.1.1 Participants Profile

Using a theoretical or criterion sampling strategy (Byrne, 2001; Warren, 2001), we were looking for the respondents who met certain criteria of being academics with previous experience of using LMS and ePortfolio systems in their teaching. Ten academics, mostly the participants of a previous institutional ePortfolio initiative[1], were approached by email and invited to participate in the research project. Nine academics from various sections of the university (College of Business, College of Education, and College of Sciences) accepted the invitation and agreed to be interviewed. In April-May 2010 we conducted nine in-depth interviews to gather the data required for the analysis. All interviews were audio recorded and transcribed to make follow-up analysis easier and more thorough.

5.1.2 Methodology

We used semi-structured interviews as an instrument for this phase of the research. Interviews were favoured over the other research methods because they are suitable for gaining insight into the experience and knowledge of others (Schostak, 2006). It was important for this project as we had a limited pool o potential participants that would

satisfy our criteria and, in this case, the required depth of investigation could not be reached with questionnaires.

The interviews were guided by a number of scenarios each described a particular situation connected to the problems of lifelong learning support in universities (See Appendix for a scenario example). The scenarios describe situations from the teaching perspective, to support talking to lecturers from their perspective. Topics for these scenarios were selected from the literature review conducted at the first stage of the project and observations from the reports and communications with the College of Sciences ePortfolio Initiative project team members[2] at Massey University.

5.1.3 Results

5.2 Students' Perspective on Lifelong Learning Support

5.2.1 Participants Profile

We used interviews with the stakeholders of the area as an instrument for this phase of the research. It was favoured over the other research methods because we had a limited pool of potential participants and needed a tool that would help us to gain an insight into the experience and knowledge of others. The interview fit well with this criteria (Schostak, 2006).

The interviews in this project were used to explore the current problems and challenges of lifelong learning support in universities. As this research is focused on system support, the problems in the teaching process and institutional policies were not among the topics for discussion during the interviews. The aim was to understand the gaps and shortcomings that currently exist in e-leaning environments, as well as to get the interviewees' views on what is needed to make the systems already used in universities become more efficient and adequate for students lifelong learning support. We also aimed to get feedback on potential system features we had proposed, based on our literature review and gaps analysis.

We used a snowball or chain sampling strategy (Mack, et al., 2005; Marshall and Rossman, 2011) to identify potential participants for the interviews. The academics, who have participated in the similar interviews at an earlier stage of the project, were asked to provide student contacts or to inform students of this research in their classroom. As the use of ePortfolio is relatively new at Massey University, this technique was used to make sure that students who took part in the interview were familiar with both systems. We believe that students who have already used both systems in practice

are more experienced and provide richer data for discussion and analysis. About 30 students were approached by email and invited to participate in the research project. Overall, nine students from various schools and colleges of Massey University accepted the invitation and agreed to be interviewed. In May-September 2010 we conducted nine in-depth interviews to gather the data required for the analysis. All interviews were audio recorded to make a follow-up analysis easier and more thorough.

5.2.2 Methodology

The interviews were guided by a number of scenarios (see Figure 1 for an example) that described some particular situation connected to the problems of lifelong learning support in universities.

Themes for the scenarios were selected from the literature review and observations from the reports and communications with the College of Sciences ePortfolio Initiative team members at Massey University. As the interviews were conducted with the students, we tried to construct every scenario to describe the situation from the learners perspective.

The participants were asked a set of open-ended questions to elicit their views on the environments that support lifelong learning in the university. They were asked how they had been using LMS and ePortfolio together and what advantages and disadvantages they saw in such a combined approach. We asked for their opinions on what features their current ePortfolio system lacked, or which features could make such system more useful and relevant to lifelong learning support in universities. The interviewees were also invited to suggest functionalities they would expect to see in a good e-learning environment that supported lifelong learning in universities.

5.2.3 Results

5.3 Requirements Elicitation

5.4 Summary

Chapter 6

Prototype - Development and Implementation

6.1 Architecture

6.2 Development Toolkit

6.3 Implementations

6.3.1 Version Control Elements

6.3.2 Concept Map Module

McAleese (1998) formally defines a concept map as a directed acyclic graph that consists of a set of Concept Labels and a non-empty set of Relationships between Concepts. Putting it simply, concept maps are graphical representation of the hierarchy of knowledge concepts and connections between them (Novak and Cañas, 2008).

Concept maps are dynamic, process-oriented and give learners an opportunity to engage in the learning process [7] which is important for lifelong learning [10], [11]. Maps are created over time by the learner who is engaged in a process of reflection, collecting and selecting appropriate examples of their work. With concept maps learners can interpret their personal knowledge and map this knowledge and individual examples against the existing theories. The hierarchical nature of the concept map allows for organizing concepts from the high level abstract concept to the more specific concepts. This property can be used by students for managing and structuring data in their

ePortfolios.

Describing future directions for ePortfolio technology, Cambridge (2010) suggested that visualization in the form of concept maps could be a potential way of generating reflections.

6.3.3 Artifacts' Fragments Extraction

6.3.4 Progress Tracking

6.3.5 Advanced Sharing

6.4 Prototype Iterations and User Tests

6.5 Summary

Chapter 7

Evaluation

7.1 Study One. Exploratory Evaluation by Lecturers

7.1.1 Goals

7.1.2 Research Protocol

7.1.3 Participants Profile

7.1.4 Data Collection and Analysis

7.1.5 Conclusions

7.2 Study Two. Group Experiment - Lifelong Learning Skills Development and Demostration

7.2.1 Goals

7.2.2 Research Protocol

7.2.3 Participants Profile

7.2.4 Activities and Artefacts

7.2.5 Data Collection and Analysis

7.2.6 Conclusions

7.3 Study Three. System Validation by Experienced Students

7.3.1 Goals

Chapter 8

Discussion

Chapter 9

Conclusions and Future Work

> We now accept the fact that learning is a lifelong process of keeping abreast of change. And the most pressing task is to teach people how to learn
>
> *Peter F. Drucker*

9.1 Summary of the Research

9.2 Research Contributions

9.3 Future Research

9.4 Conclusions

Bibliography

AAEEBL (2011, October 10). "Desire2Learn Resources for Exploring Eportfolio Technologies Webinar." Retrieved from `http://www.aaeebl.org/desire2learn-resource`.

AAEEBL (2011, September 27). "eFolioWorld Resource for Exploring Eportfolio Technologies Webinar." Retrieved from `http://www.aaeebl.org/efolioworld-resource`.

Aller, B. M., Kline, A. A., Tsang, E., Aravamuthan, R., Rasmusson, A. C., and Phillips, C. (**2005**). "WeBAL: A Web-Based Assessment Library to Enhance Teaching and Learning in Engineering." *IEEE Transactions on Education*, 48(4): 764–771.

Archer, L. (**1984**). "Systematic dethod for designers." In N. Cross, editor, "Developments in design methodology," pages 57–82. Wiley, Chichester; New York.

Ashling, J. (**2007**). "Transforming Research Communication." *Information Today*, 24(5): 29–30.

Attwell, G. (**2007**). "Personal Learning Environments - the future of eLearning?" Retrieved from `http://www.elearningeuropa.info/files/media/media11561.pdf`.

Bagnall, R. G. (**2009**). "Lifelong learning as an idea for our times: An extended review." *International Journal of Lifelong Education*, 28(2): 277–285.

Barrett, H. (**2008**). "Categories of ePortfolio Tools." Retrieved from `http://electronicportfolios.com/categories.html`.

Benseman, J. (**2006**). "Moving Towards Lifelong Learning in Rural New Zealand: A Study of Two Towns." *Journal of Research in Rural Education*, 21(4). Retrieved from `http://www.jrre.psu.edu/articles/21-4.pdf`.

Blackboard Inc. (**2009**). "Blackboard Release 9." Retrieved from `http://www.blackboard.com/About-Bb/Media-Center/Press-Releases/Archive.aspx?releaseid=881188`.

Boshier, R. (**2000**). "Running to win: the contest between lifelong learning and education in Canada." *New Zealand journal of adult learning*, 28(2): 6–28.

Boulos, M. N. K. and Wheeler, S. (**2007**). "The emerging Web 2.0 social software: an enabling suite of sociable technologies in health and health care education." *Health Information and Libraries Journal*, 24(1): 2–23.

Bourner, T. (**2002**). "The reserach journey: four steps to success." chapter 2, pages 7–12. Arnold, London, 2nd edition.

Brakke, D. F. and Brown, D. T. (**2002**). "Assessment to improve student learning." pages 119–122. Jossey-Bass, San Francisco.

Brooks, R. and Everett, G. (**2008**). "The impact of higher education on lifelong learning." *International Journal of Lifelong Education*, 27(3): 239–254.

Browne, T., Jenkins, M., and Walker, R. (**2006**). "A Longitudinal Perspective Regarding the Use of VLEs by Higher Education Institutions in the United Kingdom." *Interactive Learning Environments*, 14(2): 177–192.

Butler, P. (**2010**). "E-Portfolios, Pedagogy and Implementation in Higher Education: Considerations from the Literature." In N. A. Buzzetto-More, editor, "The E-Portfolio Paradigm: Informing, Educating, Assessing, and Managing With E-Portfolios," chapter 6, pages 109–139. Informing Science Press, Santa Rosa, California, USA.

Cambridge, D. (**2010**). *ePortfolios for Lifelong Learning and Assessment*. Jossey-Bass, San Francisco, CA.

Canadian Council on Learning (**2011**). "Composite Learning Index." Retrieved from `http://www.cli-ica.ca`.

Capell, K. (2006, October 24). "Europe's Politicians Embrace Web 2.0." Retrieved from `http://www.businessweek.com`.

Challis, D. (**2005**). "Towards the mature ePortfolio: Some implications for higher education." *Canadian Journal of Learning and Technology*, 31(3). Retrieved from `http://www.cjlt.ca/index.php/cjlt/article/view/93/87`.

Chapman, D. D. (**2009**). "Introduction to Learning Management Systems." In P. L. Rogers, G. A. Berg, J. V. Boettcher, C. Howard, L. Justice, and K. D. Schenk, editors, "Encyclopedia of Distance Learning," pages 1280–1286. IGI Global, 2 edition.

Chen, H. (**2009**). "Using ePortfolios to Support Lifelong and Lifewide Learning." In D. Cambridge, B. Cambridge, and K. B. Yancey, editors, "Electronic Portfolios 2.0: Emergent Research on Implementation and Impact," chapter 3, pages 29–35. Stylus Publishing, Sterling, Virginia, USA.

Chou, P. and Chen, W. (**2009**). "E-portfolio Use at Higher Education Institutions: Potential Problems for Pedagogy." In A. Méndez-Vilas, A. Solano Martín, J. Mesa González, and J. Mesa González, editors, "Research, Reflections and Innovations in Integrating ICT in Education," volume 3, pages 1312–1315. FORMATEX, Badajoz, Spain.

Churchill, D. (**2009**). "Educational applications of Web 2.0: Using blogs to support teaching and learning." *British Journal of Educational Technology*, 40(1): 179–183.

Clark, D. (2011, March 30). "E-portfolios – 7 reasons why I don't want my life in a shoebox." Retrieved from `http://donaldclarkplanb.blogspot.com`.

Clark, W. and Neumann, T. (**2009**). "ePortfolios: Models and Implementation."

Clarke, M. (**2003**). "The Reflective Journal: Implications for Professional Learning." Auckland, New Zealand.

Cleven, A., Gubler, P., and Hüner, K. M. (**2009**). "Design Alternatives for the Evaluation of Design Science Research Artifacts." In "Proceedings of the 4th International Conference on Design Science Research in Information Systems and Technology (DESRIST '09)," ACM Press, New York, New York, USA. doi:10.1145/1555619.1555645.

Collis, B. and De Boer, W. (**2004**). "E-learning by design." *Teachers as learners: Embedded tools for implementing a CMS*, 48(6): 7–12.

Cross, N. (**1993**). "A history of design methodology." In M. J. de Vries, N. Cross, and D. P. Grant, editors, "Design methodology and relationships with science," chapter 1, pages 15–28. Springer, Eindhoven, The Netherlands.

Curtin University (**2006**). "Graduate Attributes Policy." Retrieved from `http://policies.curtin.edu.au`.

Davies, A. and LeMahieu, P. (**2003**). "Reconsidering portfolios and research evidence." pages 141–170. Kluwer Academic Publishers, Dordrecht, Boston, London.

Dawson, R. (2007, September 30). "Launching the Web 2.0 Framework." Retrieved from `http://rossdawsonblog.com/weblog/archives/2007/05/launching_the_w.html`.

de Freitas, S., Harrison, I., Magoulas, G., Mee, A., Mohamad, F., Oliver, M., Papamarkos, G., and Poulovassilis, A. (**2006**). "The development of a system for supporting the lifelong learner." *British Journal of Educational Technology*, 37(6): 867–880.

Desire2Learn Incorporated (**2011**). "Desire2Learn ePortfolio." Retrieved from `http://www.desire2learn.com/eportfolio/highered/`.

Dewey, J. (**2004**). *Democracy and education*. Dover Publications. Originally published: New York: Macmillan, 1916, Mineola, N.Y., dover edition.

Divjak, S., Dowling, C., Fisser, P., Grabowska, A., Hezemans, M., Kendall, M., Mihnev, P., Ritzen, M., Syslo, M., Vicari, R., and van Weert, T. (**2004**). "Lifelong Learning in the Digital Age." In T. J. van Weert and M. Kendall, editors, "Lifelong learning in the digital age: sustainable for all in a changing world," chapter 1, pages 1–49. Kluwer Academic, Boston.

Dowling, D. (**2006**). "Designing a competency based program to facilitate the progression of experienced engineering technologists to professional engineer status." *European Journal of Engineering Education*, 31(1): 95–107.

EACEA (**2009**). "About Lifelong Learning programme." Retrieved from `http://eacea.ec.europa.eu`.

EFolioMinnesota (**2011**). "Showcase of Excellent eFolio Sites." Retrieved from `https://efolio.custhelp.com/`.

ELLI Development Team (**2010**). "Making Lifelong Learning Tangible! The ELLI Index Europe 2010." Retrieved from `http://www.elli.org/fileadmin/user_upload/About_ELLI/Documents/ELLI_EU_eng_final.pdf`.

Ellis, R. K. (**2009**). "Learning Management Systems 2009." Retrieved from `http://www.astd.org/LC/2009/0509_LMS2009.htm`.

European Commission (**2000**). "A Memorandum on Lifelong Learning." Retrieved from `http://www.bologna-berlin2003.de/pdf/MemorandumEng.pdf`.

Fallows, S. (**2003**). "Teaching and learning for student skill development." pages 121–133. Kogan Page, London and Sterling, VA, 2 edition.

Faure, E., Herrera, F., Kaddoura, A.-R., Lopes, H., Pertovsky, A. V., Rahnema, M., and Ward, F. C. (**1972**). *Learning to be; the world of education today and tomorrow*. Harrap/UNESCO, Paris.

Felce, A. (**2011**). "JISC Final Report ePPSME." Technical report, The University of Wolverhampton, Wolverhampton. Retrieved from `http://www.jisc.ac.uk/media/documents/programmes/institutionalinnovation/workforcedev/eppsmefinalreport.pdf`.

Field, J. and Leicester, M. (**2003**). *Lifelong learning: education across the lifespan.* RoutledgeFalmer, London.

Freire, J. (**2008**). "Universities and Web 2.0: Institutional Challenges." *eLearning Papers*, (8): 1–8. Retrieved from `http://www.elearningeuropa.info/files/media/media15530.pdf`.

Görlitz, R., Seip, B., and Zacharias, V. (**2010**). "Health 2.0 in practice: a review of German health care web portals." In B. White, P. Isaías, and D. Andone, editors, "Proceedings of the IADIS International Conference on WWW/Internet," volume 2000, pages 49–56. IADIS, Timisoara, Romania. Retrieved from `http://www.iadisportal.org/wwwinternet-2010-proceedings`.

Grabowski, U. (**2004**). "Erfolgsfaktor Persönlichkeit: Anforderungen an eine Ganzheitliche Ingenieurausbildung." *Global Journal of Engineering Education*, 8: 269–274.

Hager, P. J. (**2011**). "Concepts and definitions of lifelong learning." In M. London, editor, "The Oxford handbook of lifelong learning," chapter 2, pages 12–25. Oxford University Press, New York.

Hargreaves, D. H. (**2004**). *Learning for life: the foundations of lifelong learning.* Policy Press, Bristol, UK.

Hart, G., Bowden, J., and Watters, J. (**1999**). "Graduate Capabilities: a Framework for Assessing Course Quality." *Higher Education in Europe*, 24(2): 301–308.

Hartnell-Young, E., Smallwood, A., Kingston, S., and Harley, P. (**2006**). "Joining up the episodes of lifelong learning: A regional transition project." *British Journal of Educational Technology*, 37(6): 853–866.

Havenstein, H. (**2007**a). "Customers Courted With Web 2.0." *Computerworld*. Retrieved from `http://www.computerworld.com/s/article/print/283355/Customers_Courted_With_Web_2.0`.

Havenstein, H. (**2007**b). "IT is a key barrier to corporate Web 2.0 adoption, users say." *Computerworld*. Retrieved from `http://www.computerworld.com/s/article/9034898/IT_is_a_key_barrier_to_corporate_Web_2.0_adoption_users_say`.

Heinrich, E., Bhattacharya, M., and Rayudu, R. (**2007**). "Preparation for lifelong learning using ePortfolios." *European Journal of Engineering Education*, 32(6): 653–663.

Hernon, P. (**2006**). "Methods of data collection." pages 135–150. Libraries Unlimited, Westport, Connecticut, London.

Hevner, A. and Chatterjee, S. (**2010**). *Design research in information systems: theory and practice*. Springer, New York.

Hevner, A., March, S., Park, J., and Ram, S. (**2004**). "Design Science in Information Systems Research." *MIS Quarterly*, 28(1): 75–105.

Holahan, C. (2006, September 1). "Fantasy Football 2.0." Retrieved from `http://www.businessweek.com`.

Holahan, C. (2007, March 27). "Close Harmony: Bands and Web 2.0." Retrieved from `http://www.businessweek.com`.

Hughes, C. and Barrie, S. (**2010**). "Influences on the assessment of graduate attributes in higher education." *Assessment & Evaluation in Higher Education*, 35(3): 325–334. doi:10.1080/02602930903221485.

Iivari, J. and Venable, J. (**2009**). "Action Research and Design Science Research Seemingly Similar but Decisively Dissimilar." In "17th European Conference on Information System (ECIS)," Verona, Italy.

IMS Global Learning Consortium (**2005**). "IMS ePortfolio Information Model. Version 1.0 Final Specification." Retrieved from `http://www.imsglobal.org/ep/epv1p0/imsep_infov1p0.html`.

Ioannidis, J. P. a. (**2007**). "Limitations are not properly acknowledged in the scientific literature." *Journal of clinical epidemiology*, 60(4): 324–9. doi:10.1016/j.jclinepi.2006.09.011.

Jarvis, P. (**2004**). "From adult education to lifelong learning: a conceptual framework." chapter 2, pages 39–65. RoutledgeFalmer, London; New York, NY.

Katz, R. N. (**2005**). "Foreword: Growing up digital." In R. B. Kvavik and J. B. Caruso, editors, "ECAR Study of Students and Information Technology, 2005: Convenience, connection, control, and learning," volume 6, pages 5–8. EDUCAUSE. Retrieved from `http://net.educause.edu/ir/library/pdf/ers0506/rs/ERS0506w.pdf`.

Kay, J. (**2008**). "Life-Long Learning, Learner Models and Augmented Cognition." pages 3–5. Springer, Montreal, Canada.

Kendall, M., Samways, B., van Weert, T., and Wibe, J. (**2004**). "IFIP TC3 Lifelong Learning Position Paper." In T. van Weert and M. Kendall, editors, "Lifelong learning in the digital age: sustainable for all in a changing world," pages 191–216. Kluwer Academic, Boston.

Kennedy, G. E., Judd, T. S., Churchward, A., and Gray, K. (**2008**). "First year students' experiences with technology: Are they really digital natives?" *Australasian Journal of Educational Technology*, 24(1): 108–122.

Klamma, R., Chatti, M. A., Duval, E., Hummel, H., Thora, E., Kravcik, M., Law, E., Naeve, A., and Scott, P. (**2007**). "Social Software for Life-long Learning." *Educational Technology & Society*, 10(3): 72–83.

Knapper, C. K. and Cropley, A. J. (**2000**). *Lifelong learning in higher education.* Kogan Page, London, 3rd edition.

Kumar, R. (**2005**). *Research methodology : a step-by-step guide for beginners.* SAGE, London, 2nd edition.

Leone, S. (**2010**). "PLE: A Brick in the Construction of a Lifelong Learning Society." In J. O'Donoghue, editor, "Technology-supported environments for personalized learning: methods and case studies," chapter 3, pages 30–49. Information Science Reference, Hershey, PA.

Leung, D., Lee, H. A., and Law, R. (**2011**). "Adopting Web 2.0 technologies on chain and independent hotel websites: A case study of hotels in Hong Kong." In R. Law, F. Ricci, and M. Fuchs, editors, "Proceedings of Information and Communication Technologies in Tourism 2011 International Conference," pages 229–240. Springer, Innsbruck, Austria.

Library Technology Reports (**2007**). "Social video: videoblogging and YouTube." 43(5): 52–57.

Linden, T. and Patrinos, H. A. (**2003**). "Lifelong Learning in the Global Knowledge Economy." *International Journal of Technologies for the Advancement of Knowledge and Learning*, 5(1): 77–80. Retrieved from `http://www.techknowlogia.org/TKL_Articles/PDF/476.pdf`.

Lombardi, M. M. (**2008**). "Making the Grade: The Role of Assessment in Authentic Learning." Retrieved from `http://net.educause.edu/ir/library/pdf/ELI3019.pdf`.

Longworth, N. (**2003**). *Lifelong learning in action: transforming education in the 21st century.* Kogan Page, London and Sterling, VA.

Lorenzo, G. and Ittelson, J. (**2005**). "An Overview of E-Portfolios." Retrieved from `http://net.educause.edu/ir/library/pdf/ELI3001.pdf`.

MacMillan, D. (**2007**). "Family Trees 2.0." Retrieved from `http://www.businessweek.com/technology/content/jun2007/tc20070617_133514.htm`.

Mahara Governance Group (**2011**). "About Mahara." Retrieved from `http://mahara.org`.

Malloff, T. (**2010**). "Tamara Malloff Photostream." Retrieved from `http://www.flickr.com/photos/kootenayleadership`.

March, S. T. and Storey, V. C. (**2008**). "Design Science in the Information Systems Discipline: An Introducation to the Special Issue on Design Science Research." *MIS Quarterly*, 32(4): 725–730.

Massey University (**2008**). "Lifelong Learning Policy." Retrieved from `http://science.massey.ac.nz/eportfolios/lllPolicy.asp`.

Mcaleese, R. (**1998**). "Coming to Know: the role of the concept map - mirror, assistant, master?" In "EuroConference," University of Aveiro, Portugal.

McAlister, G. and Alexander, S. (**2003**). "Key aspects of teaching and learning in information and computer sciences." pages 278–300. Kogan Page, London and Sterling, VA, 2 edition.

Medel-Añonuevo, C., Ohsako, T., and Mauch, W. (**2001**). *Revisiting Lifelong Learning for the 21st Century.* UNESCO Institute for Education, Hamburg, Germany.

Metzger, M. J. and Flanagin, A. J. (**2011**). "Using web 2.0 technologies to enhance evidence-based medical information." *Journal of health communication*, 16(Sup1): 45–58. doi:10.1080/10810730.2011.589881.

Morgan-Klein, B. and Osborne, M. (**2007**). *The concepts and practices of lifelong learning.* Routledge, London; New York.

Mott, J. (**2010**). "Envisioning the Post-LMS Era: The Open Learning Network." *EDUCAUSE Quarterly*, 33(1). Retrieved from `http://www.educause.edu/eq`.

Mourtos, N. J. (**2003**). "Defining , Teaching and Assessing Lifelong Learning Skills." In "Proceedings of the 33rd Annual Frontiers in Education (FIE'03)," pages 14–19. Westminster, CO, USA.

Muffo, J. A. (**2001**). "Assessing student competence in engineering." pages 159–175. Stylus, Sterling, Virginia.

New Zealand Ministry of Education (**2008**). "Tertiary Education Strategy 2007-2012. Incorporating Statement of Tertiary Education Priorities 2008-2010."

Novak, J. D. and Cañas, A. J. (**2008**). "The Theory Underlying Concept Maps and How to Construct and Use Them, Technical Report IHMC CmapTools 2006-01 Rev 01- 2008." Technical report, Florida Institute for Human and Machine Cognition. Retrieved from `http://cmap.ihmc.us/Publications/ResearchPapers/TheoryUnderlyingConceptMaps.pdf`.

OECD (**2005**). "IT infrastructure: use of learning management system (LMS) and other applications." In OECD, editor, "E-learning in Tertiary Education: Where do We Stand?", chapter 4, pages 138–178. OECD Publishing, Paris. Retrieved from `http://www.oecd.org/dataoecd/54/57/34899494.pdf`.

Otala, L. (**1997**). "Implementing Lifelong Learning in Partnership with the Educational Sector and the Work Place." *The International Information and Library Review*, 29(3-4): 455–460. doi:10.1006/iilr.1997.0063.

Overton, L. (2009, August 12). "Eportfolios in Engineering Advantages and Disadvantages." Retrieved from `http://engaging-online-learning.blogspot.com/2009/08/eportfolios-in-engineering-advantages.html`.

Pebble Learning Ltd (**2010**). "PebblePad Functional Overview." Retrieved from `http://www.pebblepad.co.uk`.

Pebble Learning Ltd (**2011**). "PebblePad Examples." Retrieved from `http://www.pebblepad.co.uk/pebblepad.examples.asp`.

Peffers, K., Tuunanen, T., Rothenberger, M. A., and Chatterjee, S. (**2008**). "A Design Science Research Methodology for Information Systems Research." *Journal of Management Information Systems*, 24(3): 45–78.

Pitman, T. and Broomhall, S. (**2009**). "Australian universities, generic skills and lifelong learning." *International Journal of Lifelong Education*, 28(4): 439–458.

Rubenson, K. (**2002**). "Lifelong Learning for All: Challenges and Limitations of Public Policy." Retrieved from `http://www.oise.utoronto.ca/CASAE/cnf2002/2002_Papers/rubenson2002w.pdf`.

Scanlon, L. (**2006**). "Graduate Attributes and the Transition to Higher Education." volume 6, pages 125–148. Springer Netherlands.

Schaffert, S. and Hilzensauer, W. (**2008**). "On the way towards Personal Learning Environments: Seven crucial aspects." Retrieved from `http://www.elearningeuropa.info/files/media/media15971.pdf`.

Schuetze, H. G. and Casey, C. (**2006**). "Models and meanings of Lifelong Learning: progress and barriers on the road to a Learning Society." *Compare: A Journal of Comparative and International Education*, 36(3): 279–287.

Siemens, G. (**2004**). "Learning Management Systems: The wrong place to start learning." Retrieved from `http://www.elearnspace.org/Articles/lms.htm`.

Smidt, H. and Sursock, A. (**2011**). "Engaging in Lifelong Learning: Shaping Inclusive and Responsive University Strategies." Technical report, European University Association, Brussels, Belgium. Retrieved from `http://www.eua.be/pubs/Engaging_in_Lifelong_Learning.pdf`.

Sommerville, I. (**2007**). *Software engineering.* Addison-Wesley, New York, 8th edition.

Sutherland, P. and Crowther, J. (**2006**). *Lifelong learning: concepts and contexts.* Routledge, London : New York.

Sweat-Guy, R. and Buzzetto-More, N. A. (**2007**). "A Comparative Analysis of Common E-Portfolio Features and Available Platforms." In "Proceedings of the 2007 Informing Science and IT Education Joint Conference," pages 327–342. Informing Science Institute, Ljubljana, Slovenia.

Tian, S. W., Yu, A. Y., Vogel, D., and Kwok, R. C.-W. (**2011**). "The Impact of Online Social Networking on Learning: A Social Integration Perspective." *International Journal of Networking and Virtual Organisations*, 8(3/4): 264 – 280.

Tosun, N. and Baris, F. (**2011**). "E-Portfolio Applications in Education." *TOJNED: The Online Journal Of New Horizons In Education*, 1(4): 42–52. Retrieved from `http://www.tojned.net/pdf/tojnedv01i04-05.pdf`.

Tuijnman, A. and Boström, A.-K. (**2002**). "Changing Notions of Lifelong Education and Lifelong Learning." *International Review of Education*, 48(1/2): 93–110.

University of Toronto (**2010**). "ePortfolios in Blackboard." Retrieved from `http://ctl.utsc.utoronto.ca/technology/bb-eportfolios`.

Vaishnavi, V. K. and Kuechler, W. (**2008**). *Design Science Research Methods and Patterns: Innovating Information and Communication Technology.* Auerbach Publications, Boca Raton, New York.

van Tartwijk J. and Driessen, E. (2004, April 26). "Types of e-portfolios." Retrieved from `http://insight.eun.org/ww/en/pub/insight/school_innovation/eportfolio_scenarios/portfolios_types.htm`.

Venable, J. R. (**2010**). "Design Science Research Post Hevner et al.: Criteria, Standards, Guidelines, and Expectations." In R. Winter, J. Zhao, and S. Aier, editors, "Proceedings of 5th International Conference, DESRIST 2010," pages 109–123. Springer, St. Gallen, Switzerland.

Waters, J. K. (2009, November 9). "E-Portfolios Come of Age." Retrieved from `http://thejournal.com`.

Watson, B. W. R. and Watson, S. L. (**2007**). "An Argument for Clarity: What are Learning Management Systems, What are They Not, and What Should They Become?" *TechTrends*, 51(2): 28–34. doi:10.1007/s11528-007-0023-y.

Wheeler, S., Yeomans, P., and Wheeler, D. (**2008**). "The good, the bad and the wiki: Evaluating student-generated content for collaborative learning." *British Journal of Educational Technology*, 39(6): 987–995.

Wirtz, B. W., Schilke, O., and Ullrich, S. (**2010**). "Strategic Development of Business Models: Implications of the Web 2.0 for Creating Value on the Internet." *Long Range Planning*, 43(2-3): 272–290. doi:10.1016/j.lrp.2010.01.005.

Yin, R. K. (**2009**). *Case study research: design and methods*. Sage Publications, Los Angeles, 4th edition.