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IMPROVING SUPPORT FOR
LIFELONG LEARNING IN
UNIVERSITIES THROUGH
ENHANCED EPORTFOLIO SYSTEMS

A THESIS PRESENTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE
DEGREE OF
DOCTOR OF PHILOSOPHY
IN
INFORMATION TECHNOLOGY
AT MASSEY UNIVERSITY, PALMERSTON NORTH,
NEW ZEALAND.

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Abstract

Lifelong learning is seen as a self-directed pursuit of knowledge or skills that occur throughout one's life. While this 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, universities in particular, recognise the importance of lifelong learning and define their own strategies to promote it. Such strategies include the development of institutional graduate profiles which represent the core learning outcomes, skills and qualities, that students should acquire during their university education.

The problem identified and addressed in the current research is the lack of comprehensive technical support solutions for lifelong learning in universities. Currently, only basic level support is available in form of ePortfolio systems or incorporation of Web 2.0 tools into university settings. However, the shortcomings of these systems and tools, are hindering their full adoption, and as such the necessary support for lifelong learning is not available.

Through a literature review process followed by stakeholder interviews, this thesis analyses the needs for supporting lifelong learning in universities. According to this analysis, better support is required for reflection, communication and collaboration, development and showcasing of lifelong learning skills, and tracking of learning progress. These identified needs are then translated into requirements that are used to create a prototype system that extends a current ePortfolio system, Mahara, with new features, to provide institutional support for lifelong learning.

A number of studies, involving both lecturers and students, are conducted to evaluate whether the prototype will bring strong improvements towards providing comprehensive support for lifelong learning in universities. The results indicate that the new features can be successfully adopted by students to help development and understanding of lifelong learning skills, address institutional graduate attributes, track learning progress, as well as manage and share this knowledge with others. In addition to these student-focused results, lecturers responded positively to incorporating the prototype into their teaching. Lecturers see the opportunities for employing the new features to provide students with the guidance through their lifelong learning journey at the university.

Additional research in various fields needs to be conducted towards full support of lifelong learning in universities. This research provides a foundation for comprehensive technical support. It draws attention to the influence that technology has on teaching and learning, encourages cooperation between stakeholders, and shows the importance of listening to the learner's voice.

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Publications and Presentations

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Book chapter

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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

API – Application Programming Interface

CLI – Composite Learning Index

DSR – Design Science Research

ELLI – European Lifelong Learning Indicators

ER – Entity Relationship Diagram

GNU – a recursive acronym for “GNU’s Not Unix!”

HCI – Human-Computer Interaction

IT – Information Technology

LMS – Learning Management System

OECD – Organisation for Economic Co-operation and Development

PLE – Personal Learning Environment

QDAS – Qualitative Data Analysis Software

UNESCO – United Nations Educational, Scientific, and Cultural Organization

URI – Uniform Resource Identifier

VLE – Virtual Learning Environment

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Chapter 1

Introduction

Learning is not a product of schooling, but
the lifelong attempt to acquire it.

Albert Einstein

Simply defined by the European Commission (2000), lifelong learning represents all learning activities throughout lives of individuals aimed at improving their knowledge and skills. The concept of lifelong learning has become very popular over the last decade. The original concept 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 agenda, where citizens can be described as tools for economic development and their needs are firmly tied to the needs of industry (Carter, 2008, pp. 112-114). On the other hand, as stated by UNESCO, lifelong learning is a cultural policy which influences the nature of society and promotes positive change (Boshier, 2000, pp. 12-14). However, no matter which point of view is adopted, world economics, employment patterns and societies are changing with the increasing importance of lifelong learning (Jarvis, 2008; Simmons-McDonald, 2009). For full participation in education, workplace, and society, people today require well-developed lifelong learning skills, developed from the early stages of their lives (Ojala, 1997).

In addition to being a subject for political and economic discussion (Bagnall, 2009), lifelong learning has been established as a topic of interest in higher education, in particular universities (Knapper and Cropley, 2000). In attempt to provide support for lifelong learning, many universities are currently trying out various approaches. Among these are changing institutional policies, developing graduate profiles, and establishing cross-sector collaboration models.

Duke (2001) claims application of information technology to learning to be the major factor that put lifelong learning on the agenda of higher education. From the perspective of the technical solutions available today, the IT revolution brought the new means of accessing and delivering information for both teaching and learning purposes. Numerous systems and frameworks emerged aimed at supporting various learning activities.

As a result, the field of technology created for learning is currently over-saturated with such terms as learning management systems, course management systems, virtual learning environments, ePortfolio systems, personal learning environments, Web 2.0 technologies, and other terms. In relation to the context of this thesis, all of them provide some kind of support for learning, whether it is by facilitating assessment, as a tool for exchanging information, or in any other way. However, is supporting learning the same as supporting *lifelong* learning? Can the same tools be used to support both? Or is there a need for more comprehensive solutions?

In light of the importance of lifelong learning and focusing on the role of universities, this research project will try to answer these questions by exploring ways of addressing the need for lifelong learning support in universities.

1.1 Research Goal

The overall aim of this research is to suggest improvements to ePortfolio systems to offer university students a learner-centred e-learning environment that can provide them with support and facilitate their lifelong learning process. ePortfolios are learner focused and have the potential of supporting all types of learning, including the ones outside of scope of formal education. A review of this field will establish that the ePortfolio systems are already used in universities, sometimes in connection with learning management systems (LMS). This research explores whether these systems adequately meet the requirements of both students, lecturers and education providers (universities) as lifelong learning stakeholders.

1.2 Research Design

This research follows a well established methodology in the field of ICT Design Science Research (DSR). This methodology is well suited with the goal of this research. It is fundamentally a problem-solving approach (Cross, 1993) which does not require rigorous formal evaluation of effectiveness of the developed solutions. The importance

of this aspect will be shown and discussed later in this thesis. Going through the stages of identifying the problem, suggesting solutions, design and development, evaluation and conclusion (Peppers et al., 2008; Vaishnavi and Kuechler, 2008), this research project explores the various aspects of lifelong learning support in universities and creates a background for bringing a sound technology to students which addresses their needs in the first place.

This research is primarily qualitative due to the lack of previous research (as will be demonstrated in the course of this thesis) and the lifelong learning context of this project which by its nature is not suited to quantitative measures (Creswell, 2009). However, it also employs quantitative methods for the evaluation stage to improve the chances of getting a wide range of feedback and achieve a better understanding of the potential issues.

1.3 Scope and Limitations

Although technology is usually called a key driver of educational change (Attwell, 2007b), one can argue that in the context of lifelong learning this phenomenon 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 professional development 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 are outside of the scope of this research. However, state of the art literature and theories in the area are still comprehensively investigated.

1.4 Thesis Structure and Outline

The remainder of this thesis is structured as follows (Figure 1.1):

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

Chapter 3. This chapter focuses 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.

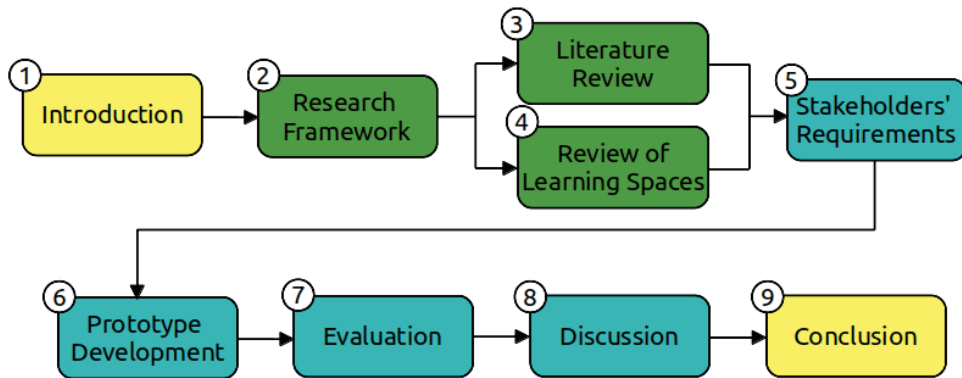


Figure 1.1: Thesis structure

Chapter 4. This chapter explores the technical worlds of learning support. System that are currently employed 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 development of a conceptual model of an environment that can provide support for lifelong learning.

Chapter 6. A prototype implementation (based on the requirements developed in Chapter 5) 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 with an attempt to analyse issues and question the outcomes. Technical considerations and practical applications of this research are presented.

Chapter 9. This chapter brings conclusions and contributions of the research presented in this thesis. It explores implications for theory and practice as well as the potential for future research.

This thesis also includes a number of appendices, namely:

Appendix A provides ethics documentation for the first stage of the requirements analysis.

Appendix B gives an overview of the documents used in the stakeholders interviews, such as questions used in the interviews and scenarios discussed with the participants.

Appendix C consists of the formal requirements specification used for development of the prototype features. This specification is developed in the form of user stories.

Appendix D includes interface screenshots of the prototype features.

Appendix E provides ethics documentation for the evaluation stage of this research project.

Appendix F overviews the documents used in evaluation Study Two (group experiment) which includes study protocol, background and exit questionnaire, participants' responses and the examples of their work.

Appendix G overviews the documents used in evaluation Study Three (case studies) which includes study protocol, background questionnaire, and interview questions.

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 by this study as the main methodology 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 and identify shortcomings.

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

- What e-tools are currently 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 the university context for 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: *How does this extended environment meet the needs of 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 lifelong learning 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 and appropriate 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). The multi-paradigmatic field of ICT offers a number of methodologies (e.g., theory building and testing, action research, interpretive research, grounded theory, etc.) drawn from the variety of research philosophies (Vaishnavi and Kuechler, 2008). This study follows Design Science Research methodology that has become well accepted 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, p. 4) define DSR as *a research activity that invents or builds new, innovative artifacts for solving problems or achieving improvements*. Unlike software development methodology that does not necessarily need any underlying theory, design science requires a theoretical foundation for research (Gero, 1999). 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 project 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).

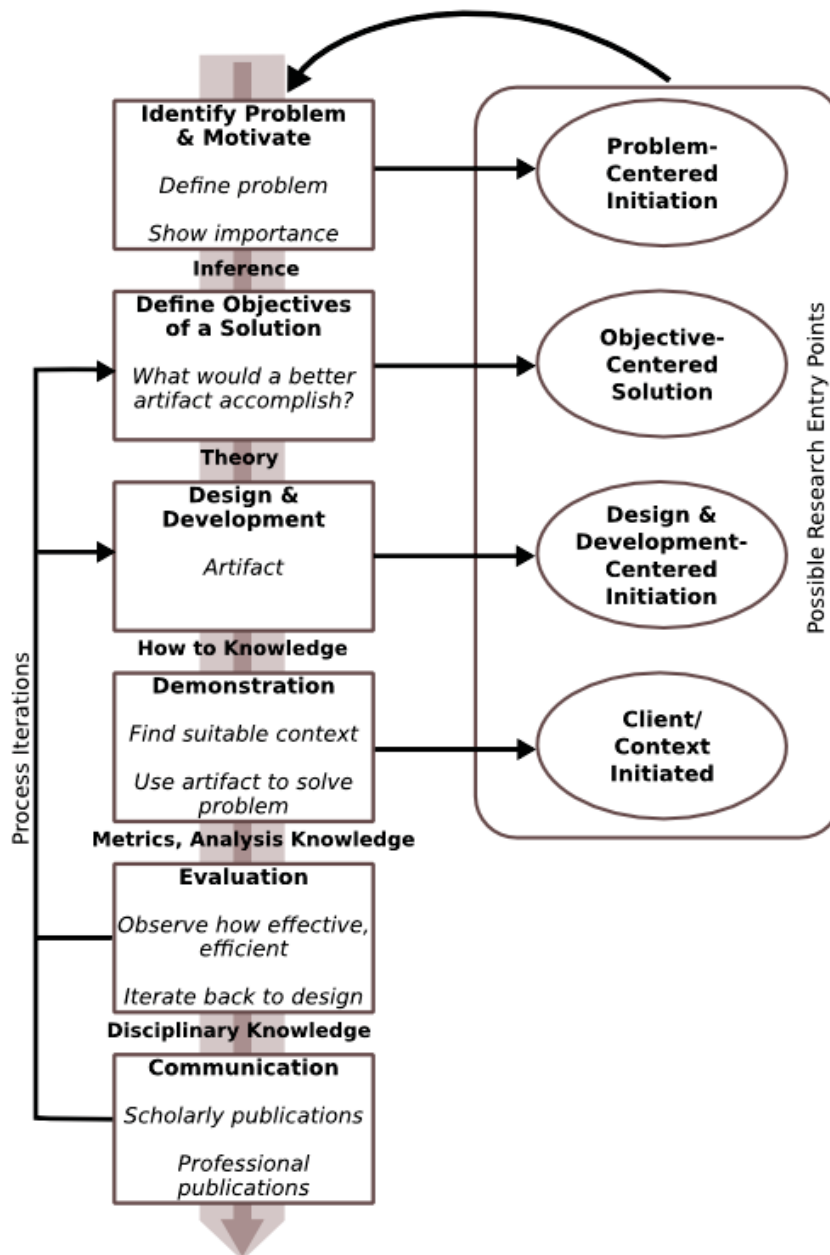


Figure 2.1: Design Science Research Methodology Process Model (Peffers et al., 2008)

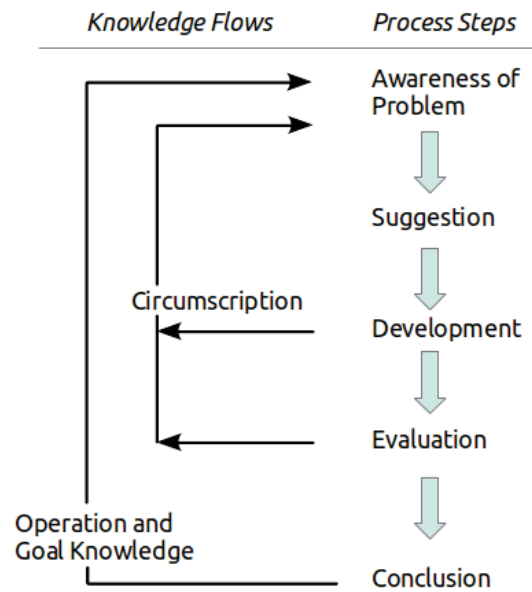


Figure 2.2: Design Science Research Cycle (Vaishnavi and Kuechler, 2008)

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, the 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 a more formal form of measurement of 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.

Described in Table 2.1 are seven guidelines identified by Hevner (2004) that should be followed by the beginning researches for effective DSR.

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

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 an effective solution to the problem
Guideline 7: Communication of Research	Research must be effectively communicated to relevant audiences

In contrast to Hevner, Venable (2010) argues that there is no common understanding of which 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.

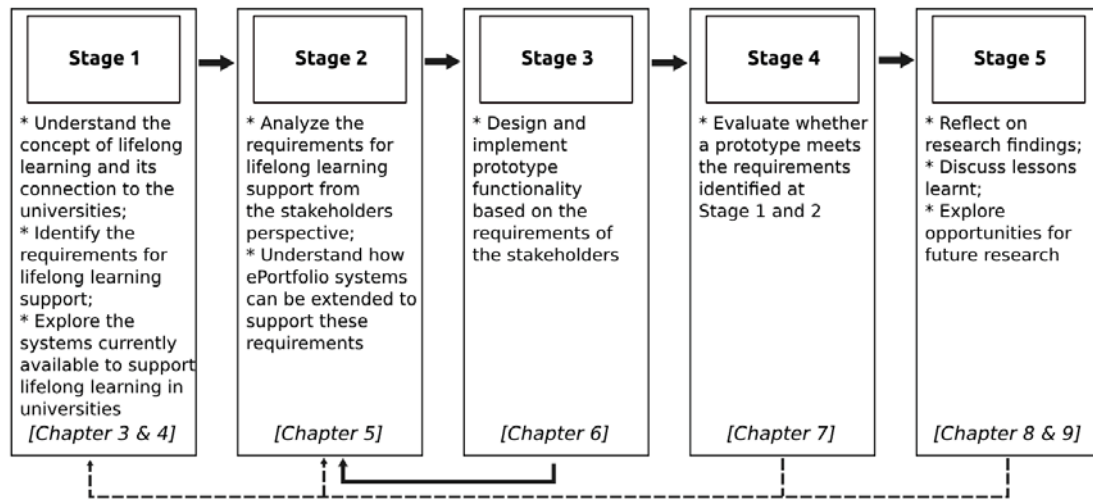


Figure 2.3: The research path

Figure 2.3 shows a research path of this project from the first to the last stage. It can be seen that at the later stages of the project it was necessary to look back and reflect on findings in order to understand whether the research objectives were met and what lessons were learnt. Other iterations in this project were between stages three and two where the prototype had to be taken back to the stakeholders for feedback. Although, according to Figures 2.1 and 2.2 the end of the evaluation can be considered another potential stage to iterate back, Peffers et al. (2008) says that the nature of the research project usually shows whether iterating back is feasible or not. In this case, due to the time and resources constraints, further improvements were left to the subsequent research projects.

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 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 asked 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 analysed. 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 a project of limited size and within a relatively short timeline, only high 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 omitted. 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 shown in Figure 2.4.

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. These iterations are shown on Figure 2.3.

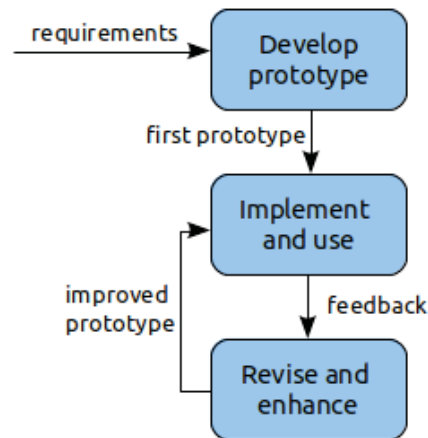


Figure 2.4: Prototyping based on Sommerville (2007, p. 411)

Mahara ePortfolio system¹ was used as a base system for the prototype. There is a number of reasons why this system was selected. Mahara is a widely-used in universities (and at Massey University in particular) and trusted 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

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 formal evaluation of the overall concept was still required.

It is not likely that a single evaluation technique can establish effectiveness and value of the prototype in a complex area of lifelong learning. In such cases it is recommended (Quinlan et al., 2008) that the evaluation design should incorporate a variety of methods, that taken together can provide reasonable evaluation outcomes.

Due to time and resource 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

¹<http://mahara.org> (Accessed April 16, 2012)

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.
- An experiment with various representatives of undergraduate students was undertaken to understand how added functionality can help them to address institutional graduate attributes and lifelong learning skills. Thirty five students with different levels of knowledge of lifelong learning skills and experience of using ePortfolio systems were involved in the experiment.
- Case studies were used to evaluate the 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). Participants with different study backgrounds 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 it was possible the results of the various stages of this research project were documented and submitted for publications and conference presentations. A full list of publications can be found in Publications and Presentations section of this thesis.

2.4 Methodological Limitations

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. In addition, the snowballing sampling technique was used to find suitable student participants which might have influences the outcomes of this stage.

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

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

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

2.5 Related Work

As lifelong learning concepts gained general acceptance, 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 All² (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 Learning³ (RIP-PLL)*: 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).

²<http://www.lkl.ac.uk/research/l4all.html> (Accessed April 16, 2012)

³<http://www.nottingham.ac.uk/ripp11> (Accessed April 16, 2012)

- *ELGG-Moodle*: In autumn 2006 Klagenfurt University, Austria was piloting the project that aimed to integrate 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, 2007b).
- *Accessible Lifelong Learning for Higher Education⁴ (EU4ALL)*: A project started in 2006 that 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 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.
- *An ePortfolio based Pedagogy for Small to Medium-sized Enterprises⁵ (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).
- *Australian ePortfolio Project, Stages 1 and 2 (AeP and AeP2)⁶*: This two-stage project funded by the Australian Learning and Teaching Council aimed at examining ePortfolio practice in Australian higher education. Among its main findings were publishing concept guides about ePortfolio practice (the AeP Toolkit⁷), establishing an ePortfolio community of practice across sectors of higher education and vocational training, and developing recommendations on how ePortfolio practice can enhance the quality of education (Hallam et al., 2008, 2009).
- *The e-portfolio implementation toolkit⁸*: A project that resulted in designing a toolkit to support the implementation of ePortfolios in higher education and work-based learning. It developed a framework for embedding e-portfolios in curriculum design and addressing the challenges of the introduction of technologies for learning. The toolkit was created based on the experiences of 12 UK, 4 Australian and 3 New Zealand institutions. This project is still going, and its toolkit is being launched during the period of March to October 2012.

⁴<http://www.eu4all-project.eu> (Accessed April 16, 2012)

⁵<http://www.wlv.ac.uk/ePPSME> (Accessed April 16, 2012)

⁶<http://www.eportfolioppractice.qut.edu.au> (Accessed April 16, 2012)

⁷<http://www.eportfolioppractice.qut.edu.au/information2/toolkit> (Accessed April 16, 2012)

⁸<https://epip.pbworks.com> (Accessed April 16, 2012)

Unlike this research, the majority of the above described projects focused either on collaboration between sectors (school – university or university – workplace) or were aimed at developing theoretical rather than practical solutions. As well, these projects were analysed with the intention of adopting a suitable evaluation design. However, an approach feasible for the research of this size and timeframe has not been found among the previous projects.

2.6 Summary

To address the objectives and research questions stated at the beginning 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 review undertaken to understand the concept of lifelong learning and the requirements for its efficient support. It will provide a background for the further theory development of this research.

Chapter 3

Literature Review – Lifelong Learning

In order to answer the first research question “*What is the concept of lifelong learning and its connection to the universities?*”, it is important to establish a full understanding of the main concepts used in this thesis. Doing so requires reference to areas outside of ICT field as underlying concepts can be found primarily in the domain of Education.

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 centre 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. 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”. These journals were selected to review the area in cross-sections, such as New Zealand – Europe and education – technology.

In addition, a keyword search was carried out on the Internet and academic resources (such as Education Research Complete¹, Academic Search Premier², Directory of Open Access Journals³, Journal Storage – JSTOR⁴, Google Scholar⁵) to cover conference publications not available in the library or through electronic library databases. 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, the literature review shows that little substantial work exists on combining these two areas.

¹<http://www.ebscohost.com/academic/education-research-complete> (Accessed April 16, 2012)

²<http://www.ebscohost.com/academic/academic-search-premier> (Accessed April 16, 2012)

³<http://www.doaj.org> (Accessed April 16, 2012)

⁴<http://www.jstor.org> (Accessed April 16, 2012)

⁵<http://scholar.google.com> (Accessed April 16, 2012)

As a continuous process, the literature review for this research was updated by actively acquiring and reading the relevant articles emerging in the literature throughout the duration of the thesis. To structure and facilitate the literature review process, these articles were organized into a literature database and managed by the Mendeley⁶ reference manager.

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

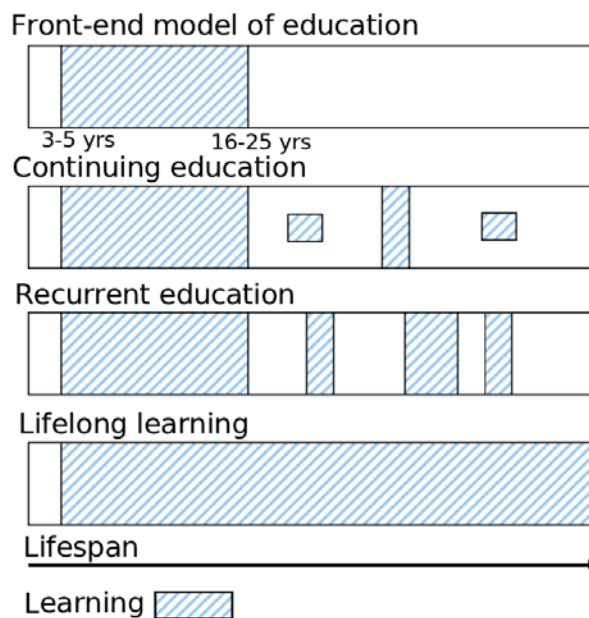


Figure 3.1: Changing concepts of learning (Jarvis, 2004)

⁶<http://www.mendeley.com> (Accessed April 16, 2012)

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.

The term *recurrent education* was widely used by OECD until the 1980s (Jarvis, 2004). Unlike intermittent continuing education, the idea of recurrent education was to allow 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 education discourse: it was too expensive and difficult to support this policy.

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

The initial term *lifelong learning* originates back in the early 20th century and is contributed to John Dewey (2004). From his perspective, lifelong learning had to be centred 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* first came to real prominence 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* is overly narrow as it 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 original idea of lifelong education was introduced, it re-emerged in the policy discourse under the term 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 they are responsible for this decision. 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 for both personal and public benefits (Chen, 2009).

However, a perspective drawn by Duke (2001) offers another, less optimistic interpretation of this change. Shift of focus from education itself to the learner brings up important and unresolved problems. If it is accepted that learning is "*essentially an individual and private matter*" (Duke, 2001, p. 508), then providing resources and public funding for education as well as the problem of inequitable access of individuals to this education become less important. Taking into account that not everyone has the same opportunities to participate in lifelong learning due to structural barriers depending on cultural capital, this shift appears to be a serious issue.

Following Duke's ideas, Aspin and Chapman (2001) note that lifelong learning is not only about needs of individuals. There is an element of public good embedded in the concept of promoting citizens who are lifelong learners and in this sense society at large benefits as well as the individual. To guarantee the welfare of everyone, society has an interest in providing opportunities and securing conditions for all of its members where they can perform their duties as citizens in a *participative democracy* (Aspin and Chapman, 2001).

Nevertheless, 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 restructured to support seamless connections and lifelong learning ideas, although there is no explicit policy in this area (Benseman, 2006).

In contrast, 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).

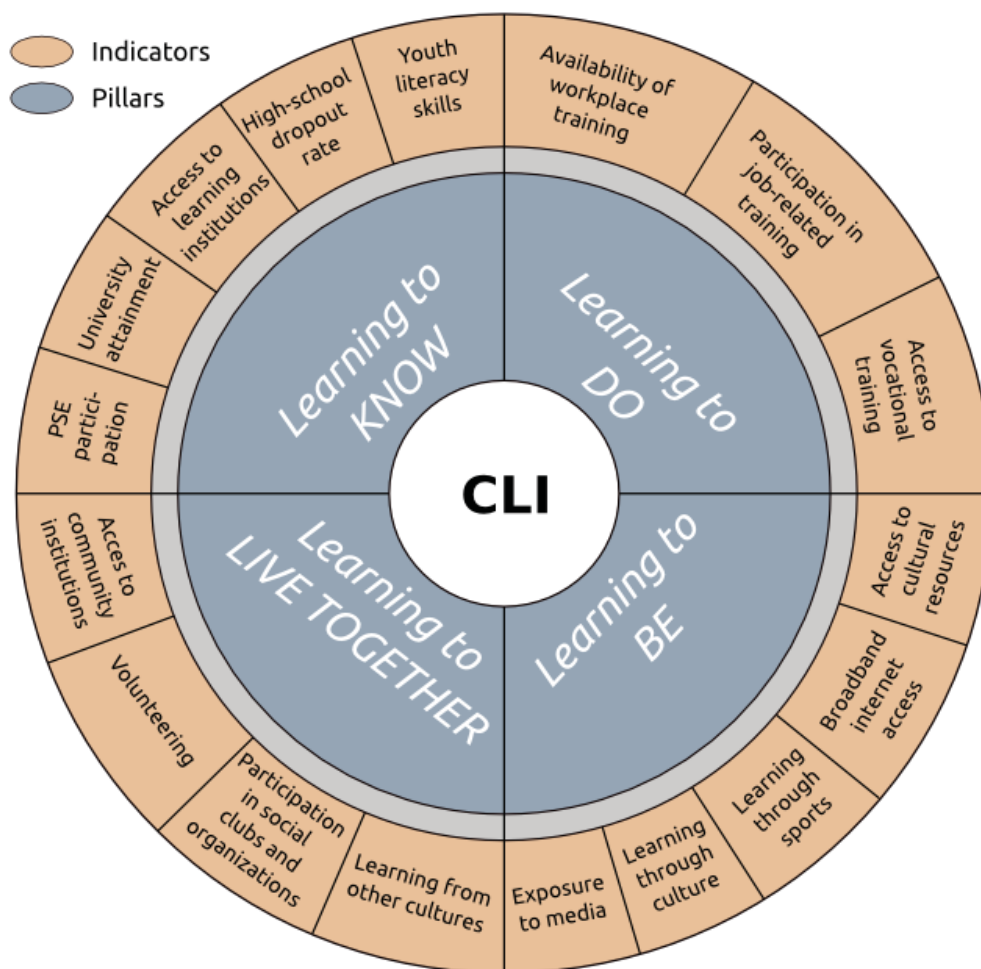


Figure 3.2: The 2010 Composite Learning Index of Canada (Canadian Council on Learning, 2011)

By 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). Both CLI and 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). However, their focus was on learning instead of the original emphasis on education.

3.2.3 Components and Attributes of Lifelong Learning

As shown on Figure 3.3, in terms of purposeful learning activities lifelong learning is sometimes split into 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.

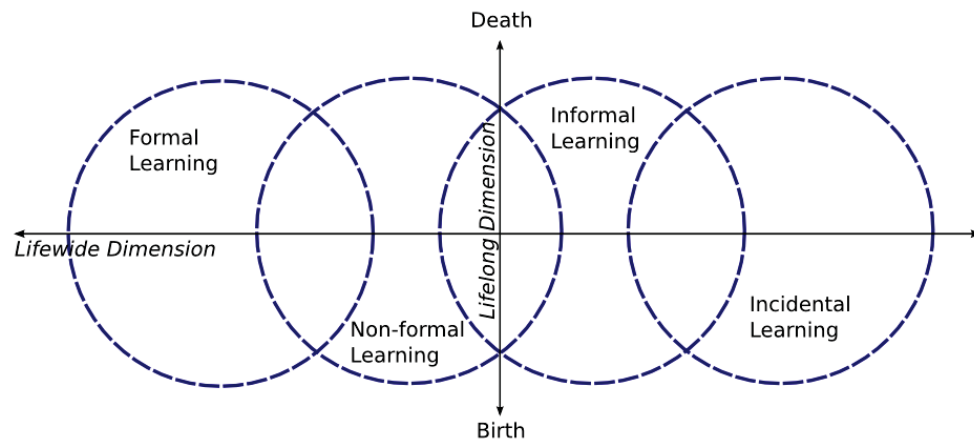


Figure 3.3: Framework for Lifelong Learning (based on Divjak et al., 2004, p. 11)

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 that formal and non-formal learning have practically nothing to do with each other.

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 and does not limit itself to education.

Other essential characteristics of lifelong learning identified by Weert and Kendall (2004) include, but are not limited to the following:

- 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, hence the concept of a portfolio has always been central to supporting lifelong learning.

These characteristics describe lifelong learning as flexible, social and personal at the same time. According to Weert and Kendall (2004), lifelong learning can also be called a demand-driven as the current economics develops the need for *education on demand* where learners decide the content of their education striving to get marketable and better developed skills.

Over recent years the skills that are central to supporting lifelong learning ability have been identified and expanded in more detail. Although not exclusive, 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, analysing and organizing information; planning and organizing activities; cultural awareness and understanding (Brooks and Everett, 2008; Heinrich et al., 2007; Ojala, 1997; Pitman and Broomhall, 2009).

Figure 3.4 summarizes all concepts mentioned in this section. The version of lifelong learning used throughout this thesis will be referred to as the one that is based on formal, non-formal, informal and incidental learning with long-term, life-wide and self-directed attributes. This lifelong learning is demand-driven, flexible and supports personal as well as social learning activities.

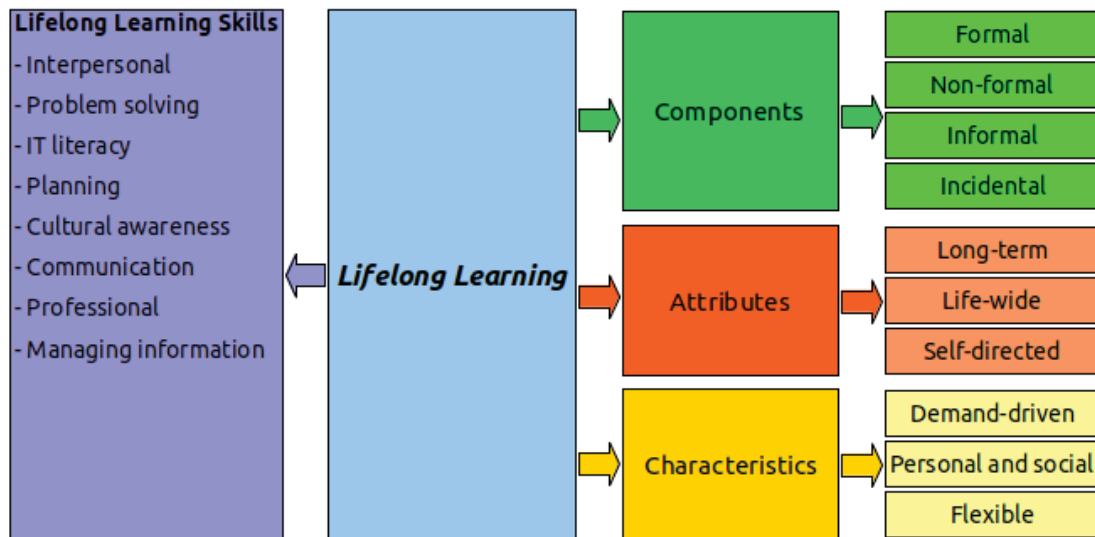


Figure 3.4: Lifelong Learning Dimensions

Hereinafter, any further reference to lifelong learning will be made in terms of these concepts.

3.3 Lifelong Learning in Universities⁷

This section now turns attention to the concept of lifelong learning as it relates to universities. Lifelong learning, including such attributes as *life-long*, *self-directed* and

⁷This 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 and Presentations section.

life-wide learning, has significant implications for universities. 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 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 (2007b) 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). Recent research (Simmons-McDonald, 2009) shows that lifelong learning becomes an important factor that influences employability. Individuals today need to continue to update and upgrade their skills and knowledge even after completing formal education in order to survive and thrive in today's changing world. Ojala (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). Graduate attributes generally represent the core learning outcomes, skills and qualities that students should develop during their university education (Hughes and Barrie, 2010). Australian universities, such as Curtin University, have made policy declarations committing to graduate attributes across their programmes (Curtin University, 2006). Among the latest developments, to explore the role of graduate attributes in higher education, the Higher Education Research and Development Society of Australasia (HERDSA⁸) is organizing an annual series of symposia with a different graduate attribute as the core

⁸<http://www.herdsa.org.nz> (Accessed April 16, 2012)

of each symposium (HERDSA, 2012).

The College of Sciences at 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 programmes (Davies and LeMahieu, 2003; McAlister and Alexander, 2003). The accreditation criteria for engineering degrees now refer to and demand soft skills that are the skills essential for lifelong learning (Aller et al., 2005; Guest, 2006; 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; Herson, 2006).

In order to enact policy, academics need to incorporate development opportunities for these skills into their teaching and learning designs. Arguably, 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.

A possible explanation of this problem 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 to promote constructive alignment (Hughes and Barrie, 2010; Biggs and Tang, 2007). One consequence of the lack of alignment between courses and graduate profiles is that students are not presented with a coherent picture across their courses and that it is difficult to see the connections between single courses.

Some academics may lack awareness, knowledge and support to fully incorporate the development of lifelong learning skills into their teaching. Arguably, 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 key point is that 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, many of these systems are overly 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 within university settings. While no explicit set of requirements has been found, the literature identifies a number of guidelines that have to be satisfied in order to achieve successful lifelong learning support in universities. These guidelines and recommendations can be summarized as following:

- G1** Universities should provide support for all aspects of lifelong learning (formal, informal, non-formal, incidental) (Attwell, 2007b; Smidt and Surssock, 2011);
- G2** Students need guidance on various levels of academic development and learning (Leone, 2010);
- G3** Lecturers should be an active facilitators and promote involving learning experiences (Leone, 2010);
- G4** Learning materials should be organized in the way that would help students learn how they learn (Medel-Añonuevo et al., 2001);
- G5** Communication and collaboration are essential parts of learning process (Schaffert and Hilzensauer, 2008);
- G6** Learning progress should be recorded from various sources and maintained over a long period of time (Kay, 2008);
- G7** Students need to be aware of their personal achievements (Schuetze and Casey, 2006);
- G8** 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);
- G9** 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. However, already at this point a distinction can be made between the technology that can potentially be used for supporting lifelong learning and the technology aimed at supporting education alone. Technology for education is generally oriented on the needs

of institutions and does not provide equal support for learners. From the perspective of lifelong learning, technology should aim at the needs of an individual and be conducive to the principles of and characteristics of flexible, life-wide, and self-directed learning.

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 societies (Jarvis, 2008; Simmons-McDonald, 2009; International Labour Office, 2008); 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 many 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 virtual learning spaces that are currently used in universities and outside of educational sector to support various learning activities. Characteristics as well as strength and weaknesses of the existing systems in supporting lifelong learning in universities will be discussed. 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, specifically technical support. It reviews the area of technology and systems available for supporting various aspects of learning, and examines how availability of a suitable virtual learning environment may provide the lifelong learning support required by students in universities.

There are several terms that need to be clarified when discussing virtual systems, spaces or environments. In this chapter, in order to have a common understanding of these terms, they will have the following meaning unless specified otherwise:

Open systems: the systems which provide users with open access and allow them to contribute, manage, organize, edit, use, re-use, mashup, create or alter content of the system (Fay, 2009). Such systems might even allow to make changes to the actual programming code of the system. Examples of the open systems might include Wordpress, Blogger, MediaWiki, Unix, or to some extent Facebook and YouTube.

Closed systems: the systems which allow users to use content as is, with minimal modification to the actual system or program (Fay, 2009). Such systems are usually proprietary or have a proprietary format of content. Access to the closed systems is can be restricted. Examples of closed systems might include electronic library catalogues, online banking systems, or conference proceedings database.

The virtual learning spaces of universities are dominated by Learning Management Systems (LMS) supporting course-related work. LMS have been started as and still 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 LMS and then contrasts them with the Web 2.0 virtual social spaces. Finally, it introduces an ePortfolio and ePortfolio systems as a potential solution that can help to close the gap that exists between the institutional and personal learning environments. ePortfolio characteristics as well as the strengths and weaknesses of selected ePortfolio systems are reviewed. A possible way of mapping of the features these systems provide against the lifelong learning guidelines is discussed. 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). Since then, 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 Moodle¹ or Sakai², 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

¹<http://moodle.org/sites> (Accessed April 16, 2012)

²<http://sakaiproject.org/community-home> (Accessed April 16, 2012)

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). It provides users with access to teaching and learning materials, such as lecture slides or exercises. A virtual space within the LMS is shared by staff and students of a particular course. This space forms a platform for course discussions and facilitates 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 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.

Looking at all described above characteristics of the LMS, it becomes obvious that this kind of system cannot provide required level of support for lifelong learning. One of the reasons for this is that being managed and controlled by the university, the LMS can only be used for formal education (Venable, 2011). As a result, non-formal, informal and incidental types of learning stay outside of institutional focus which also means that *life-wide* attribute of lifelong learning is not supported. Another reason is that in the majority of the LMS, access stops when a course finishes. This means that the LMS cannot provide support for learning that goes outside of the time-span of the university study and therefore cannot support *life-long* attribute of learning. The last reason lies in the *self-directed* attribute of lifelong learning. As was described earlier, LMS has a strict hierarchy of user access rights as well as control over content, tool-set and involvement of the learners. Such conditions are less likely to encourage users to

take charge of their learning, but rather to follow the predefined structure of their study curriculum.

In addition to the above arguments, LMS create further limitations from the perspective of work-based learning. In this context, assessors and mentors are not easily provided with robust access to an LMS environment as it is designed for enrolled students and staff members, rather than ‘outsiders’.

Due to all these reasons, the answer to lifelong learning support problem has to be sought outside of the domain of controlled institutional environments, like LMS.

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, text messages, 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.

Although there is no official classification of Web 2.0 resources, they can be categorised as shown in Figure 4.1 by grouping these resources according to their primary purpose. While this classification is not very important for the context of this thesis, the figure illustrates the large variety of Web 2.0 resources available online. Particularly this figure captures only 62 Web 2.0 companies and applications considered to be prominent by Dawson (2007). The actual number of such resources is much bigger. For example, the largest Web 2.0 directory, Go2Web20³, accounts for more than 3000 active resources and services, and this number grows every day showing the high popularity of Web 2.0 tools.

Based on statistics and publications on the Internet (as can be found by searching for the keywords *Internet statistics*, *Web 2.0 statistics*, and *Web 2.0 resources popularity*⁴), the most popular Web 2.0 tools, services and resources are the ones that allow:

³<http://www.go2web20.net> (Accessed April 16, 2012)

⁴As of February 2012



Figure 4.1: Web 2.0 Landscape (Dawson, 2007)

- Create and publish information (e.g. blogs)
- Collaborate with others (e.g. wikis)
- Network and build community (e.g. forums, social networking sites)
- Share personal stories with the world (e.g. podcasts)

These Web 2.0 tools promote a *culture of participation* (Shelly and Frydenberg, 2011) which might explain their attractiveness to the users. For example, wikis encourage users to collaborate on creating, organizing, and publishing information while discussing content and sharing knowledge. Whereas wikis have become a popular tool for collaboration, blogs have been primarily used by the individuals for various purposes. Blogs give the users an opportunity for self-expression and sharing experience as well as promoting their businesses or professional expertise. Another widely used way of sharing personal stories with the world is podcasts. Such popular resources as YouTube and iTunes allow users to upload and broadcast media files, both audio and video. Social networking sites (e.g. Facebook, Google+, LinkedIn, MySpace) are aimed to connect people who have common interests and goals. They give a high level of interaction between users, a sense of community, and shared emotional connection (Zhan, 2010). A notion of public opinion is present through the commenting feature which the majority of the above mentioned Web 2.0 tools have. In comments users can give feedback,

discuss ideas, and share their view of the topics of interest.

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 votes (Capell, 2006); business models are changing, trying to adopt Web 2.0 characteristics (Wirtz et al., 2010); communication with customers is 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 Flanagan, 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); the tourism 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; Hosein et al., 2010; Jones, 2010).

4.3 Gap Between Learning Environments

Students in universities have access to both environments, the institutionally controlled LMS and the participatory managed Web 2.0 resources and services. On the whole, 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 at universities, as 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 facilitate the development of lifelong learning skills. This space has to be integrated into university environment 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 a space needs to put students in charge of their learning and offer them privacy for exploration,

while still allowing 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 a university's learning environment that has the 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)⁵ (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 was already mentioned, an important distinction can be made along the lines of the portfolio's purposes, 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,

⁵<http://www.educause.edu> (Accessed April 16, 2012)

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 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 a 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 (Lorenzo and Ittelson, 2005).

Portfolios are often linked to assessment. The 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 (IPENZ, 2007; Sullivan et al., 2004; Boyatzis, 2008). 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.

Despite these variations, there are several key processes included in most if not all portfolio work (Malloff, 2010; Heinrich and Bozhko, 2012), as 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;

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

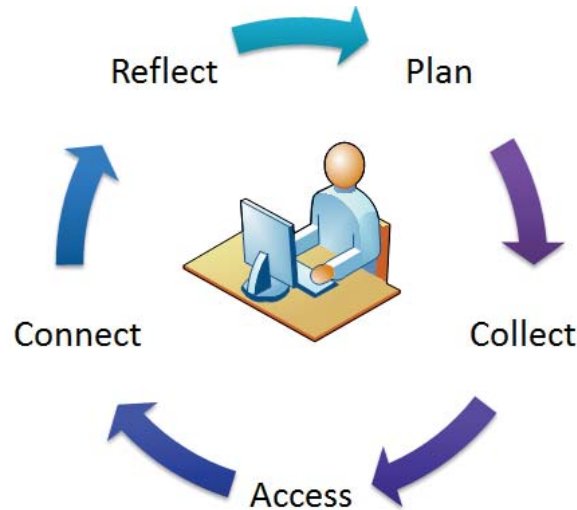


Figure 4.2: ePortfolio key processes

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).

Using the specialized ePortfolio systems has its benefits over the non-specialized approach. One of the benefits is that the specialized systems have clearly defined centralized access control to the resources. For example, when a user who is employing a wide range of different Web tools for ePortfolio work wants to share their ePortfolio with others, they need to make sure that all the artifacts in this portfolio have the same access level and the reviewers will not come across the “access denied” items. In addition to centralized access control, the specialized ePortfolio systems have a centralized repository which makes selecting, aggregating and showcasing examples and artifacts easier and less time consuming. For evaluation and feedback purposes, the specialized approach is better for managing shared resources where the artifacts have potentially to be locked so that changes cannot be made during the assessment time. From the

technical support perspective, the specialized systems are easier to maintain and ensure that all users have the same high quality of services. For all these reasons, this thesis is going to focus on systems specialised for portfolio work.

ePortfolio systems are centred 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. Unlike in the LMS, 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 and 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 or removed from public access at any time. 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 above mentioned features looked at separately can be found in other computer systems or Web 2.0 tools. For example, blogs can be used for reflection, computers' hard drives with all their disk and folder structure can be suitable for a portfolio repository, email can serve as sharing and giving feedback method, etc. However, the combination of these features within one system is what makes ePortfolio systems so valuable.

4.4.2 ePortfolio Systems Overview⁶

As was shown in the previous section, mature ePortfolio systems should provide a wide range of functionality. This section presents a review of the features and functionality of various ePortfolio systems that are currently in use around the world. 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. When demonstration web sites were not available, the systems were reviewed by analysing user or administrator documentation, video demonstrations, attending

⁶The ePortfolio systems in this section will appear in alphabetical order.

demonstration seminars, and external reviews. If not specified otherwise, any material in the systems overview can be referred back to the developer's official web site.

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 can provide comprehensive support for lifelong learning.

4.4.2.1 BlackBoard ePortfolio

In 2006, a popular LMS provider BlackBoard⁷ 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 cannot 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 the LMS. Without activation of various features, the repository might be restricted to text and hyper-links 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 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 the 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 the tools (Clark and Neumann, 2009). In addition, portfolios can be linked to learning objectives defined by lecturers, administrators or learners themselves.

⁷<http://www.blackboard.com> (Accessed April 16, 2012)

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 the form of comments (Figure 4.3). 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.

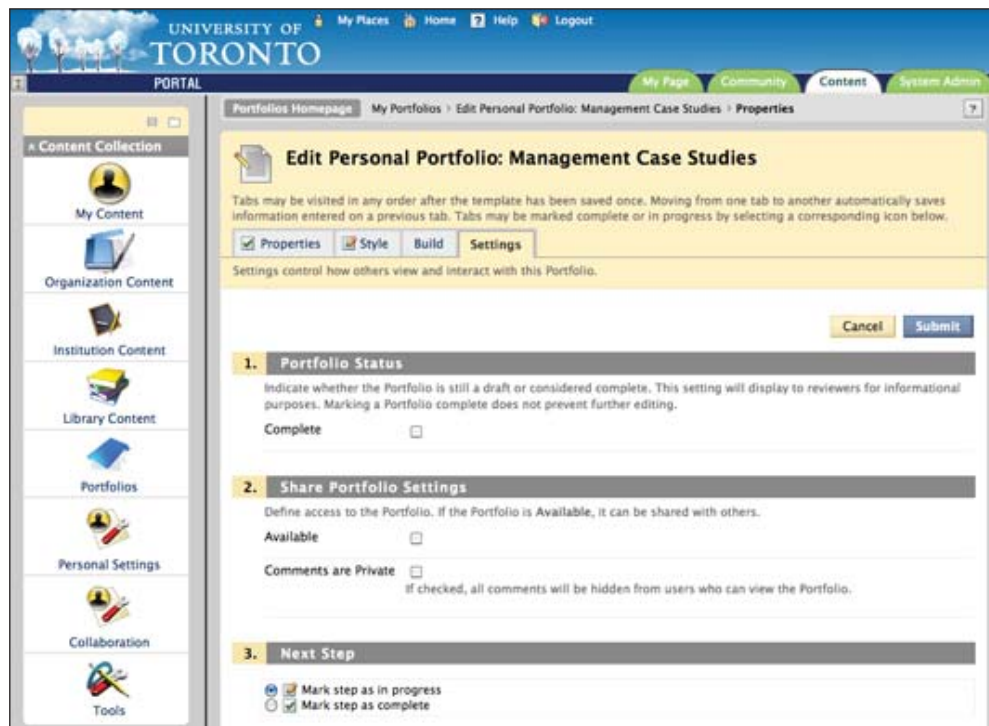


Figure 4.3: BlackBoard ePortfolio example (University of Toronto, 2010)

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 per institution 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.

4.4.2.2 Desire2Learn

Desire2Learn⁸ 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 (AAEEL, 2011a).

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

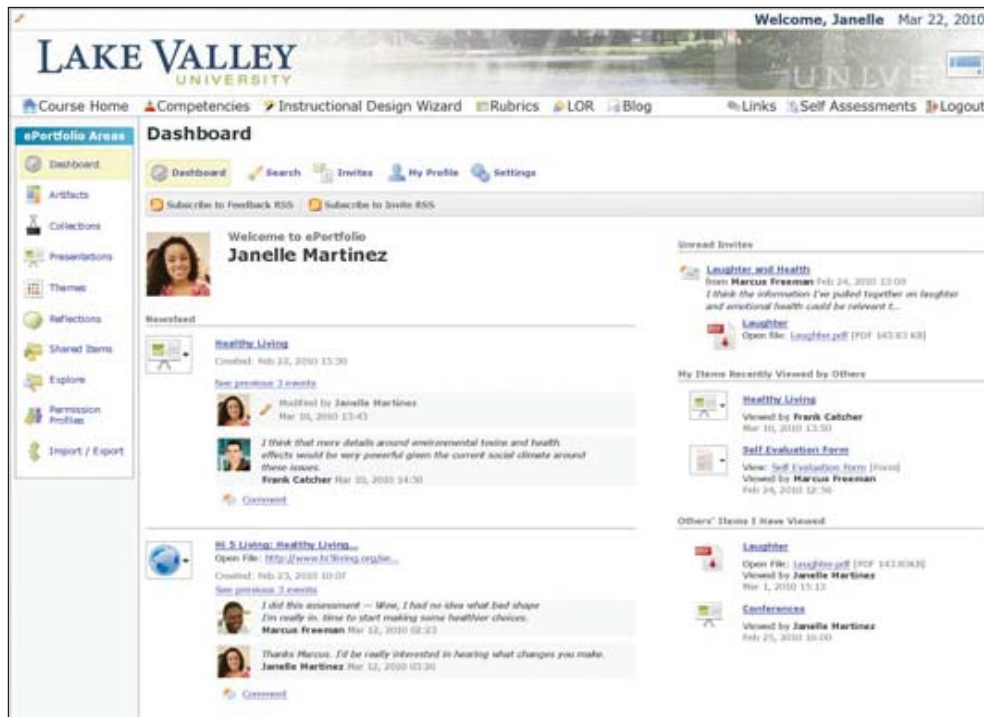


Figure 4.4: Desire2Learn ePortfolio example (Desire2Learn Incorporated, 2011)

There is a standard range of functionalities associated with artifacts in this ePortfolio system: they can be grouped, shared with others, commented on, assessed directly or submitted as an assignment (Figure 4.4). 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

⁸<http://www.desire2learn.com> (Accessed April 16, 2012)

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 the import of 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.

4.4.2.3 eFolio

The eFolio⁹ 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 eFolioMinnesota¹⁰ (over 60,000 active users) and eFolioWorld¹¹ (over 34,000 active users) (AAEEBL, 2011b). Although eFolio is a hosted service, it is still possible to get self-hosted solutions for very large implementations.

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

⁹<http://www.avenetefolio.com> (Accessed April 16, 2012)

¹⁰<http://www.efoliominnesota.com> (Accessed April 16, 2012)

¹¹<http://www.efolioworld.com> (Accessed April 16, 2012)

comes with a number of build-in display and style formats (Figure 4.5). However, according to the comments (AAEEBL, 2011b), the system does not provide as much page layout flexibility as some users would expect.

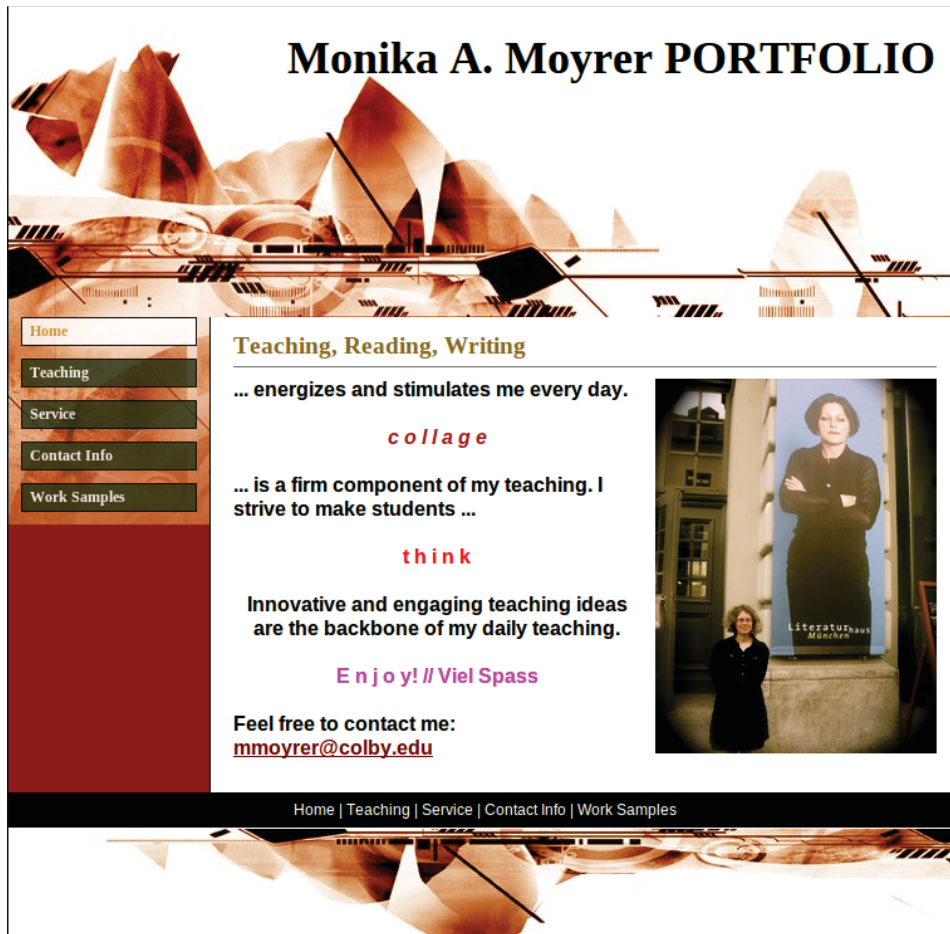


Figure 4.5: eFolio system example (EFolioMinnesota, 2011)

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 Content groups items by data types such as artifacts, courses taken, goals, images, URLs, employment, etc. As well, users can add or create the items on the 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. Under-age user sites are always private by default and cannot be made public. Alternatively, 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 (AAEEBL, 2011b) 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).

4.4.2.4 ELGG

ELGG¹² is an open source social networking and social publishing platform started in 2004 and released under the GNU General Public License v2¹³. 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*.

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.

Most the end-user functionality comes from plugins which can be loaded into the 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.

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.

In ELGG, each account has a profile page which links to all available artifacts created

¹²<http://elgg.org> (Accessed April 16, 2012)

¹³<http://www.gnu.org/licenses/gpl-2.0.html> (Accessed April 16, 2012)

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 (Figure 4.6) is as well the main option for showcasing as users cannot have multiple ePortfolios.

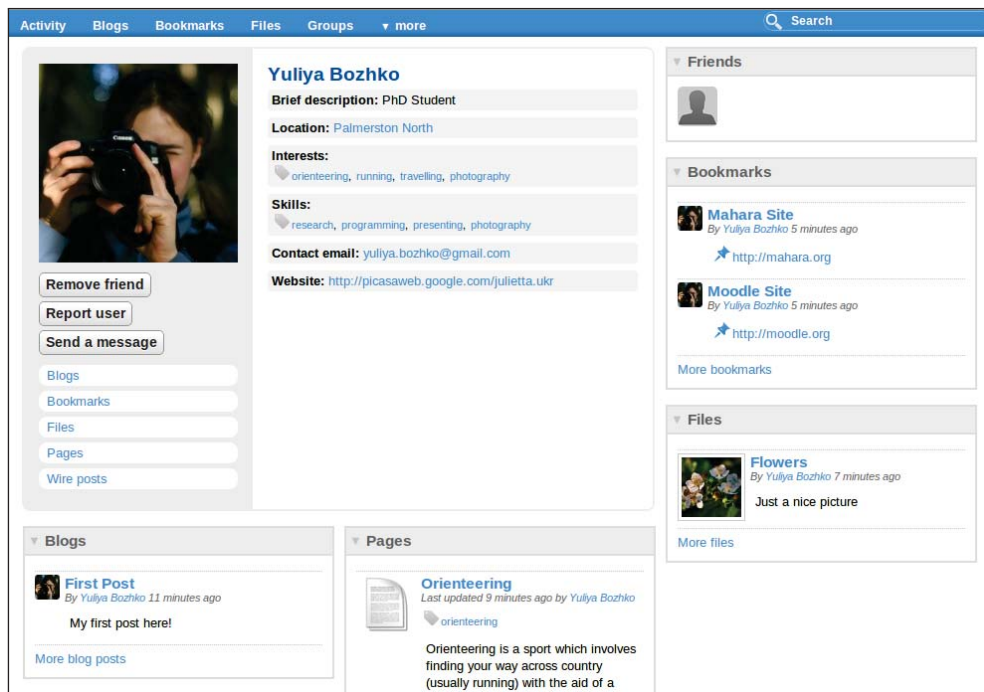


Figure 4.6: ELGG 1.8 example

Similarly to some other ePortfolio systems, 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 downloads, 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.

4.4.2.5 Mahara

Mahara¹⁴ is an open source ePortfolio system started by a group of education academics at Massey University in 2006 funded by the New Zealand Tertiary Education

¹⁴<http://mahara.org> (Accessed April 16, 2012)

Commission (Brown et al., 2007). The system is a standalone application and does not require any kind of LMS or other system installed. Its modular and extensible architecture 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 an internal résumé builder which allows users to create their digital CV with various information options. Sharing is done through pages which are called *views* (Figure 4.7). 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.

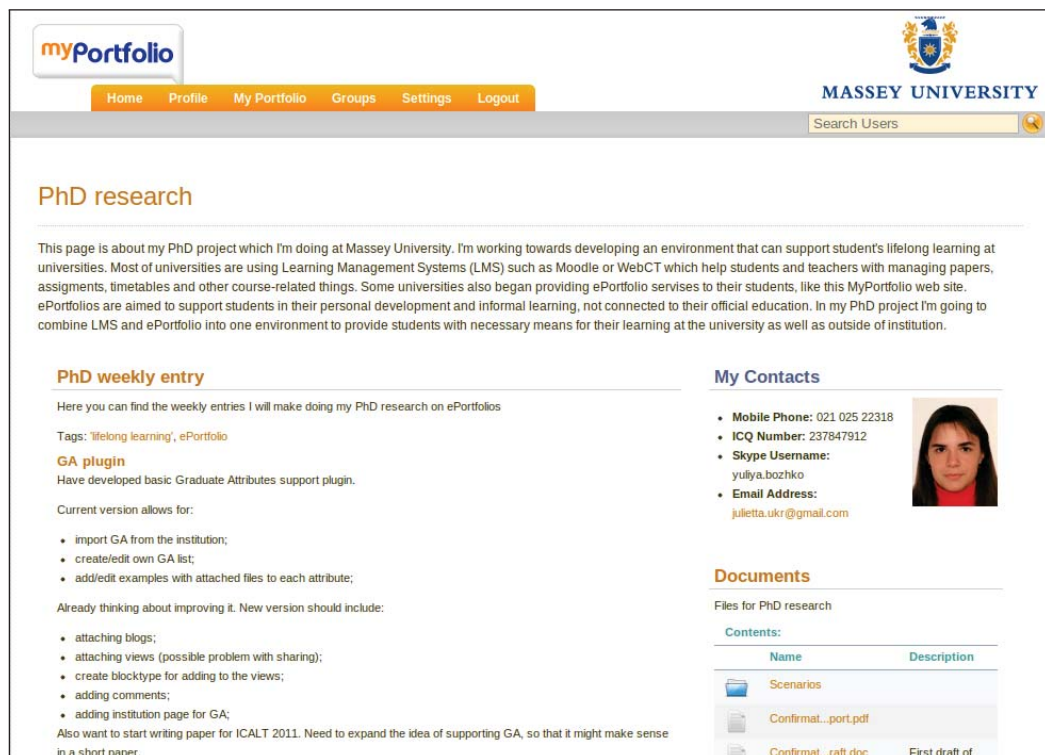


Figure 4.7: Mahara ePortfolio 1.3 example

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.

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 (Mahara Governance Group, 2011) which allows the import of portfolio content to Mahara and export to another ePortfolio system, provided that this interoperability standard is implemented on 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.

4.4.2.6 PebblePad

PebblePad¹⁵ 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, 2010b). 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 such projects as ePistle¹⁶ and File-Pass¹⁷.

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, Flash-based applications require a plugin which in turn might cause many standard browser features not to 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 that support the sight impaired cannot read them which results in poor accessibility.

¹⁵<http://www.pebblepad.co.uk>

¹⁶<http://jisc.ac.uk/whatwedo/programmes/edistributed/epistle> (Accessed April 16, 2012)

¹⁷<http://jisc.ac.uk/whatwedo/programmes/edistributed/filepass> (Accessed April 16, 2012)

PebblePad has a customizable user interface (Figure 4.8) 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.

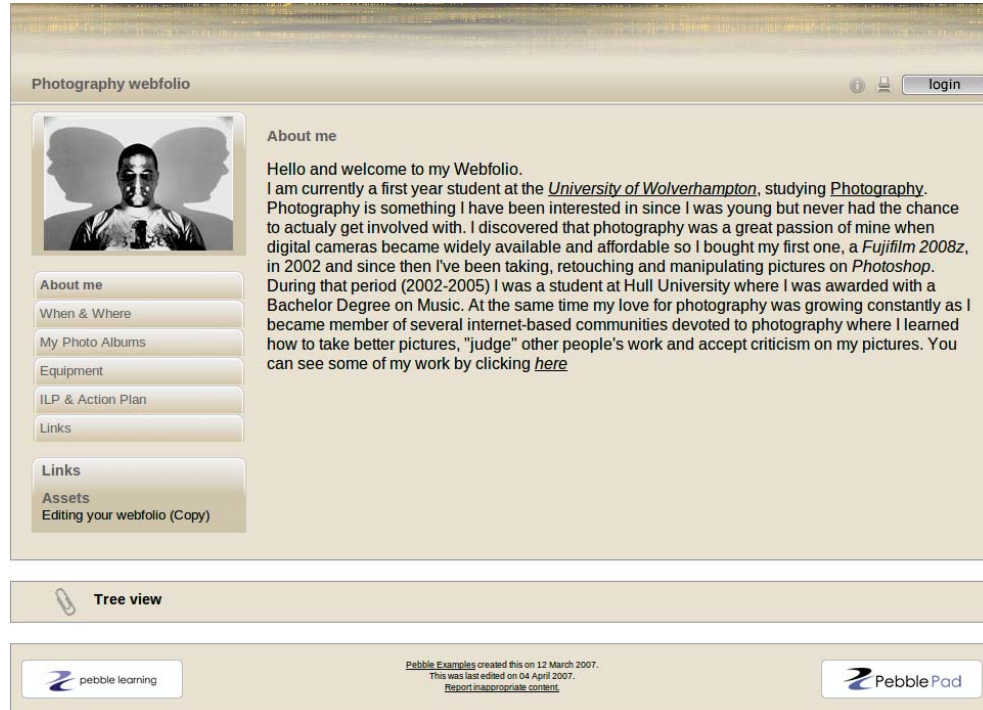


Figure 4.8: PebblePad ePortfolio system example (Pebble Learning Ltd, 2011)

Items stored in the PebblePad repository are called assets. There are thirteen asset types that are subdivided into three core types, namely: 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 the 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.

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 hyper-links 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 sign-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 the vendor's website, as at the middle of 2011, the price of PebblePad adoption ranged from 14,95GBP per year for individual accounts hosted by the company to 1GBP per user per year 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.

4.4.2.7 Discussion

The overview of the ePortfolio systems showed that they have relatively standard set of features. All systems provide support for the key ePortfolio processes of collecting, selecting, reflecting, planning and connecting as described in Section 4.4.1. Collecting is usually done through gathering various files and creating records in the systems. After information capturing is finished, user can sort artifacts selecting the ones that can be used for intended purpose. Reflection in the majority of the ePortfolio systems is supported through personal blogs. Some systems (eFolio, PebblePad) also provide reflection options linked directly to the individual artifacts. Planning is implemented in the form of personal learning objectives or learning plans, although not all ePortfolio systems have this feature. Connecting of artifacts is largely achieved through web pages or other internal aggregation methods. All reviewed ePortfolio systems allow meaningful collections of artifacts to be shared for feedback and assessment purposes.

Apart from common functionality, some of the ePortfolio systems have unique features not present in the majority of other systems. Among these are:

- Creating audio recordings within the ePortfolio environment (Desire2Learn)
- Individual items can have multiple reflections (eFolio)
- Social networking features (e.g., friends lists, message board, etc.) (ELGG, Mahara)
- Threaded topics for reflection (BlackBoard ePortfolio)
- Initial set-up wizard (BlackBoard ePortfolio, eFolio)
- Pluggable interface (ELGG, Mahara)
- Sharing of individual artifacts (eFolio, PebblePad)

Reviewing the ePortfolio systems from the lifelong learning perspective requires looking further than the key ePortfolio processes and activities. Suitability and ability

Table 4.1: Mapping ePortfolio systems' features against lifelong learning guidelines

	BlackBoard ePortfolio	Desire2Learn	eFolio	ELGG	Mahara	PebblePad
G1	Combination of ePortfolio and LMS supports all types of learning	Combination of ePortfolio and LMS supports all types of learning	Potential integration with Moodle LMS can cover support for all types of learning (<i>No reliable information found</i>)	Potential single sign-on with Moodle LMS can cover support for all types of learning (<i>No reliable information found</i>)	Integration with Moodle LMS covers support for all types of learning	Integration with Moodle LMS covers support for all types of learning
G2	<ul style="list-style-type: none"> Initial guidance through ePortfolio set-up wizard; Guidance through course goals and objectives; Feedback in form of comments on web pages 	<ul style="list-style-type: none"> Feedback on various types of artifacts; Guidance through pre-define competences in LMS; Templates can be used as guidance 	<ul style="list-style-type: none"> Feedback on various types of artifacts; “Getting started” Wizard for initial set-up 	<ul style="list-style-type: none"> Feedback on web pages and individual artifacts Templates of web pages can be used as guidance 	<ul style="list-style-type: none"> Feedback on web pages and artifacts on web pages; Templates of web pages can be used as guidance 	<ul style="list-style-type: none"> Feedback on assets can be provided as guidance for students
G3	<ul style="list-style-type: none"> Lecturers can define learning objectives; Lecturers can provide feedback on shared resources 	<ul style="list-style-type: none"> Lecturers can define competences in LMS; Lecturers can provide feedback and evaluate; Lecturers can create templates for evaluations 	<ul style="list-style-type: none"> Lecturers can provide feedback on shared resources; Lecturers can create templates to map competences 	<ul style="list-style-type: none"> Lecturers can set up questionnaires; Lecturers can provide feedback 	<ul style="list-style-type: none"> Lecturers can provide feedback on shared resources; Lecturer can create templates of web pages 	<ul style="list-style-type: none"> Lecturers can provide feedback on shared assets
G4	<i>No information found</i>	<i>No information found</i>	<i>No information found</i>	<i>No information found</i>	<i>No information found</i>	<i>No information found</i>
G5	<ul style="list-style-type: none"> Collaboration through sharing; Enhanced communication through LMS features 	<ul style="list-style-type: none"> Collaboration through sharing; Enhanced communication through LMS features 	<ul style="list-style-type: none"> Integrated communication tools 	<ul style="list-style-type: none"> Groups are used for collaboration; Communication is in the form of comments, message board and internal message system 	<ul style="list-style-type: none"> Groups are used for collaboration; Communication is in the form of comments, wall messages and internal message system 	<ul style="list-style-type: none"> Collaborative work with assets; Communication is in the form of comments; Assets re-sharing
G6	Data and grades export from LMS to ePortfolio	Data and grades export from LMS to ePortfolio	<i>No information found</i>	<i>No data integration with external sources or LMS</i>	Data export from LMS to ePortfolio	Data export from LMS to ePortfolio
G7	<ul style="list-style-type: none"> Users can define learning objectives; Users can associate artifacts with learning objectives 	<ul style="list-style-type: none"> Achievements can be recorded in form of presentations; Users can set up personalized learning plans 	<ul style="list-style-type: none"> Mapping of specific competencies and learning outcomes into individual portfolios 	<ul style="list-style-type: none"> No specialized way or recording achievements. Blogs and pages can be used for this purpose 	<ul style="list-style-type: none"> Achievements are described as a part of user profile; Users can create goals in form of plans 	<ul style="list-style-type: none"> Achievements can be recorded through the assets “achievements” and “experiences”
G8	<ul style="list-style-type: none"> Addressing high-order skills through defined by lecturers learning objectives / course goals 	<ul style="list-style-type: none"> Addressing high-order skills through assessment rubrics or integration with LMS 	<ul style="list-style-type: none"> Addressing high-order skills is done in form of web pages or tied to institutional rubrics 	<ul style="list-style-type: none"> Addressing high-order skills is done in form of web pages 	<ul style="list-style-type: none"> Addressing high-order skills is done in form of web pages 	<ul style="list-style-type: none"> Addressing high-order skills can be done in form of web pages or assets
G9	<ul style="list-style-type: none"> Reflections are in form of blogs and threaded topics 	<ul style="list-style-type: none"> Forms can be used for self-evaluation; Reflections are a separate form of artifacts 	<ul style="list-style-type: none"> Reflection in the form of blogs 	<ul style="list-style-type: none"> Reflection in the form of blogs 	<ul style="list-style-type: none"> Reflection in the form of blogs 	<ul style="list-style-type: none"> Reflection through wizard when creating assets; Reflection in the form of blogs

of the systems to provide support for lifelong learning should be evaluated against the guidelines and recommendations discovered in the literature (Section 3.4). Table 4.1 shows possible mapping of these recommendations to the features of the reviewed ePortfolio systems.

Exploration of these features from the lifelong learning perspective showed that not all guidelines are followed or supported by the ePortfolio systems. Particularly, no information was found on the ePortfolio systems helping students to understand how they learn and develop their skills through better organized learning materials. However, while rigorous analysis has been attempted, a number of reasons have hindered this analysis and suggest caution when looking at the findings. Firstly, in some cases no reliable information was found to make unambiguous conclusion. Secondly, the majority of proprietary systems were reviewed relying on the sources of information other than first-hand experience of the researcher which might have influence their trustworthiness. Finally, the guidelines provided in the literature were not formal requirements and therefore their assessment was largely done using analogical reasoning. Due to these issues, a further exploration of the ePortfolio systems from the lifelong learning perspective is required, and the next section provides additional reasons for this.

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 identified 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.

The previous section described an attempt to address this problem trying to map the recommendations against the features of the reviewed ePortfolio systems. However, due to the highly conceptual level of these recommendations, the results of this analysis should not be considered complete and final. As was explained earlier, common sense and personal experience had to be followed to perform this analytical mapping. To solve this problem, bringing the recommendations to the practical level is the next 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 found that would look at the ePortfolio systems from the lifelong learning perspective, there are 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 abstract 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 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 repositories 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 conceptual 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 the university needs;
- It should fit the learners' needs and be accepted by students.
- 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 that exists between LMS and Web 2.0. As was discussed earlier, LMS cannot provide the required level of support for lifelong learning as it is focused primarily at supporting formal education.

While Web 2.0 tools have the potential to do so, providing quality of service for these tools in institutional settings is not feasible.

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? The 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 systems 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

Stakeholder Requirements for Lifelong Learning Support in Universities

This chapter describes the results of interviews conducted with lecturers and students of Massey University as a part of lifelong learning requirements analysis. There were three reasons for involving stakeholders at this stage of the research. The first reason was that the literature did not provide information on successful lifelong learning support that would go beyond the highly conceptual recommendations. The second reason was that at this stage it was difficult to understand whether ePortfolio as a system created to support lifelong learning was effective enough in doing so. The last reason was that to understand whether ePortfolio systems follow the recommendations identified in the literature, these recommendations have to be translated into system requirements. Therefore, to support the findings from the literature and the review of the learning spaces in Chapter 4, it was necessary to take the guiding principles of lifelong learning support together with the ePortfolio system requirements to the practical level. In this case, the main stakeholders – students and lecturers – were invited to analyse the area of lifelong learning support in universities from their perspectives.

5.1 Limitations

As was already mentioned in the methodological limitations section of Chapter 2, a limitation for this stage included a small sample size due to the limited pool of the potential participants who would meet certain criteria. In case of this research project, one

of the main criteria included having prior experience of using e-learning environments, ePortfolio systems in particular, in teaching and learning contexts.

In addition to above mentioned criteria, availability of potential student participants was reduced even more by the desire of involving a mature student audience (aged 25 and older). This decision was based on the findings from the studies in various fields which showed that mature students are more oriented towards meaning-directed learning (Smith et al., 2010), better express their ideas (Lea et al., 2010) and overall perform better in various tasks due to their life experience and knowledge (Sherwood et al., 1987). In a personal communication with the researcher, this notion was also supported by the academic developer involved in the College of Science ePortfolio initiative and responsible for facilitating ePortfolio use at Massey University. According to their experience, younger students might lack understanding of the lifelong learning concepts and tend to be guided by teachers and grades. It was expected that more mature students would be better aware of the lifelong learning skills than younger students and would try to look at their study at university from the lifelong learning perspective.

5.2 Lecturer Perspective on Lifelong Learning Support

The goal of the interviews with the lecturers was to explore the current problems and challenges of lifelong learning support in universities from their teaching perspective. However, 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-learning environments, as well as to get the interviewees' views on what is needed to make the systems already used in universities, ePortfolio systems in particular, become more efficient and adequate for supporting students in lifelong learning.

5.2.1 Participant Profiles

Using a theoretical or criterion sampling strategy (Byrne, 2001; Warren, 2001), this phase of the project looked for respondents who met certain criteria of being academics with previous experience of using e-learning systems, ePortfolio systems in particular, in their teaching. Ten academics, mostly the participants of a previous institutional ePortfolio initiative¹, were approached by email and invited to participate in this research project. Nine academics from various sections of Massey University (College of Business, College of Education, and College of Sciences) accepted the invitation and

¹<http://science.massey.ac.nz/eportfolios> (Accessed April 16, 2012)

agreed to be interviewed. Nine in-depth interviews were conducted in April-May 2010 to gather the data required for the analysis. All interviews were audio recorded and transcribed to make follow-up analysis easier and more thorough.

5.2.2 Methodology

In-depth, semi-structured, face-to-face interviews were used as an instrument for this phase of the research. It was favoured over the other research methods for the following reasons. This kind of interview has an open style while remaining structured (Gillham, 2000) which gives an interviewer freedom within the predefined framework. Due to its openness and flexibility, semi-structured interview has become widely applicable and popular research instrument.

Face-to-face interviews have more quality advantages than telephone ones (Shuy, 2001), however this characteristic adds a restriction to the number of people that are feasible to interview. According to Gillham (2000), face-to-face interviews require high costs/time and potential interviewees accessibility which makes it necessary to keep the number of participants to a minimum, just to cover representativeness. Therefore, every participant becomes a *key* informant in the project.

Depth of meaning is considered to be central in the interview. Johnson (2001) described the benefit of in-depth interviewing as the one that gives an interviewer an opportunity to achieve deep understanding inherent to participants in some daily activity and as well allows to get the multiple perspectives on this activity.

Due to all mentioned characteristics and being able to gain insight into the experience and knowledge of others (Schostak, 2006), in-depth semi-structured interviews were considered to be a suitable instrument for this project phase. It was important for this project as it had a limited pool of potential participants that would satisfy the selection criteria and, in this case, the required depth of investigation could not be reached with other methods, such as 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 (Appendix B.1). The scenarios described 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 members² at Massey University. The participants were also asked

²<http://science.massey.ac.nz/eportfolios/contacts.asp> (Accessed April 16, 2012)

open-ended question (Appendix B.2) on their experience of using an ePortfolio system in their teaching, problems encountered with their current ePortfolio system, and improvements they would like to see in the systems.

5.2.3 Findings

Analysis strategies suggested by Marshall and Rossman (2011) were used to analyse issues and gaps identified during the interview discussions. Themes to group these issues were developed. These themes included the topics of integration of an ePortfolio system with LMS, addressing graduate attributes, supporting learning outside of the course boundaries and other issues. The direct quotations in this and all following sections were taken from interview transcripts.

Theme 1: Integration with LMS for supporting course-related activities

All participants said that including development of lifelong learning skills in university programs changed the way they teach, interact with students, and use e-learning systems. Talking about the latter, lecturers wanted to see the systems they used integrated into their regular activities. This meant that systems should not be external to the teaching and learning process, but be a part of it. Systems should not be seen as creating extra work or adding to workload. However at this stage, from staff's point of view, all their experience of using e-learning technology was about creating more workload.

Academic 1: For us [lecturers] ePortfolio, with all its blogs, pages, views, presentations, or anything else, will never get any traction until it behaves like an electronic assignment.

Lecturers saw the importance of introducing students to various lifelong learning skills. They said that the development of lifelong learning skills should be integrated through everything that students do and supported at the system level as well. They emphasized that for students the current systems look like two separate worlds. These worlds both provide some pieces of activities, but cannot be seen as a whole.

Academic 2: Unless there are no layers built in each year in connection, students will see that this [work with systems] is really disconnected.

Therefore, they would like to see an ePortfolio system and LMS integrated in a way such that students would be able to do simple, but valuable activities as a part of their learning process rather than in addition to it. For example, this might include

introducing students to the importance of being reflective about the choices and efforts they make; writing reflections or keeping reflective journals in ePortfolio system with an opportunity of submitting everything they do as an assignment to the LMS; getting feedback on their assignments directly to ePortfolio after they were marked; and reflecting on this feedback afterwards. This approach would partly address the requirement of providing support for all aspects of learning and being able to record progress from various sources. It would also allow students and lecturers to work in the system that suits their needs best and provides support for various activities, like developing and sharing content, assessing, reflecting, or giving feedback.

While talking about communication as an essential part of learning process (Schaffert and Hilzensauer, 2008), it was mentioned that the feedback cycle between students and lecturers needed a better support. Lecturers said that they wanted to give students their feedback on various kinds of work, such as assignments, reflections and discussions. The majority of academics did not see any problems if students decided to copy the teacher's feedback to their personal ePortfolio.

Academic 3: For me they have shared their learning with me, so whatever I put in there from my perspective that is for them to do whatever they want to do with that. I don't have a problem with them keeping it or putting it elsewhere, because if I did, I would not put it in there. For me it is about helping them to learn.

However, what was really important for lecturers in the process of communicating with students through feedback was student's response. They wanted to see that their feedback was not ignored, but was listened to by students and used to improve their learning outcomes.

Academic 1: Teachers don't like giving feedback if it is ignored. What would be interesting is if the students had to respond to the feedback that the staff member gave. Creating some kind of dialogue between staff and students. Conceptually, it is really important that this dialogue is going on. It motivates staff members when they see their feedback is being listened to.

In summary, academics were looking for the e-learning environment that would allow students and lecturers to make various educationally valuable tasks so easy, that they would be done by both, on a regular basis.

Theme 2: Addressing graduate attributes

Graduate attributes could be used as a way of addressing higher-order skills which is

required for successful lifelong learning (Hart et al., 1999). All interview participants agreed that introducing students to graduate attributes/profiles at an earlier stage of their study was important. It would give students a complete picture of what kind of graduates they are expected to become and would give them an opportunity to integrate their knowledge from various sources other than only from the degree programme.

Academic 3: It is good for students to know what is expected from them at the end. So they can understand how the assessment and what they do puts together. Lots of students see everything just like the course that they have to pass, rather than a coherent course of study that has a reason for being together. For example, why are the communication skills so important? – Because at any job later you will need to be able to talk to people, to be able to write, because these things are fundamental.

From the lecturers' point of view, graduate attributes were a balance between what was required from the university to *produce* good graduates and what, primarily, had to be achieved by students to become lifelong learners. It was also suggested that graduate attributes were a challenge to introduce. They had to be really thought through and integrated right through everything students do.

Academic 4: They [Graduate Attributes] are a challenge to set. Students need a bigger picture to go really beyond the university because there are so many timeframes and stages beyond the university. It will help students to start understanding that they got lots of talents. They can link it to examples, which is what gets lost when there is so much going on.

Lecturers saw graduate attributes as a potential solution to the problem that students did not consider their formal learning as a part of their lifelong learning. Lecturers believed that graduate attributes might help students to focus beyond what is required for a particular programme of study.

Lecturers also said that it was important to give students an opportunity to develop their own set of graduate attributes, in addition to institutional ones. This would allow them to describe their aspirations and help them to define their future goals. However, this should be done carefully as students still require guidance and support.

Academic 6: So, graduate attributes, I think, are positive thing. They are just a wider example of what we do now by intended outcomes for each paper. We should be absolutely explicit of what our students are able to do when they finish. I think, we want to give students freedom – absolutely, but

not absolute freedom. It is a freedom within a structured process that says “You have to get from here to here, and it is up to you which way to go, but still you have to get from here to here”.

From the systems perspective, several respondents suggested providing students with a comprehensive template that would define a set of generic lifelong learning skills, as well as skills specific to their programme of study. This template should be populated by students with various examples from their ePortfolio as they move across their study supported by the lecturer’s guidance and feedback. It should be up to university policy when and how to evaluate graduate attributes, but grades should not be kept in the ePortfolio system. Lecturers thought that only feedback or references should go to the students’ personal ePortfolio space.

One of the respondents was critical about a template approach. According to his point of view, there might be a danger that students would see a template as a simple *ticking checkboxes* activity. To avoid it, there should be a way of supporting each example with a detailed explanation or reflection on experience gained.

Theme 3: Going beyond the course boundaries

One of the respondents described a good e-learning environment in universities as bringing two worlds into one:

Academic 1: It should create two worlds in one for them [students]: content world and the world where they do their learning. Last world should give them the confidence to explore whatever they want to. This world should be within the programme and beyond the programme somehow.

From a lecturer’s perspective, the LMS was a world of content which they delivered to students and a world where students’ formal education happened with such course-related activities as submitting assignments for marking or discussing course-related problems on forums. However, as was shown through the review of learning spaces, in the majority of LMS, students lose access to the items they have created when they finish a course section or graduate.

All interviewees thought that it was important for students to retain access to the work that they do. Some stated that due to the institutional LMS policy they often recommended that their students saved their work externally in order not to lose it later.

To deal with this problem, lecturers suggested LMS and ePortfolio systems to be integrated in a way that would allow for easy data transfer between systems. Integrated

systems should give students an option of transferring all items at once or copying them one by one.

While discussing data flow options, some concerns about copying collaborative work were revealed. For example, when students participate in discussions on a course forum, is it ethical to allow them to copy posts by other participants into a personal ePortfolio? Should other participants' names be substituted with pseudonyms when data transfer is performed? The majority of academics said that the best solution for them would be a general policy for the forum which would tell students before they join the discussion that their posts might be copied to another participant's ePortfolio. In this case, any participant in the discussion should have an option whether they want to become anonymous or not, when the discussion is copied from one system to another.

Theme 4: Non-functional and other issues

Although, the aim of the interviews was to identify the gaps and shortcomings in existing systems, other issues, not all connected to technical ones, were discussed.

One of the issues was that academics noticed that a lot of students struggled with technology. Therefore, any system developed for students should have intuitive and visually appealing interface which would satisfy novice users as well as advanced users.

Academic 5: Some people struggle with technology. There should be something that they understand quite clear. I think the less you ask them [system users] the better. As much as possible should be done automatically.

Academic 1: I think it's all about integration. There are so many tools there already in both, social world as well as institutional. . . . Ease of use is going to be crucial. . . . bring everything together and let the systems do what they do best.

Another issue was that students should be provided with the example of good ePortfolio, so that they could see what *a good ePortfolio* means, what features make it *good* and how it can be developed.

Academic 2: I think that students still don't see a sample ePortfolio and how it could work for them. Unless it is clear for them that ePortfolio can be used this way, they will see this as an extra piece of work and ask "what would be the benefit?"

The last issue was that students and lecturers require institutional support. Students need to be taught to use the system as well as to understand the general concept of

the ePortfolio process. It was important to show them how ePortfolios could connect course-related activities with their lifelong learning. Lecturers, in turn, need support from the university on how to include the practice of developing lifelong learning skills to the teaching process.

Academic 6: ePortfolio for lifelong learning is a very good idea, but you have to introduce it at first year first semester at the university. So, when students are at the end, they have a record in ePortfolio of what they have done. And it's just a tool you learn like learning to use LMS. But to do that, it should be integrated into the teaching.

5.2.4 Discussion

Analysis of the interviews showed that lecturers looked at an ePortfolio system as a part of the learning environment in connection to LMS. It was not surprising as they were focusing primarily on efficient teaching and making their work easier at the same time.

The feedback given to the scenarios was generally congruent with the information found in the literature. The interviews showed that academics saw and understood the value of lifelong learning skills. They were willing to incorporate activities aimed to develop these skills into their teaching as soon as they were supported on various levels such as department or institutional. They saw the support on a system level as an important part of lifelong learning support in the university.

The majority of the participants said that the scenarios showed to them were realistic and described the problems of lifelong learning support from various angles. The participants tended to give a lot of information on potential solutions. Therefore, it was assumed that they had encountered similar problems and had been thinking about ways to deal with these.

From the lecturers' perspective, the main challenge in providing system support for lifelong learning would be to make it connected through every learning activity students do. If the ePortfolio systems were to be used in the universities for lifelong learning, then they should be connected with the LMS. In this case, student's acceptance condition for such an e-learning environment would be the ease with which they could move between the systems while doing regular learning tasks. According to the participants' teaching experience, students usually expect an immediate reward for everything they do. Students lack motivation if learning activities are not compulsory

or not marked. They also have problems with seeing the bigger picture of their personal and professional development, focusing rather on passing the courses that lead to the degree qualification. Therefore, lecturers saw the value of integrating LMS and ePortfolio systems for lifelong learning support and using such an approach to show students the opportunities for their development as lifelong learners. An integrated environment would let students gather the small parts demonstrating their development and so contributing to the bigger picture of lifelong learning.

5.3 Student Perspective on Lifelong Learning Support

As the overarching aim of this research is to support students' lifelong learning, it is crucial to understand the requirements from a student perspective in the first place. Together with the results of the interviews with lecturers, the findings from the interviews with students would provide valuable background for the requirements specification of an ePortfolio enhanced environment in universities.

5.3.1 Participant Profiles

A snowball or chain sampling strategy (Mack et al., 2005; Marshall and Rossman, 2011) was used to identify potential participants for the interviews. The lecturers, who participated in the interviews at an earlier stage of the project, were asked to provide the researcher with student contacts or to inform students of this research in their classroom. As the use of ePortfolio was relatively new at Massey University, this technique was used to make sure that students who took part in the interviews were familiar with e-learning systems such as LMS and ePortfolio. It was anticipated that students who have already used both systems in practice were more experienced and would 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 (College of Education and College of Sciences) accepted the invitation and agreed to be interviewed. Nine in-depth interviews were conducted in May-September 2010 to gather the data required for the analysis.

5.3.2 Methodology

Methods used to explore lifelong learning support in universities from the student's perspective were similar to the methods used for the interviews with the lecturers. The

only difference was in the scenarios presented to the students. This time they were constructed to describe the situations connected to the problems of lifelong learning support in universities from the learner's perspective (Appendix B.3).

In addition to the scenarios, all participants were asked open-ended questions (Appendix B.4) to elicit their views on the environments that can support lifelong learning in the university. They were asked for their opinions on what features their current ePortfolio system lacked, or which features could make the system more useful and relevant to lifelong learning support in universities. The interviewees were also invited to suggest ePortfolio functionality that would provide support for lifelong learning recommendations. It was important to understand what potential system features could be developed and how existing features could be improved, based on the literature review and gaps analysis.

5.3.3 Findings

Similarly to the analysis methods used during the interviews with the lecturers, the issues and gaps were identified from the discussions with the students and grouped into themes described further in this section. To get different perspectives on the same problems, some themes follow the discussion topics from the interviews with the lecturers.

Theme 1: Supporting course-related activities vs. going beyond the course boundaries

Unlike the lecturers who seemed to have an understanding of how every day course activities link to the development of lifelong learning skills, students admitted of having difficulties with finding a balance between doing course-related activities and having one big personal development picture in mind. They claimed that current study programs had not been designed properly to encourage them to look beyond the course boundaries.

Student 6: Everything we learn is disconnected. As a student, I expect a reward for what I am doing. Probably, if lecturers could make it so that this reward would connect with the aim of long-term development, it would be helpful.

Students said that including ePortfolios into their studying process at the university might be helpful in solving this problem. The majority of the participants said that they liked using ePortfolios for their learning activities. They found some things (such

as reflection or selection of proper examples) quite challenging, but noticed that at the end they understood the value of what they had been doing.

However, in order to use an ePortfolio system in the university as a system for lifelong learning, students expected it to be integrated through all tasks in their learning process. In this case, it meant using ePortfolio throughout every course, being able to use the results of their ePortfolio work as assignments, getting feedback on their learning progress from the lecturers and mentors, etc. Otherwise, without a proper integration and until the way academics develop study program and construct learning activities changes, the situation will most likely remain the same:

Student 1: We are not required to use it [ePortfolio] this year, so I just cannot force myself to go there and keep it updated for my study because it is not integrated. If it was, I would be more likely to do that.

Although, this might seem to be a problem that requires some complex administrative and policy changes and cannot be resolved by improving systems alone, its solution would influence the ways the systems are currently used in the universities and would depend on functionality to support these changes.

Theme 2: Addressing graduate attributes

All students agreed that graduate attributes could be a good approach that might show them the full picture of their study. However, as was mentioned in the previous theme, achieving these attributes should be connected through every activity that students do in their study.

Student 2: I think that it's really good that there are certain things you need to have achieved and you commit to achieve them, but it should be in course design.

From the systems perspective, students came up with a similar solution to the one suggested by the lecturers. A template in an ePortfolio system that would define a set of lifelong learning skills would be sufficient for students to start working towards these skills. It should be possible to attach examples as evidence from their ePortfolio space as well as LMS. In addition, it would be helpful if lecturers could point out the opportunities for such examples in the learning activities students do for their degree program study.

It would be important for students to be able to add their own set of skills to the list of institutional attributes as it could help them to set up their personal development

goals and understand what they want to achieve. Some students also added that once completed this kind of template might be helpful in their job, scholarship or other applications.

Theme 3: Data flow between systems

In addition to the previous themes, to emphasise the importance of integrating LMS with ePortfolio system through course design, it was confirmed that students need these systems to be combined. Otherwise, they would see these systems as two different worlds.

Student 1: Most of my time these days is spent in LMS. My readings are all there, my assignments are all there, and my forums are there. That's where I work. So, if ePortfolio were a part of my e-learning environment in a seamless manner, I will be more likely to use it of my own initiative.

Students found it was time consuming to work in two separated environments. It was difficult to keep track of what was stored in each system and difficult to transfer from LMS items like assignments feedback or forum posts that were potentially good examples to showcase in their ePortfolios.

Student 7: My current course is my focus and that is the most important thing to me at the moment. But after I finish it, I want to be able to wrap it up and save to ePortfolio where I can showcase what I've done.

Moreover, as in LMS students tended to lose access to their courses once they were finished or after graduation, students could not treat LMS as a space suitable for their personal development. Without being able to transfer everything they have done during their course study, students could lose a lot of valuable examples of their achievements.

Student 4: My supervisor just told me to save everything, so that when LMS is closed for me, at least I will have information saved. So, I did it with every single thing I had.

To deal with this problem, students wanted LMS and ePortfolio systems to be integrated in a way that would allow for easy data transfer between systems. Integrated systems should give students an option of transferring all items at once, copying them one by one, or setting up transfer schedule.

Ethics concerns about transferring collaborative work could be resolved by setting up rules or getting permissions.

Student 3: If we are discussing something with someone on the forum, I treat their ideas as their intellectual property. So, if I want to use these ideas, I will ask for their permission and would expect the same from their side.

In addition, a suggestion on the general policy made by lecturers was put to students. It appeared to be suitable to all the participants.

Theme 4: ePortfolio knowledge management

Looking at ePortfolio as a system with long-term access revealed the problem already mentioned in the previous chapter – management of ePortfolio knowledge. An ePortfolio can be called a container of knowledge that needs to be organized. Students collect a lot of artifacts while studying not always knowing which items to select and where the items they put in their ePortfolio should go. As the amount of information stored increases and students move to supporting their emerging knowledge with artifacts, it becomes more and more difficult to find items and to structure them.

Student 3: At the moment my portfolio is not very big, but if I were using it more intensively, I would imagine that to be one of the problems. Especially, when I bring to my portfolio all the elements like my personal stuff, my career or my hobbies.

The majority of ePortfolio systems reviewed in the previous chapter provide such functionality as tagging. However, during the interviews it was discovered that most of the students do not find this feature useful.

Student 2: I don't use tags, because they don't help me... No, I don't use them properly.

From students' point of view, tagging did not give necessary meaning to the artifacts. Students said that they needed something more than tags such as “report” or “semester 1” which could not give much information over a long period of time. Although, none of the participants could come up with a solution suitable for them, they all agreed that they need system functionality that would allow them to build a flexible structure to depict their emerging knowledge within the ePortfolio.

Theme 5: Personal progress tracking

Progress tracking was mentioned as another functionality currently not provided by the ePortfolio systems developers. Progress tracking is required by students to see their achievements and how they improved over time.

Student 2: I would like to see my progress as a timeline. For example, I would like to see everything that I did at the first year of my study and see how I progressed or how my lecturer's comments have improved or my marks have improved. So, every artifact, everything you've done you could attach to time and after that you can say "what was I doing at semester 2?"

This problem might be related to the problem of managing ePortfolio knowledge: unless ePortfolio is properly structured, developing a required progress picture would be a time consuming and inefficient activity. One of the solutions offered by students was to *define the areas of development and separate the achievements by these areas* followed by *to take snapshots of current achievements and put them on a timeline*. In this case, a challenging task for students would be to learn how to define such areas and to understand what items and why they belong to them.

Theme 6: ePortfolio sharing and communication support

Being able to get feedback at any stage of ePortfolio development was very important for students.

Student 3: For me the most important part of ePortfolio is feedback. I am putting things in ePortfolio and sharing them with others because I want to see what they think about my achievements.

Feedback from the outside of institutional environment was no less valuable for students than feedback from their lecturers. At the time when the interviews took place not many ePortfolio supported this functionality. However, as the area of ePortfolio systems development is getting more mature, the system engineers now include sharing options by secret URL and e-mail as well as creating a temporary account in the system. In addition to these options students mentioned a number of other sharing requirements: access reminder notifications, pages/artifacts access tracking, sharing history, and easy re-sharing.

In their current ePortfolio systems students could not find other ways of responding to the feedback given by someone except by adding further comments. For a better support of communication they would expect to be able to take snapshots of the changes they make or to pin comments to the changes which would emphasize what exactly was altered and how it addressed the given feedback.

Student 3: ePortfolio should have something like Wikipedia where I can edit pages and save versions, see what changed, respond to the feedback someone

had given me. It is some kind of a history of why I made choices, I can see change from here to here and I can justify that change.

Overall, students noticed that improvements which they would like to see in sharing and communication support were minor. However, being added to the system they would make students' ePortfolio work much easier and more efficient.

5.3.4 Discussion

Although, it is assumed that looking at their education from lifelong learning perspective depends on maturity of students, the assumptions are that being properly guided by lecturers, younger students can develop understanding of lifelong learning skills and attributes.

The current major challenges are to make system usage connected through every activity students do. Some students lack motivation when learning activities are not compulsory or not graded. Others would like to use systems more often, but found it difficult to stay engaged if the systems were not used for learning activities on a regular basis. To address these problems, considerable changes to the courses design and institutional policy are required. However, as this project is focused on technical support, these changes stayed out of scope of this research.

The remaining and more technical changes included improving long-term aspects of lifelong learning support. These meant providing suitable functionality for managing ePortfolio knowledge, progress tracking and better sharing and communication support. All these features were important for students to be able to work in the system for their personal and professional development.

5.4 Requirements Elicitation

This section operates with the terms commonly used in software engineering for requirements management. Based on Wiegers (2003), *requirement* can be either a capability that must be implemented in a system, description of how the system should behave, or a property of the system. *Feature* is a set of related requirements that provides users with a capability to satisfy their objectives or needs.

The problems described in the previous sections were translated into a set of features to be considered for the future implementations. While the aim of this project is to support students in lifelong learning, because learning and teaching are closely intertwined, both

lecturers and students were interviewed for requirements elicitation purposes. This can potentially create a problem of conflicting project stakeholder priorities (Leffingwell, 2011) because the majority of lecturers were focusing on their own teaching needs in providing students with lifelong learning support. Therefore, to avoid this problem, students' requirements were favoured over the requirements of lecturers.

Table 5.1 outlines the potential features identified through the interviews. Features were grouped according to the major themes developed through the interviews analysis and listed in descending order of priority based on students' opinion.

Table 5.1: Identified ePortfolio system features, improvements and additions

#	Feature
<i>ePortfolio knowledge management</i>	
F1.1	Being able to organize ePortfolio content in a way that would reflect their learning
F1.2	Being able to establish a link between the concepts of skills that are learnt and the practical tasks that are done every day
F1.3	Being able to add reflections to any artifact in ePortfolio repository that would suit specific purposes
<i>Personal progress tracking</i>	
F2.1	Being able to set up learning goals
F2.2	Being able to organize data in a timeline way that would show progress towards the goals
F2.3	Be able to track and share achievements from a specific perspective
F2.4	Being able to evaluate own learning progress
F2.5	Being able to see the changes in reflections, marks, or feedback from specific perspectives
<i>Improved ePortfolio sharing</i>	
F3.1	Being able to <i>pin</i> feedback to a specific part of shared ePortfolio
F3.2	Being able to respond to given feedback
F3.3	Being able to point out the changes made according to the feedback
F3.4	Being able to share specific parts of ePortfolio with relevant audiences
F3.5	Provide notifications about shared resources
F3.6	Provide options for easy re-sharing of information and history of access
<i>Data flow between systems</i>	
F4.1	Data transfer (export/import) between systems
F4.2	Being able to provide resolution of confidentiality, ownership, and ethics issues
F4.3	Being able to bulk export everything that has been done by a student from LMS to ePortfolio
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#	Feature
F4.4	Providing notifications about future changes in access to the systems provided by the university
F4.5	Being able to set up automatic synchronization of the data
<i>Addressing graduate attributes</i>	
F5.1	Provide a way of recording institutional graduate attributes and other lifelong learning skills
F5.2	Being able to add own set of skills in addition to institutional graduate attributes
F5.3	Being able to provide own understanding of the skills
F5.4	Being able to link the skills to examples from the personal repository
F5.5	Being able to showcase achievements connected to the skills
F5.6	Being able to import institutional template with the list of graduate attributes
<i>Going beyond the course boundaries</i>	
F6.1	Being able to link everything students learn as a way of understanding development of knowledge and skills
F6.2	Being able to point out opportunities for good examples of skills development
F6.3	Support for a dialogue between students and audience outside of institutional environment
<i>Supporting course-related activities</i>	
F7.1	Integration between an ePortfolio system and other systems used in university
F7.2	Being able to submit ePortfolio work for formal evaluation
F7.3	Support for a dialogue between lecturers and students

Table 5.2 shows analytical mapping of these features to the recommendations and guidelines for successful lifelong learning discovered in the literature (Section 3.4).

Table 5.2: Matching features to the recommendations

Guidelines/Recommendation	Matching Features
Universities should provide support for all aspects of learning [G1]	F7.1, F4.1, F7.2
Students need guidance in learning [G2]	F3.1, F6.2, F6.3, F5.6, F7.3
Lecturers should be an active facilitators [G3]	F7.3, F6.2, F3.1
Learning materials should be organized in the way that would help students learn how they learn [G4]	F1.1, F1.2, F6.2
Communication and collaboration are essential parts of learning process [G5]	F3.2, F3.3, F3.4, F3.5, F3.6
Learning progress should be recorded from various sources and maintained over a long period of time [G6]	F4.1, F4.2, F4.3, F4.4, F4.5
Students need to be aware of their personal achievements [G7]	F2.1, F2.2, F2.3
Students should develop understanding and confidence in their knowledge and be able to address higher-order skills [G8]	F5.1, F5.2, F5.3, F5.4, F5.5, F5.6
Students should be able to evaluate and reflect on their own performance and learning progress [G9]	F6.1, F2.4, F2.5, F1.3

This mapping shows that all guidelines were covered in the discussions with the stakeholders. The gaps that exist in the current ePortfolio systems can also be identified based on this mapping. Among these gaps, the ones that are apparent (based on ePortfolio systems overview in Chapter 4) include helping students understand how they learn, organizing learning material and knowledge, developing awareness of personal achievements and learning progress, improving support for reflection on performance and communicating own learning progress.

At the next stage of this project, a prototype implementation of the required features was aimed at supporting each guideline and was based on the features prioritizing by students. As had already been shown in Table 5.1, arranged in decreasing order of their priority to students these features included the functionality related to ePortfolio knowledge management, learning progress tracking, improved ePortfolio sharing, data flow between systems and addressing graduate attributes.

Formal requirements specification for the implemented features and their description can be found in Appendix C and in the relevant sections of Chapter 6 respectively.

5.5 Summary

This chapter explored lifelong learning support from the perspective of the main stakeholders in university – students and lecturers. The stakeholders were interviewed to understand whether their needs coincide with the guiding principles and recommendations outlined in Chapter 3. All participants were invited to analyse the ePortfolio systems functionality, express their needs and suggest improvements or new features that would help to provide better support for students in lifelong learning. Information obtained from the interviews was translated into potential features each mapped to the recommendations for successful lifelong learning. It allowed this project to move to the next stage of implementation of the prototype functionality. The next chapter will discuss design and development of this functional prototype.

Chapter 6

Prototype – Development and Implementation

This chapter presents design and implementation decisions for the ePortfolio aided environment that provides support for lifelong learning in universities. By the term *environment* this chapter describes a generic set-up of two interconnected systems such as an ePortfolio system and LMS. For the development and evaluation purposes, in this research, Mahara ePortfolio system was used as an ePortfolio system and Moodle¹ was used as a LMS.

Previous chapters (Chapters 3 and 4) identified recommendations and needs for successful lifelong learning support. With the help of the major stakeholders, Chapter 5 took these highly conceptual requirements to the practical level of the system features. Now, in this chapter, development of these features using open-source ePortfolio system Mahara as a basic platform for implementation is described.

This chapter starts with briefly discussing the overall architecture of the environment and development toolkit. Then, each implemented component is presented with its relation to the requested features and lifelong learning recommendations from the literature. This chapter concludes with a brief discussion of technical considerations.

6.1 Overall Design and Implementation Decisions

Figure 6.1 shows the overall architecture of the environment which consists of two main components: institutionally controlled LMS and an external, but institutionally

¹<http://moodle.org>

supported ePortfolio system. The systems are connected in terms of data exchange and users account management. LMS provides resources for formal learning along with its outcomes which can be transferred to ePortfolio system. Being hosted outside of institutional barrier, an ePortfolio system provides students with private space for personal development and informal learning.

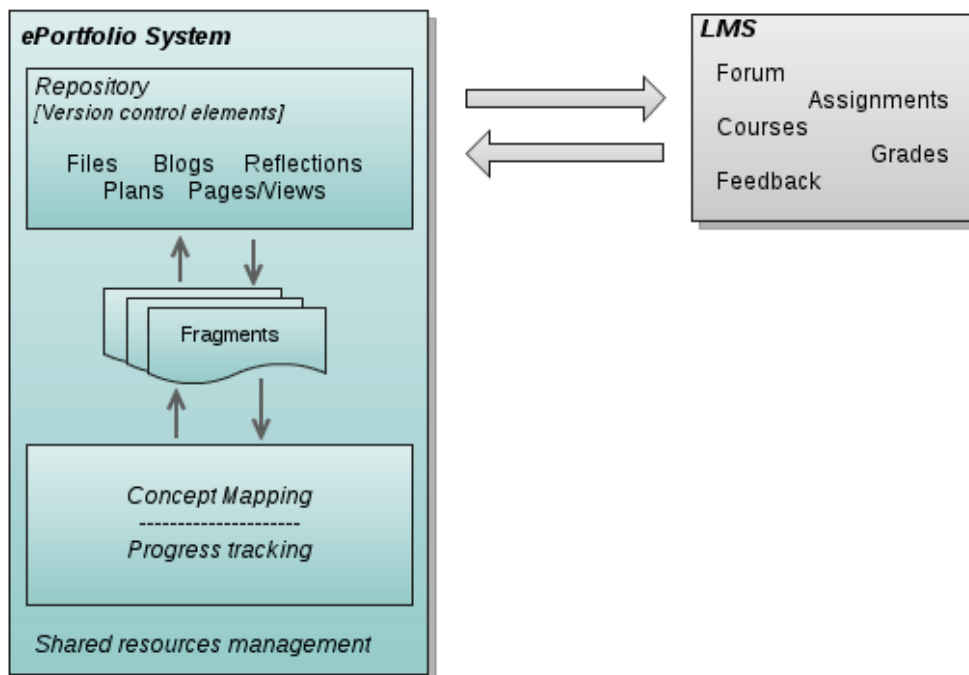


Figure 6.1: Environment architecture

In this project, the main implementations were carried out in the ePortfolio system environment, Mahara. Due to cost vs benefit issues, features that involved LMS environment, Moodle, were not considered for development.

Benefit was analysed based on how high the interview participants had ranked their requirements for lifelong learning support. According to this, LMS aspects of system support had not been identified as highly important in lifelong learning context.

The cost was measured by referring to the LMS developing communities that had ePortfolio and LMS integration on their road-maps. For example, based on the issue MDL-14591² on the Moodle LMS issue tracking system, it took one developer from the development team, who probably had already been familiar with the environment and its APIs, more than two years to develop an ePortfolio API that would support single sign-on and enable simple data export/import functionality. To date, this functionality still has a large number of unresolved issues and bugs that require fixing (as can be

²<http://tracker.moodle.org/browse/MDL-14591> (Accessed April 16, 2012)

seen from searching “portfolio” in Moodle Issue Navigator³).

As another example, based on discussions from “Moodle and Elgg in Education” group⁴ of Elgg community, more than 100 days were spent on development of a proprietary plugin that would allow single sign-on and getting user statistics from Moodle to Elgg.

Therefore, it can be concluded that investment into time and resources for the development of the features that would allow integration between the systems would exceed the benefit that would be gained from them by the users.

For these reasons, guidelines (G1 and G6) and features, that would have involved modifications of Moodle LMS, were not realized by implementations and are not to be discussed further in this chapter. However, for completeness, LMS is still included in overall architecture as a system that supports formal learning in universities.

Features identified through the interviews with the stakeholders were grouped (based on groups described in Table 5.1) and developed in the following components and modules:

- Version control – for addressing the issues of guidance, facilitation and communication for lifelong learning;
- Artifacts’ fragments extraction – for better communication of specific part of ePortfolio and organizing learning materials;
- Concept mapping – for linking abstract concepts to practical skills, managing ePortfolio knowledge, supporting reflection and developing awareness of personal learning achievements;
- Timeline based progress tracking – for showcasing personal learning achievements and evaluation of progress towards learning goals;
- Shared resources management – for addressing the issues of guidance and facilitation from non-institutional audiences, providing learners with better control over shared resources.

These components are discussed in detail further in this chapter.

Each component provided working functionality sufficient to demonstrate the general concept. Some non-functional requirements, described in Chapter 5, were not taken into account during implementation as they did not alter the prototype’s essential functionality (Robertson and Robertson, 2006). For example, making fully visually appealing user interface was out of scope of these implementations.

³<http://tracker.moodle.org/secure/IssueNavigator.jspa> (Accessed April 16, 2012)

⁴<http://community.elgg.org/pg/groups/1057> (Accessed April 16, 2012)

6.2 Development Toolkit

Using Mahara ePortfolio system as a base system defined technologies that were employed in development phase. Development and prototype systems were installed on LAMP⁵ software bundle for Linux which included Apache HTTP Server, MySQL database server and PHP. These were the basic components for building a general purpose web server.

Development environment consisted of the Eclipse Platform with PHP Development Tools⁶. A public GitHub repository⁷ was used for code version control during development and between the prototype iterations.

Following standards, libraries, and external packages were used during implementation:

- HTML5⁸ + CSS⁹ – standards combined with JavaScript used for drawing diagrams that represent concept maps, developing a dynamic timeline and accessing fragments of media (audio/video);
- jQuery¹⁰ – a JavaScript library that simplifies HTML document traversing, event handling, animating, and Ajax interactions for rapid web development;
- jQuery UI¹¹ – a JavaScript library built on top of the jQuery for development of highly interactive web applications;
- jCrop v0.9.9¹² – jQuery Image Cropping Plugin used in artifacts fragments (Section 6.3.3);
- Graphic JavaScript Tree with Layout¹³ – a library that allows drawing dynamic concept maps. This library was significantly modified to meet the needs of the project.

Prototype functionality was tested mainly in Google Chrome¹⁴ v14.0 and Mozilla Firefox¹⁵ v4.0 web browsers. Other web browsers (e.g. Microsoft Internet Explorer¹⁶) that

⁵[http://en.wikipedia.org/wiki/LAMP_\(software_bundle\)](http://en.wikipedia.org/wiki/LAMP_(software_bundle)) (Accessed April 16, 2012)

⁶<http://eclipse.org/pdt> (Accessed April 16, 2012)

⁷<https://github.com/ybozhko/phd-mahara> (Accessed April 16, 2012)

⁸<http://www.w3.org/TR/html5/> (Accessed April 16, 2012)

⁹<http://www.w3.org/TR/CSS/> (Accessed April 16, 2012)

¹⁰<http://jquery.com> (Accessed April 16, 2012)

¹¹<http://jqueryui.com> (Accessed April 16, 2012)

¹²<http://deepliquid.com/content/Jcrop.html> (Accessed April 16, 2012)

¹³<http://www.codeproject.com/Articles/16192/Graphic-JavaScript-Tree-with-Layout> (Accessed April 16, 2012)

¹⁴<http://www.google.com/chrome> (Accessed April 16, 2012)

¹⁵<http://www.firefox.com> (Accessed April 16, 2012)

¹⁶<http://www.microsoft.com> (Accessed April 16, 2012)

did not provide native support for HTML5 elements such as Canvas, required for concept map layout, and embedded video/audio, used in artifact’s fragments, were not used in testing.

6.3 Implementations

Components added to the standard Mahara ePortfolio installation were expected to address the requirements developed by the stakeholders and derived from the literature review. In most cases, the suggestions from stakeholders, when they provided their own vision of what kind of features could have been implemented to solve particular problems, were used during development. In other cases, where the stakeholders could not propose any suitable solution, it was necessary to refer to other domains and analyse solutions to similar problems. In this case, most suitable, as well as feasible for development, approach was adopted.

Table 6.1 matches implemented components to the guidelines they support and the requested features. Guidelines and feature identifiers used in this table were described in Sections 3.4 and 5.4, respectively.

Table 6.1: Matrix of implemented ePortfolio system components

Guidelines	Implemented components				
	<i>Version control</i> Section 6.3.1	<i>Concept mapping</i> Section 6.3.2	<i>Artifacts’ fragments</i> Section 6.3.3	<i>Progress tracking</i> Section 6.3.4	<i>Managing sharing</i> Section 6.3.5
G1					
G2	F7.3			F3.1	F6.3
G3	F7.3				F6.3
G4		F1.1, F1.2	F1.2		
G5	F3.2, F3.3, F3.4		F3.4		F3.5, F3.6
G6					
G7		F2.1		F2.1, F2.2, F2.3	
G8		F5.1, F5.2, F5.3, F5.4, F5.5, F5.6			
G9		F6.1	F1.3	F2.4, F2.5	

Table 6.1 also shows that implementations are covering at least partially each of the guidelines. Complete lists of the requirements for each component in the form of user stories are described in the relevant sections of Appendix C. Detailed screenshots of the interface can be found in Appendix D.

6.3.1 Version Control Elements

Version control adopted in this prototype resembles functionality of standard revision control systems (such as Git¹⁷, Subversion¹⁸, or Concurrent Versions System¹⁹) that allow management of changes in the documents, source code, and other types information stored in files.

Creating and keeping versions of the shareable resources was suggested by the stakeholders as a way of communicating changes made to the ePortfolio items and responding to the comments and feedback. According to the systems review in Chapter 4, conventional functionality of the ePortfolio systems does not support multiple versions of repository items or web pages making it difficult to track changes being made. Normally, when learners get feedback on the shared part of their ePortfolio, they would just apply changes according to this feedback making it nearly impossible for others to compare what was actually altered. This results in a mismatch because feedback still refers to the old version of shared ePortfolio while content is already renewed. Being able to take snapshots of various ePortfolio parts is a simple solution requested by the stakeholders to address this problem.

This feature was easy to fit into the system and straightforward to implement. As every record in ePortfolio has its own time-stamp, all that was required was to create a new copy of the current record, allow users to make changes and, after changes are saved, present the new record to users in a way that would allow tracing back to the previous versions.

A simple revision control implemented in the prototype supported *parent* → *child* relationship between versions (Figure 6.2), but did not support versions branching as in complex revision control systems. This made it possible to bring work with versions to intuitive level for less computer-savvy learners.

Creating a new version of an item is triggered by users on demand and is not done automatically every time user alters or saves the item. This allows users to control what they want to save and when.

As can be seen from the requirements in Table C.1, this feature was implemented for the ePortfolio pages. It was considered sufficient to demonstrate the general concept as ePortfolio pages could be shared with others, and experience of using this feature can be easily transferred to other shareable resources.

¹⁷<http://git-scm.com> (Accessed April 16, 2012)

¹⁸<http://subversion.apache.org> (Accessed April 16, 2012)

¹⁹<http://savannah.nongnu.org/projects/cvs> (Accessed April 16, 2012)

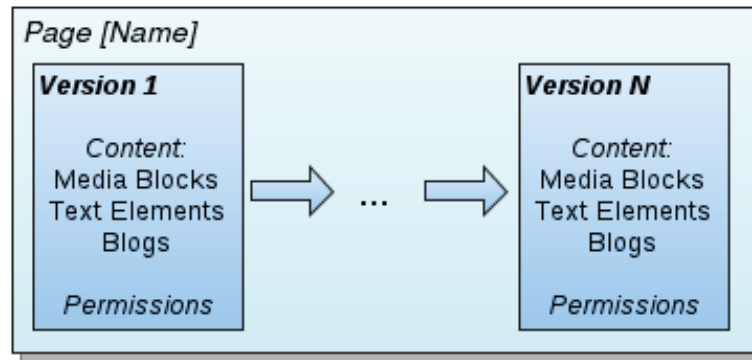


Figure 6.2: Page version control

The component does not perform an automated difference analysis between versions because pages can incorporate both textual and block elements that would make it technically difficult and time consuming to implement this kind of analysis. Therefore, analysing the difference between versions was left for users.

Adopting version control elements in ePortfolio system was expected to provide support for communication and feedback-response cycle between students and lecturers, as well as between students and audience outside of institutional environment.

6.3.2 Concept Mapping Module

Addressing the challenges of ePortfolio knowledge management²⁰ and development of graduate attributes was a complex problem which required a creative approach and no clearly suggested solution from the stakeholders. While looking at the other areas for potential solution, it was discovered that qualitative data analysis and knowledge visualization using concept mapping tool have properties suitable for ePortfolio domain. Like ePortfolio work, qualitative data analysis is characterised by rich data sets, opening the possibility of borrowing well established techniques. Concept maps had potential as a supporting tool for organizing these data sets into concepts and visualising them in a way that could be understood by relevant audiences.

This section describes how bringing these two techniques together helped to develop a solution for the problems outlined earlier.

²⁰In this thesis, the ePortfolio knowledge management is referred to in terms of creating knowledge, sharing it, managing and organizing it in ePortfolio space.

6.3.2.1 Parallels to qualitative research

An ePortfolio can be called a container whose content needs to be organized, with students not always knowing which items to select and where the items they put in their ePortfolio should go. Students start their ePortfolio work by collecting *raw* data available from formal learning and outside activities and transforming it into information that they decide to put into their ePortfolio. After working with and reflecting on this information students arrive at knowledge. However, sometimes there is just too much data for students to cope with efficiently as they might be initially lacking organizing skills. In this case, an ePortfolio system could provide supporting solutions to help students manage their data.

A parallel with qualitative data analysis can be drawn here where researchers either develop new theories from data, moving from specific observations to general concepts and theories (inductive approach), or they try to check if their data map against the theories that are already known and understood (deductive approach) (Strauss and Corbin, 2008; Patton, 2002). An assumption here is that analysing one's own learning process takes similar steps as qualitative data analysis: small bits, specific data that learners are collecting, contribute to the bigger picture of knowledge development.

The difference is that the learner developing their ePortfolio is not aware of the existing theories yet. These theories are the concept structures that exist in the understanding of society, institution and employers. However, these must be eventually understood and *made their own* by the learner. Like the qualitative researcher, the learner needs to immerse themselves in their data and to come to an understanding of the kind of material they should be collecting in their ePortfolio and the concepts that express their learning goals. They need to find (and to a certain degree construct by exposing themselves to learning opportunities) evidence in their data to show that they conform to these concepts.

In qualitative research, a number of techniques are available to the researcher in managing, analysing and interpreting their data, such as coding, grouping, generating categories and themes, rearranging and sorting (Marshall and Rossman, 2011). To support these techniques, specialized qualitative data analysis software (QDAS), like NVivo²¹ and MAXQDA²², has been developed which largely allows coding, linking and mapping unstructured information. Although, QDAS could provide students with necessary functionality for data analysis, it cannot substitute the role of an ePortfolio system in the learning process. Reasons for that are outlined in Table 6.2.

²¹http://www.qsrinternational.com/products_nvivo.aspx (Accessed April 16, 2012)

²²<http://www.maxqda.com> (Accessed April 16, 2012)

Table 6.2: Conceptual difference between QDAS and an ePortfolio system

QDAS	An ePortfolio system
Do not share the analysis data	Showcase parts of the ePortfolio content to others
Only intermediate steps/data are contained, the research findings are written and communicated outside the system	Reflections, pages and data are apart of the ePortfolio
Produce a report as an end point of the research	Does not have an end point; data is constantly evolving; old concepts are changing and new are emerging with changing understanding of these concepts

However, the strength of QDAS is in how it allows to work closely with data. Researchers *label* data with codes, not just in order to connect these labels later, but as an opportunity to *dive* into their data by re-reading, listening or watching it over and over again. This strength is important for students as they need to revisit their material as their understanding of concepts grows.

Currently, the majority of ePortfolio systems allow tagging their content with user-defined tags. However, according to the results of interviews with students, tagging does not provide necessary meaning to the ePortfolio data, cannot show relations between concepts and does not allow building a flexible structure. To address this problem, concept mapping was introduced into ePortfolio environment to help students to be able use the same techniques available in qualitative data analysis to manage unstructured data and develop learning concepts in their ePortfolio.

6.3.2.2 Concept maps

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 fit well with the qualitative data analysis techniques, outlined in the previous section, as they are dynamic, process-oriented and give learners an opportunity to engage in the learning process (Mcaleese, 1998) which is important for lifelong learning (Schuetze and Casey, 2006; Divjak et al., 2004). 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.

In addition to the conclusions drawing from comparison with qualitative data analysis, support for utilizing concept maps also comes from the literature. While 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.

QDAS already offers tools similar to concept maps in form of textual hierarchies of nodes/terms/labels/concepts or as diagrams that show relations between labels. Adding concept maps functionality to an ePortfolio system might make it possible to borrow well established techniques of qualitative data analysis and help students, who are analysing their learning, to formally do what QDAS already does informally.

Concept maps have been already successfully used to in education to communicate complex ideas, assess understanding of learning objectives, elicit knowledge and provide conceptual frame for learning (Novak, 2010). A complete review of the concept maps is beyond the scope of this thesis. For detailed examples and evaluation of effectiveness of this tool refer to The Institute for Human and Machine Cognition research group report (Cañas, 2003).

6.3.2.3 Component implementation

The component (Figure 6.3), presented in this section, adopts the idea of concept maps in terms of developing or understanding concepts and relations between them. Following qualitative data analysis techniques, students create their own codes for the concepts which later form a concept map. Students can also be provided with a map structure predefined by universities as a set of Graduate Attributes in form of abstract concepts. Going through the program of study, students can learn to understand these concepts and recognize the valuable examples of their work in the learning process.

Using a *tree* is considered to be the commonly used and natural way of visualizing hierarchical data (Görg et al., 2007; Holten, 2006). Trees are more visually appealing, easier to master, and since trees are hierarchical, they are better understood by many people. According to Le Grand and Soto (2006), they are also easier to interpret than graphs. Therefore, instead of implementing a complete directed acyclic graph structure, as described in the previous section, concept mapping in this component was simplified

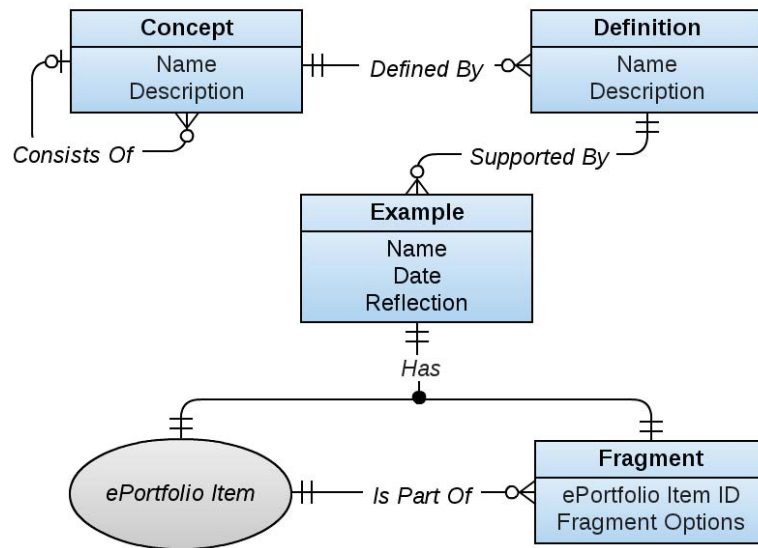


Figure 6.3: ER diagram of the concept mapping elements

to a tree-like structure and did not provide cross-linking between the concepts.

Each map starts with an abstract core or key concept followed by optional supporting sub-concepts. Hierarchy of the concepts can go as far as required by learners starting from highly abstract concepts and going to very specific ones. As shown on Figure 6.3, students can provide definitions for the concepts, which gives them descriptions from learners' point of view. As it was noticed from the interviews with the stakeholders, often students do not understand the meaning of the concepts offered by the university in the graduate profiles or attributes. In this case, being able to provide own definitions to the concepts, might help learners to express their own understanding and communicate it to others.

Examples chosen by students for the concepts and definitions represent their personal experiences and achievements. These examples are the fragments of items, or entire items, from the ePortfolio repository. A detailed description of this feature can be found in Section 6.3.3.

An ePortfolio concepts structure can be represented as shown in Figure 6.4. Data for the example was taken from the examples offered by Marzano et al. (1993) on how to assess lifelong learning standards.

Due to the dynamic nature of learning process, this kind of structure might never be complete. It is constantly changing as students deepen their understanding and potentially find more suitable evidence to underpin their development.

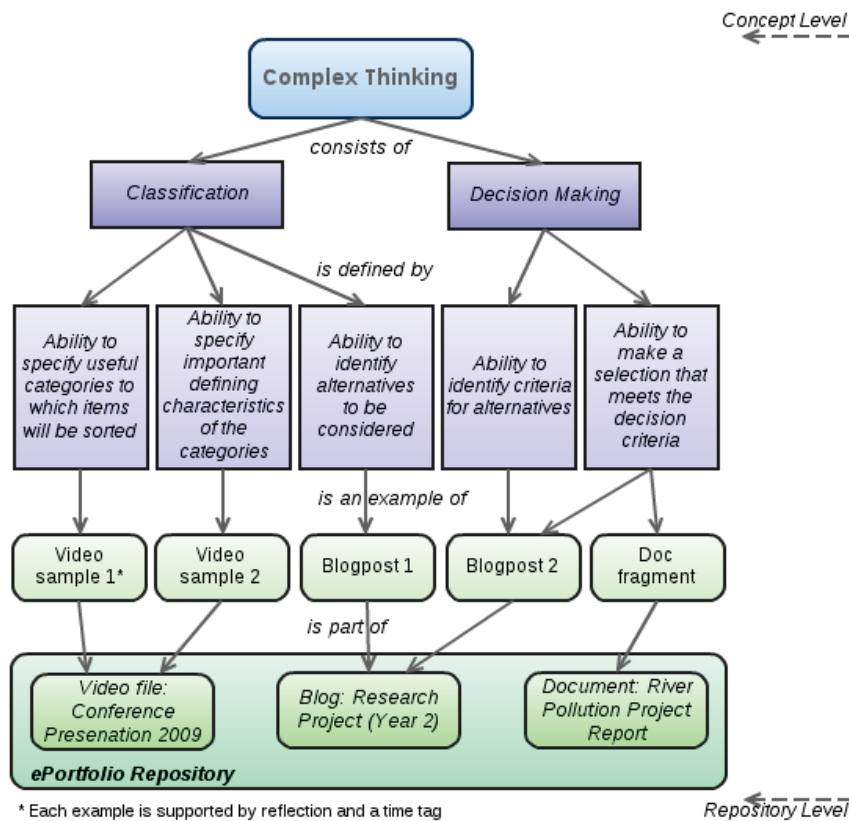


Figure 6.4: Concept mapping framework applied to the example

The expectations are that this approach would allow students to:

- Manage and structure large amounts of information in their ePortfolio: students will be able to organize and navigate through the information, find relations between the content and the concepts and see the data in their ePortfolio from various perspectives: from an item belonging to different structures; from a concept containing multiple evidences; and from items and concepts attached to a timeline (Section 6.3.4);
- Share their progress/development map with others for feedback or evaluation: students will be able to create specific structures for various purposes to show to the audience specific parts of their ePortfolio (for example, share with a potential employer communication and writing skills developed over the last year at university);
- Access and address institutional graduate attributes: by providing students with a concept map of the graduate attributes (maybe even already supported by the institutional definitions), universities would be able to help students to understand the skills requirements of their study area and look at their study program

from the lifelong learning perspective;

- Develop a flexible structure for self-directed learning: students are provided with all operations necessary to make their structures flexible such as creating new concepts, removing or merging existing ones, creating links between structure fragments and taking snippets of ePortfolio items as examples (Section 6.3.3);
- Facilitate setting up learning/development goals and expressing students visions of their knowledge: constructing their own concepts and definitions might encourage students to think of what skills are important to them, how they understand these skills and how it links to their learning outcomes.

6.3.3 Artifacts' Fragments Extraction

Artifact's fragments extraction was developed as a part of the concept mapping module. This feature allows selecting ePortfolio artifact's fragments and using them as example in definitions of the concepts described in the previous section.

The idea behind this feature was to allow students to share specific parts of ePortfolio artifacts linked to the conceptual level of their learning. Because extracting a fragment is a part of creating an example to the concepts, each fragment has to be supported by the student's reflection. Reflection should explain what is so special about this example, or how it addresses some specific concept which it refers to. It is expected to help students understand that their ePortfolio space is not a place for *dumping* all possible items. Each element of an ePortfolio is an important example of their personal and professional development carefully selected to showcase learning progress.

When learners create a fragment as a part of an example, they can link it directly to the concepts that already exist in their ePortfolio. In case learners do not know where this example belongs to in the hierarchy of concepts, they can leave it as a free fragment and use later.

To demonstrate this feature, the following artifact fragments were implemented:

- Image: JPEG, PNG, GIF – by selecting of a part of an image;
- Video: OGV, MP4, 3GP, WEBM – by specifying start and end time of a fragment;
- Text: TXT – by selecting a text fragment;
- Blog – by selecting one or more blogposts;
- Bookmark: URL of the resources on the Internet – no selection is required.

Figure 6.5 shows the way of extracting fragments for various ePortfolio artifacts.

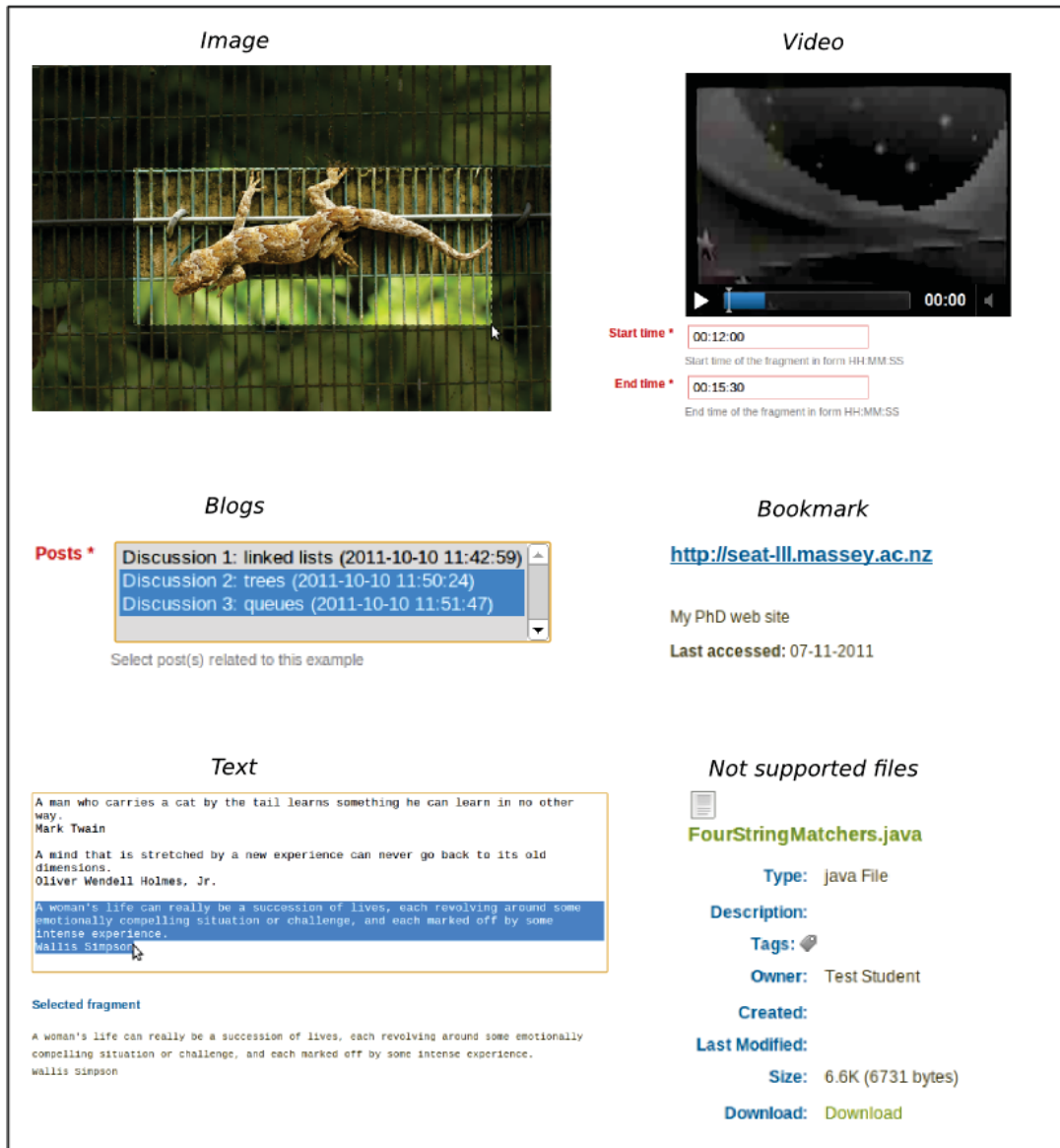


Figure 6.5: Artifact's fragment extraction

At this stage, fragments of textual files support only TXT files because popular, but proprietary formats as PDF or DOC do not allow selecting fragments. Although it is possible to access specific fragments of PDF documents through fragment identifiers, it is not possible to extract the fragment and restrain access to this fragment only.

Files that do not support fragments extraction allow attaching an entire artifact for download. Each extracted fragment can be as well accompanied with a link to the item in case learners would want to allow its download.

Using fragments of artifacts can be useful for a number of reasons:

- it allows to draw attention to a specific part of artifacts (like part of a picture, or fragment of a video);
- it allows the presentation of different parts of artifacts to different audiences;
- it helps to avoid files duplication;
- it saves user's time that otherwise would be spent on cropping images, videos, or textual files;
- it can help to solve some ethics issues (for example, students studying to become teachers are not allowed to show the faces of children they teach at schools, but they still have to demonstrate their competencies of teaching).

From the perspective of this component evolving Media Fragments 1.0 specification (Media Fragments Working Group, 2011) becomes very useful as it describes the ways of extracting temporal and spatial media fragments using Uniform Resource Identifiers (URI). Once it is finished (as planned for December 2011 – January 2012), this specification could be adopted in the ePortfolio system for improved fragments description and extraction.

6.3.4 Learning Progress Tracking

Timeline representation of learning progress was developed in conjunction with concept mapping component. It is used to present the data from the concept map in chronological order.

Timelines are used in various areas, such as education, history, natural sciences, software development and project management, for presenting and often visualizing a progression of related events. This valuable property of a timeline to show progression was used in the prototype development to bring a sense of change over time to the learners analysing their personal or professional development.

Timelines in the prototype are generated automatically and do not require user's input. Each example described in the previous section is accompanied with a *time tags* whether is it taken from the properties of the artifact as creation date or added as a customary selected date. These time tags of the examples allow any concept map to be transformed into a timeline, as shown on Figure 6.6. Each entry on the timeline is an example from the concept maps.

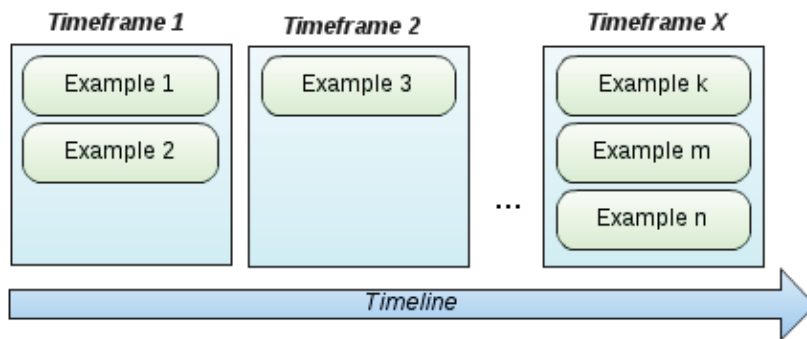


Figure 6.6: Timeline structure

Standard representation of the timeline uses a linear time scale available in two options, i.e., month and year. In addition to the standard representation, users can create their own time scales with the custom time frames (e.g., BA year 1, BA year 2). In custom time frames, users need to specify start and end date of the frame. Examples are then grouped and visualised under a specific time frame based on their time tags.

Users can navigate through any part of the timeline by clicking on the bar labelled with time frames. Clicking on the entry brings up a window with the details of the example: title, reflection and concept it belongs to.

Information on the timeline can be filtered based on the concepts hierarchy of the map. This can be used to see the progress towards development of some specific concept(s), changes in feedback and improvements of the examples.

Adoption of this component is expected to provide support for tracking personal progress in various areas and aspects. Generating timelines could add a temporal dimension to students progress analysis: they would be able to see how their skills evidence changed with time, how feedback received from the others reflects their growing understanding, what achievements they have made and what concepts require more input. It could also help to showcase the progress for evaluation or share it with others for feedback purpose.

6.3.5 Shared Resources Management

To be able to share the parts of ePortfolio in a way required by the stakeholders was another important aspect of lifelong learning support that needed improvements. As was shown in the previous chapters, current ePortfolio systems already provide extensive list of sharing options: by email, secret URL, temporary accounts, etc. However, managing shared resources was missing from the features provided by these systems.

The following improvements were implemented in this area to provide a better control over shared resources:

- Saving sharing/access history: every time a page or a concept map is shared with others a record is created in the user access log. This allows the user to review when a part of ePortfolio was shared and with whom;
- Easy re-share through access history: Saving access history made it possible to re-share resources with the same audience once their access expires;
- Notifications on access expiry for system users and resources shared by email: if set up by a learner, when access to the shared resources is close to the expiry date, the system sends notification to people on the access list;
- Control over level of feedback provided: bringing concept mapping with its hierarchy of concepts and examples into ePortfolio, opened opportunity to give learners control over level of feedback they expect to get. In concept maps, learners can choose what kind of feedback they want, whether it is feedback on overall map structure, individual examples or a group of examples related to a concept. From lecturers' perspective, it allows them to attach their feedback to the elements of a concept map which means that they can focus on specific aspects as well as on the general picture.

Better control over shared resources has potential to bring more confidence to learners, support dialogue between interested parties, improve quality of feedback, and facilitate its provision in a timely manner.

6.4 Prototype Iterations and User Tests

Before formal evaluation was undertaken, implemented functionality had been reviewed by users. Overall, despite time and resources constraints of the project two prototype iterations were possible. Each iteration produced a workable version of the implemented features. At the end of each iteration, the functional prototype was presented to a student and a lecturer selected from the participants of the requirements elicitation phase who had agreed to continue their participation in this research.

Each feedback session included up to an hour demonstration and discussion of the implemented functionality. Users were encouraged to give their ideas about additional improvements and provide their thoughts on possible drawbacks of presented implementations.

Feedback between iterations was very useful as it facilitated further discussion with the stakeholders and helped to get more information on potential improvements. Users were generally satisfied with the improvements and made largely positive comments. However, several issues were noticed. Most notably, users mentioned that they would have difficulties using the system on their own without comprehensive instructions. Some features not common for web interfaces, like right-click context menu in concept mapping, might confuse novice users. It was decided that starting tips on the web-pages could be an additional help to the beginners who are not familiar with the system.

All discovered issues were addressed in the later versions of the prototype in preparation for the formal evaluation stage.

6.5 Technical Considerations

As it was already mentioned in this chapter, a number of technologies were used in this project to implement the prototype. The main focus was on utilizing the new features offered by the HTML5 standard and reusing existing JavaScript libraries (described in Chapter 6). These technologies showed to be a good choice as they allowed for rapid prototype interactions and easy code maintenance and execution.

The benefit of using HTML5 for extracting video/audio fragments and drawing concept maps was that it did not require any additional plugins to be installed on the user side. This can be considered an advantage over Flash-based implementations which depend on plugin and sometimes may require a specific version of this proprietary plugin to perform correctly. Using HTML5 helped to ensure that the prototype features would work on most web browsers as expected.

Along with the benefits, these technologies also created a number of challenges in development. Among these was a relative novelty of the HTML5 standard compared to the established and widely-used HTML4. The Web Hypertext Application Technology Working Group²³ (WHATWG) and World Wide Web Consortium²⁴ (W3C) started working together on HTML5 standard in 2007 (World Wide Web Consortium, 2012). However, at the time of the prototype development in 2011 this standard was still a working draft. As a result, some browsers did not provide full support for the new features offered by HTML5 such as embedded video/audio and canvas elements.

To provide dynamic user-website interactions and enhanced user interfaces, the implementations also used scripts, libraries, and modules based on JavaScript. This can be

²³<http://www.whatwg.org> (Accessed April 16, 2012)

²⁴<http://www.w3.org> (Accessed April 16, 2012)

a potential problem for users who have JavaScript disabled on their browsers as they would not be able to use features that rely on JavaScript functionality. Especially, it can be a case for institutional environments where computers are usually set up by the IT support groups. According to the researcher's experience, these tend to disable JavaScript executions for security reasons (for example, to prevent cross site scripting attacks).

Despite these challenges, it can be concluded that the technologies employed in the prototype development offered a wide range of libraries, modules, and APIs that made implementations less complicated and time consuming. At the same time, these technologies helped to develop high quality features and functionalities, as well as acceptable user interfaces.

6.6 Summary

This chapter presented design and implementation of additions and improvements of the ePortfolio system based on the needs of the stakeholders and lifelong learning success guidelines discovered in the literature. A set of features was introduced to the standard ePortfolio installation with the aim to address various aspects of lifelong learning support in universities. These features are expected to support understanding, development and showcasing of lifelong learning skills, learning progress tracking, management of ePortfolio content and knowledge, communication between students and lecturers, and better control over access to the ePortfolio resources.

From this stage, to understand whether new implementations meet the needs of the stakeholders, a formal evaluation has to be undertaken. The next chapter looks at the improved ePortfolio system prototype from the perspective of lecturers and students with various levels of experience.

Chapter 7

Evaluation

In the course of this thesis the requirements, design and prototype implementation of the ePortfolio system that can support lifelong learning has been discussed. This chapter focuses on the evaluation of this research and its contributions based on three studies. The studies were designed to look into the specific aspects of lifelong learning support and understand how well developed features satisfy the requirements identified earlier by the lecturers and students.

The number of studies represents perspectives of all of the stakeholders that have been involved in this research earlier, i.e., lecturers and students. Reason for this was to ensure that all of the perspectives are being captured as *different stakeholders often have different perspectives* (Hevner and Chatterjee, 2010, p. 111). In addition, the evaluation from the students' perspective has been split into two studies as the requirements elicitation stage discovered that the perception of lifelong learning depends on the maturity of students. Therefore, it was decided to use different evaluation approaches for each group of students.

The first section of this chapter describes the approaches and data collection methods used in the evaluation stage. Further, each of the three studies is presented with the detailed participants profile description, exercise protocol followed by the study, artifacts collected and the results of data analysis. Each study section ends with conclusions that look into recommended improvements to the ePortfolio system prototype and its processes.

7.1 Design Overview

As this chapter aims to evaluate this research and its contributions, the relevant research question and its sub-questions are restated here:

How does the 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 lifelong learning skills using new features?*
- *How can new features help students track their learning progress, manage ePortfolio knowledge and organize content, demonstrate and share their achievements with others?*

To answer these questions, three studies were carried out independently from each other. The results were used to evaluate the developed prototype from three different perspectives: lecturers, mature students and less experienced students. Each study followed its own exercise protocol described in the related sections. Detailed design of each study can be found further in this chapter in Sections 7.4, 7.5, and 7.6 respectively.

Data collection for analysis was performed using both quantitative and qualitative methods to support the principles of multiple sources and multiple perspectives of data advocated by many researchers (Yin, 2009; Maimbo and Pervan, 2005; Marshall and Rossman, 2011). The following techniques were used over the course of all studies:

- Behaviour observations made by the researcher during all studies.
- Observation data in form of digital photographs taken during the group experiments.
- Audio recordings of the face-to-face interviews collected to facilitate more thorough interview analysis.
- Open-ended questions asking for participants opinion on the features and tools used in the studies.
- Close-ended questions that required participants' evaluation based on ten point scale, from *not useful at all* to *highly useful*, included in exit questionnaire.
- Physical artifacts in form of paper records made by participants of the group experiment.

- Digital artifacts in form of electronic records in the ePortfolio system made by participants of the group experiment and case studies.
- System logs demonstrating ePortfolio system use by case study participants.
- Additional evidence, comments and opinions collected by the researcher through informal discussions that would help to support analysis and conclusions.

Audio recordings as well as digital photographs were collected with the permission of the participants and performed without interrupting the process of each study. More detailed description of data collection methods for each study can be found in the relevant sections this chapter and associated appendices.

7.2 Evaluation Limitations

It is important to remember that in the context of this thesis, it is impossible to fully evaluate lifelong learning. Ideal evaluation would include providing students with a technical support solution developed in the course of this project and monitoring their activity through the years of studying at the university. However, this approach appears to be not feasible due to the nature and scale of this research project, its time and resources constraints. Even if it had been possible to involve student participants for a longer term, the issue would have been for them working in a system they cannot have access to long-term as the Mahara ePortfolio system used in this project was different from the Mahara installation recommended by the university.

Overall, no existing evaluation design has been found that would suggest an acceptable approach. Therefore, the evaluation stage in this project followed its own design that attempted to explore and analyse the implementations from the perspective of the lifelong learning stakeholders.

7.3 Ethical Considerations

Similarly to the earlier stage of the requirements elicitation, the Massey University Ethics Approval process was followed for the evaluation studies of this research. Analysis of the evaluation design with the Human Ethics Chair concluded that none of the three studies required full ethical approval. Therefore, a “Low Risk Notification” was submitted to the Massey University’s Low Risk Database.

Ethics documentation, such as the Ethics Approval Letter, student information sheets and participant consent forms, used for this research project stage, can be found in Appendix E.

7.4 Study One. Exploratory Evaluation by Lecturers

To achieve the ultimate goal of this research project to develop a system that can provide support for lifelong learning in universities, it is important that learning facilitators, e.g. lecturers, could successfully utilize improved technology to help and guide students in their learning journey. Therefore, this study explores the prototype implementations from the lecturers' perspective to understand whether their initial requirements were met.

7.4.1 Goals

The goal for this study was:

To determine how useful lecturers find new features in providing students with guidance and support, and helping them to understand lifelong learning skills.

To support achievement of this goal, the main objectives were:

- To evaluate whether new features can provide better communication opportunities between lecturers and students;
- To determine how lecturers can use new features to help students understand the link between lifelong learning skills and their university degree study;
- To explore how lecturers can utilize new features in the classroom to guide students through development of lifelong learning skills.

7.4.2 Research Protocol

This study was an exploratory study that used a demonstration and participants interviews as a research evaluation approach. According to Peffers et al. (2008), *demonstration* is normally used to show that idea works and precedes a more *formal* evaluation. In this research project, demonstration was included into the overall evaluation design.

The expectation was that in combination with the participant interviews, followed after each demonstration, it would provide a valuable insight into the lecturers' perspective on the prototype features.

For the purpose of this study, six one-on-one interviews and one small group discussion were organized with the participants. Group discussion was undertaken during the annual staff meeting and involved three participants.

This study did not follow a strictly defined research protocol as the directions of the meeting discussions were based on the outcomes of the semi-formal conversations with the participants. Each meeting started with the brief introduction of the research and the purpose of the demonstrations undertaken. To guide the course of the study, the researcher initially had a set of topics to cover in the presentation and demonstrate the prototype functionality with the examples of how it could be potentially adopted in the learning environment. The discussion topics were based on the implemented features described in detail earlier in Chapter 6.

Each of the topics was presented to the participants in the following order:

- the problem addressed in the topic;
- an implementation suggested to solve the problem;
- a step-by-step demonstration of how this implementation works in the ePortfolio system;
- expected/intended use of the feature in the classroom;
- where possible, examples of use in the ePortfolio system.

After the demonstrations, the participants were asked to assess the prototype features based on their personal and professional experience. From their perspective they evaluated whether the presented scenarios of use were realistic and what challenges they could see in the suggested ways of using the features.

The lecturers were then asked to suggest how they would use new features and how they would apply the methods these features incorporate with their students. At the end of the topic discussion, the participants were offered to recommend the potential improvements.

All interviews were audio recorded and transcribed for the purpose of more thorough analysis. Direct citations in the results section (Section 7.4.4) were taken from the interviews transcripts.

7.4.3 Participant Profiles

This study used a number of techniques to identify suitable participants. Initially, each of the lecturer-participants of the previous stage of identifying requirements for lifelong learning supported by ePortfolio systems was offered to take part in the evaluation of the prototype implementations at the later stages of this research. Three lecturers expressed interest in continuing their participation in the project.

The rest of the participants were recruited using snowball sampling strategy which had already been employed earlier in this research. This strategy relied on recommendations of the existing participants having knowledge of the suitable candidates who would potentially be interested in this research. Based on criteria of being a lecturer or having previous lecturing experience, and also having experience of using an ePortfolio system with the students, six other participant were identified from the suggested candidates.

Overall, the data was gathered from nine participants, all lecturers at various schools and colleges of Massey University. Table 7.1 shows demographics of the participants:

Table 7.1: Demographics of the Study One participants (n = 9)

University Structure	Number
College of Science:	
– School of Engineering and Advanced Technology	1
– Institute of Veterinary, Animal and Biomedical Sciences	1
– Institute of Food, Nutrition and Human Health	1
College of Education:	
– School of Curriculum and Pedagogy	2
– School of Educational Studies	3
Centre for Teaching and Learning	1

One of the participants was a program coordinator for a Bachelor degree program and had a particular interested in how the prototype functionality can be used with the university graduate attributes and lifelong learning skills.

The lecturers from the College of Education had the most experience of using portfolios or ePortfolios with their students. The reason for this was that every aspiring teacher in New Zealand had to meet the requirements developed by the New Zealand Teachers Council in form of Graduating Teacher Standards¹. These standards closely resemble university graduate attributes and lifelong learning skills. Teaching portfolio has to be created by students as a proof that they meet these standards. The College of Education lecturers were at the earlier stages of adoption of the institutionally supported

¹<http://www.teacherscouncil.govt.nz/te/gts/> (Accessed April 16, 2012)

ePortfolio system for these purposes and therefore were highly interested in giving their feedback on the prototype implementations.

A representative of the Centre for Teaching and Learning was considered a suitable participant as they had previous teaching experience, both at school and at university, and at that time was assisting adoption of the new learning technologies, ePortfolio systems in particular, in the university courses.

Each participant was approached by an invitation email to take part in this research and evaluate the developed features in a face-to-face meeting with the researcher.

7.4.4 Results

In general, feedback given by the lecturers based on the demonstrations was positive.

Concept mapping ePortfolio module with all adjacent to it features such as artifact's fragment extraction, timeline progress tracking and sharing opportunities raised the most interest among the lecturers.

Some lecturers looked that the demonstrated features from the assessment perspective. Version control in the ePortfolio system was found useful for giving better feedback to student and tracking their responses as well as progress. Concept maps was called a tool for more rigorous assessment of students' understanding of the concepts they have learnt. Some of the lecturers had been using mapping techniques for assessment of their students' knowledge before and said that having the tools that could support concept mapping in the ePortfolio system would be very useful.

From another perspective, as was described by the lecturers, students might be interested in using the new concept mapping tools for two reasons: to communicate what they have learnt to somebody else or to try to make sense of the things that they are learning at the moment.

One lecturer said that they liked concept mapping module in particular for its potential to provide support for both horizontal and vertical integration of knowledge and skills. Integrating the knowledge of their study degree as well as bringing together the things that students learn from other subjects is very important:

Participant One: What I like about this tool is that at the end students should be able to clearly see how everything is built towards them achieving these [graduate] attributes or not.

However, stepping away from discussion of implementations, another participant noticed that the problem with the new tools might be that students are less likely to use them “for their own good” [Participant 2]. Therefore, an element of assessment might be required at first. In this case, it becomes an exercise that needs to be completed which is not the same thing as using the system on the learner’s own motivation.

Two of the participants mentioned that, before making any serious decision whether the demonstrated features are feasible for use with students, they would like to hear their opinion on these features:

Participant Two: I can see some opportunities for what we are trying to do in the future. I definitely see potential. However, to be sure, I would be interested in the students try to use these tools and tell us how they see it.

The group meeting with three lecturers from College of Education had the most active discussion of the implementations compared to one-on-one interviews with other participants. These lecturers just finished their first trial with the students where they were using an institutional ePortfolio system for creating students’ teaching profile. As a result, they had most recent experience with students using an ePortfolio system to support lifelong learning.

According to the feedback given, the following are the attributes of the implementations that the participants of the group meeting liked most of all:

- Visual nature of concept mapping;
- Simplicity of making complex things;
- Challenge of conceptual understanding;
- Authentic evidence that students meet the outcomes;
- Opportunity for various levels of feedback;
- Ability to draw attention to the specific elements with fragment extraction;
- Ability to see students’ progress towards learning goals.

Along with the positive features, a number of potential challenges were noted:

- Not only students, but lecturers as well require training on how to use new systems and new features in their classroom:

Participant Three: Teachers need training too. We used to think that teachers know everything and know how to bring new technology to their classroom. But in reality, they don't.

- Students need assistance throughout the process of learning the ePortfolio system:

Participant Four and Five: We have all sorts of students and not all of them are on good terms with technology. Some struggle with such simple things as writing a blog or creating a web page, even when they have all the instructions required. If you want this system to be accepted by students, they need to be sure that help is always out there for them.

- Curriculum should be adjusted to support lifelong learning:

Participant Six: Our challenge is to develop the notion of lifelong learning ability and what it means for that to be a good practising [engineer, lawyer, doctor]. And we need to embed it early on, because they [students] don't know the notion at the moment.

It is also important to mention that after the formal part, five out of nine participants asked when they could expect to see the demonstrated features in the official release of the ePortfolio system that they had been using in the university and expressed willingness to include these into their work with students. Arguably, this can be considered as an indicator of value and usefulness of the developed features recognized by the participants during the demonstration.

7.4.5 Conclusions

Overall, the outcomes of Study One were very useful and provided a valuable first-hand evidence reaffirming that the lecturers were satisfied with the developed features and their requirements of the earlier project stage implemented in the prototype had been met.

Although, no potential improvements were recommended by the participants, a number of challenges of using prototype feature to support lifelong learning were identified: need for training of lecturers, providing support for students, and adjusting study programs to develop the notion of lifelong learning ability.

Based on discussions during the demonstrations and the interviews with participants afterwards, it can be concluded that the prototype features were well accepted and raised a high interest among the lecturers. However, it can be also seen that at that stage

one of the important things for the lecturers was to ensure that students themselves see these features as positive which required further evaluations of the prototype.

7.5 Study Two. Group Experiment – Lifelong Learning Skills Development and Demonstration

This study investigates students perception of the concept mapping tools and adjacent to it features as a part of the prototype in terms of constructing and sharing knowledge, understanding and demonstrating achievements, and linking practical experiences to the conceptual skills.

7.5.1 Goals

The goal for this study was:

To find out whether undergraduate students find concept mapping embedded into the ePortfolio system helpful in terms of addressing graduate attributes, learning objectives, and lifelong learning skills and tracking their progress in learning.

To support achievement of this goal, the main objectives were:

- Determine whether concept mapping embedded into the prototype provides students with a suitable tool for addressing graduate attributes and lifelong learning skills;
- Investigate whether the process of development of concept maps influences students' understanding of personal learning achievements and skills that they learn during degree program study;
- Determine whether concept mapping embedded into the prototype can be successfully used to demonstrate personal achievements and skills;
- Analyse how useful students' consider concept mapping methods as a part of the ePortfolio system.

7.5.2 Research Protocol

To ensure a better control over the experiment settings, it was conducted primarily with the small groups of students at a time (35 participants in total). Such groups usually did not exceed five participants. The exception was one large group of students from the College of Education where the experiment was conducted right after the practical class has finished. This group had 19 participants.

All groups followed the similar process outlined in Study Protocol in Appendix F with up to two hours for the entire experiment to complete. Time of completion might have varied between groups due to the differences of the participants' previous experiences. For example, some of the students did not require explanation of lifelong learning concepts or tutorial on how to construct the concept maps.

Work with each group of students began with an introduction to the research, activities to be performed and an explanation of participants' rights. Ethics documents, such as the information sheet and the consent form, were then distributed. Signed consent forms to participate in the experiment had been collected before any other activities and exercises were started.

The introduction included a brief overview of the research project, a presentation on lifelong learning concepts, demonstration of ePortfolio systems and examples of use. Concept mapping as a method of constructing knowledge was discussed in detail.

After the introduction part, each participant was provided with a pen and a sheet of paper to work with the first exercise, examples of institutional attributes and courses learning objectives, examples of concept maps, unique access account to the prototype, user manual for the prototype concept mapping tool and artifacts fragments extraction, and exit questionnaire sheet.

Second part of the experiment consisted of two exercises: the first one performed on paper and the second one performed using the prototype tools. Between the exercises, students were given a demonstration of the prototype functionality that allowed to construct concept maps in the ePortfolio system and attach examples from the ePortfolio repository to the concepts. After the demonstration, students proceeded to the second exercise.

At the end of the experiment, all participants were asked to complete the exit questionnaire to collect their evaluations and opinions on the tools and methods they had just used.

Although, working independently during the experiment was highly encouraged, students were allowed to do exercises in pairs or groups up to three students. In case they

were working in pairs, students still had to complete the exit questionnaire independently.



Figure 7.1: Experiment settings

Figure 7.1 shows the settings in which the experiment was performed. Standard university computer classrooms were used for the experiment. Participants did not have allocated places which allowed them to choose more comfortable settings for the duration of the experiment. The researcher was available at any time during the experiment for assistance.

7.5.3 Participant Profiles

As was already mentioned in the previous section, thirty five students from various undergraduate and graduate programs at Massey University agreed to participate in this experiment. Table 7.2 shows the wide range of degree programs the students were enrolled in.

Table 7.2: Degree programs of the Study Two participants ($n = 35$)

Degree Program	Number
Bachelor of Engineering	2
Bachelor of Health Science	1
Bachelor of Science	3
Bachelor of Veterinary Science	7
Graduate Diploma in Secondary Teaching	14
Graduate Diploma in Primary Teaching	7
Bachelor of Information Sciences	1

All participants were volunteers recruited through the announcements in the classroom of various courses in College of Education and College of Science or through the poster invitation distributed through the lecturers at Massey University.

As shown in Figure 7.2, participants' age ranged largely from twenty to thirty years which was expected as this experiment aimed at studying undergraduate students. Gender distribution was relatively equal with fifteen male and twenty female participants.

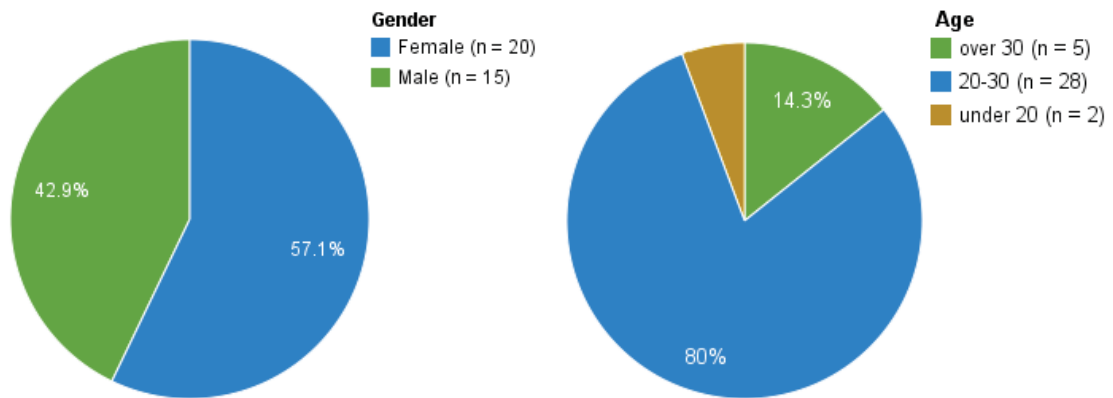


Figure 7.2: Participant demographics (n = 35)

Twenty seven students reported that they were familiar with the concepts of lifelong learning before taking part in this experiment. However, only thirteen of these twenty seven students said that they were familiar with the term *graduate attributes*. They were primarily Teaching Graduate Diploma students from the College of Education. As was discovered during the informal post-experiment discussion, this might be explained by the fact that College of Education of Massey University uses term *teaching profile* instead of *graduate attributes* to describe lifelong learning skills and competences of the degree program.

In the background section, twenty nine students said that they knew about *ePortfolio* prior to the experiment. Seven of these students reported using an ePortfolio system to demonstrate their lifelong learning. They were Veterinary Science students who had Mahara ePortfolio work included into their degree program curriculum.

7.5.4 Activities and Artifacts

Figure 7.3 provides an overview of the experiment procedure and the activities or tasks performed by the participants for each part, based on the above described study protocol.

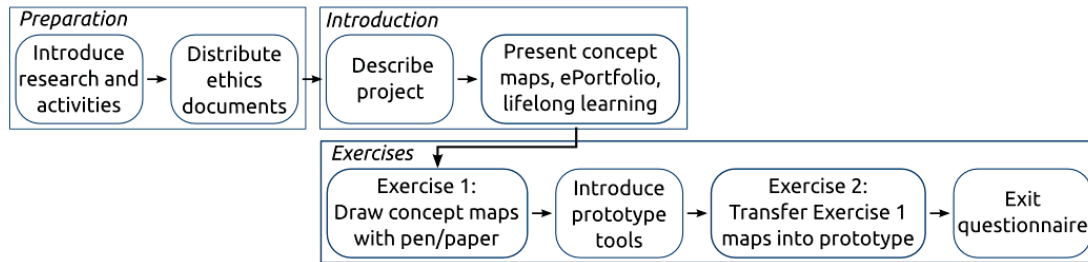


Figure 7.3: Experiment procedure

Length of the presentations and information content of the introduction part varied depending on the participants' experience.

List of the artifacts used by the students in this experiment was following:

- Ethics documents: a) information sheet, and b) consent form;
- Pen and paper for the first concept mapping exercise;
- Examples of the institutional graduate attributes and courses learning objectives taken from the Massey University web-site;
- Examples of concept maps in the prototype created by the researcher;
- Instruction sheet with the unique access account to the prototype;
- User manual for the prototype concept mapping tool;
- User manual for artifacts fragments extraction;
- The exit questionnaire.

Appendix F provides samples of the documents used in the experiment, such as the poster invitation to participate in this experiment, study protocol followed, the exit questionnaire and the responses to it (Section F.5).

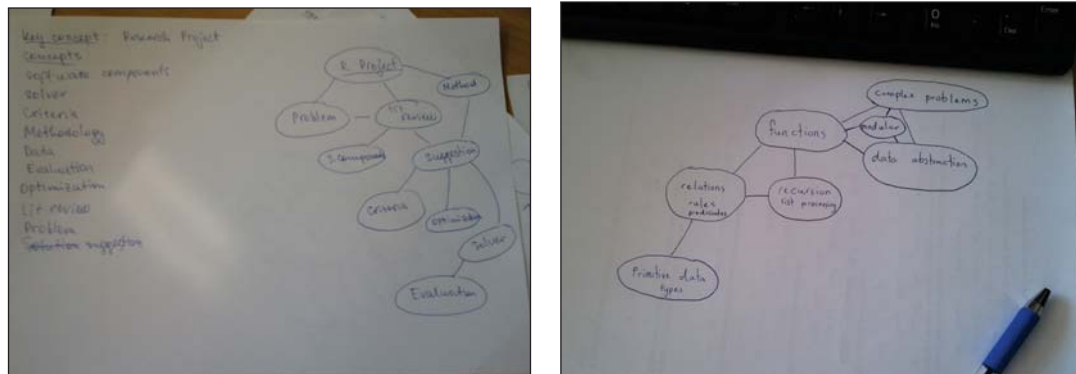
7.5.5 Data Analysis and Results

The data collected during this evaluation were based on exit questionnaire results, observations, and system and paper records. These are described in the related subsections of this section.

7.5.5.1 Observed Behaviour

Based on observations, the most difficult for students was the very beginning of each of the exercises. In the informal discussion after the experiment, some of the students admitted that having a blank sheet of paper or an empty prototype account in front of them as they started was rather intimidating. At first, students expected to be told what to draw and which concepts to include into their diagrams. After a short explanation that there were no right or wrong concept maps that could represent their own learning experience or skills, the process of working with concept maps moved on.

All students were able to complete exercises in allocated time. Students, new to the concept mapping, followed the techniques presented in the introduction tutorial on how to build the maps. This included deciding the main message or the key concept of their map followed by identifying the related concepts. When this was done, they tried to organize the concepts into maps (Figure 7.4, a).



(a) Example 1

(b) Example 2

Figure 7.4: Concept map drawing examples by the students

More experienced students preferred to follow their own established procedure of creating concept maps. Some of them did not spend time making a list of the concepts, but were adding concepts straight to the maps making corrections when necessary (Figure 7.4, b).

Before the experiment, the researcher had no access to the information about the participants' prior knowledge of the studied concepts. As a result, during the experiment, some groups consisted of the students with diverse levels of experience of ePortfolio systems, concept mapping or lifelong learning concepts. The problem with this situation was that while the students with no experience required assistance, more experienced participants tended to jump ahead of the group in doing exercises, following the manual on their own and not waiting for the demonstration of the evaluated functionality of

the prototype. At this stage, it is not possible to analyse whether this had any influence on the results of the evaluation, as the demonstration which those students would have followed, had the same information content as the user manual on the prototype functionality. Therefore, it possible to assume here that all participants worked under the same conditions.

7.5.5.2 Exit Questionnaire Results

The exit questionnaire responses were the major data collection source for the user feedback and evaluation. The questionnaire consisted of two parts: Section A (background information) and Section B (evaluation). The responses on Section A have already been described in Participants Profile Section for this study. This section will focus on the responses on Section B of the questionnaire.

In the evaluation part of their exit questionnaire the participants were asked various primarily open-ended questions aimed at understanding what kind of experience they had working with the prototype and getting their feedback on the tools and methods used during the experiment. Following the questions, the students described their impression of using new ePortfolio features, considered the impact that these features might have on their personal learning and while addressing graduate attributes, indicated most and least favoured elements in the implementations, provided their measure of usefulness based on ten point scale and suggested potential areas for the improvements.

In general, the responses were very positive. Comments made by the participants during the exercises showed that they enjoyed the work with concept mapping tools in the prototype.

Based on the responses to the Section B of the exit questionnaire, students found ePortfolio concept mapping to be a valuable experience. According to their comments, the tools and methods that were used during the experiment helped them to think about bigger picture of their learning,

Most of all I like that it allows me to can see bigger picture of my learning and development.

make links between the concepts they have learnt at the university,

I think that being able to layout concepts in a clear structure like you can here with definitions and examples would help to cement an understanding of the significance of what a student has learnt in a specific subject and how it links to other subjects.

think how these concepts contribute to the skills development,

It helps to bring in to focus the actual results of studies. Graphical representation is much easier to recognize and it helps to sort the ideas. Helps to think about skills over marks.

and organize their previous experience in a structured way that could be shared with others.

Would be excellent for creating interactive C.V. which could be useful for self-reflection and future employers.

In the informal conversation after the experiment, a number of students asked for permission to keep the prototype login information they have been provided with for the time of the study in order to use it later on their own. Although, these students have not been rejected in the system access, they were warned that this particular Mahara ePortfolio system prototype was going to be fully supported only for the duration of the research project. From the perspective of the research evaluation, this expression of interest can be considered an additional measure of success of the tools used by the students.

Table 7.3: Participants' feedback on the concept mapping in the ePortfolio system

Most favoured part/feature	Least favoured part/feature
Ease of use (11)	Complicated to add examples (6)
Extracting fragments (7)	Might be time consuming (6)
Visual representation of knowledge (7)	Might be difficult without initial help (4)
Link between concepts and experience (5)	Restricted maps formatting (2)
Sharing of development (4)	Restricted examples format (1)
Tracking progress (4)	Learning system is complex (1)
Shows bigger picture (3)	
Targeted reflection (2)	
Gets the thinking process going (1)	

Table 7.3 summarizes the overall participants experience of using concept mapping in the prototype system. The number in brackets indicates the number of participants who mentioned these features in their responses. In some cases one student could name more than one feature they liked or not mention anything at all.

Additional examples of responses to the Section B of the exit questionnaire can be found in Section F.5 of Appendix F.

At the end of the exit questionnaire, the participants were asked to evaluate usefulness of the used tools based on ten point scale where ten (10) points represented *highly*

useful score and one (1) point represented *not useful at all* score. Chart 7.5 shows the overall scores based on participants responses.

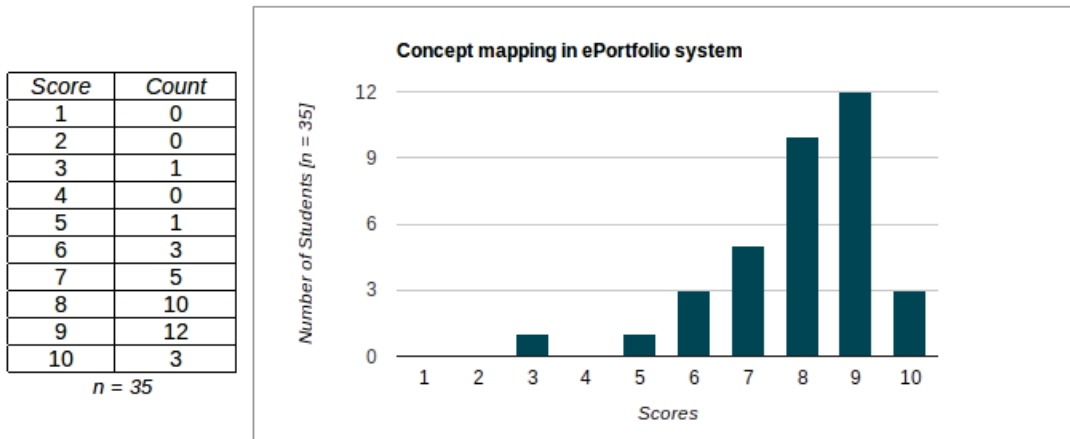


Figure 7.5: Overall views on usefulness of the used tools and methods

The questions that can be asked here is whether participants' previous experience with either ePortfolios systems or familiarity with the lifelong learning concepts influenced their perception of usefulness of the concept mapping tool as a part of the Mahara ePortfolio system.

For this purpose, the results were split into three groups (Figure 7.6) based on the differences in participants' experience reported in the background section (Section A) of the exit questionnaire:

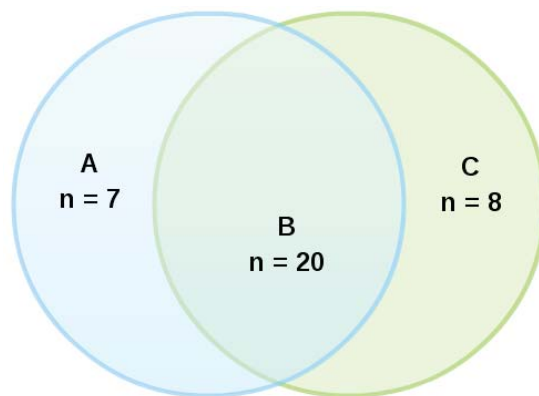


Figure 7.6: Experiment groups based on student profiles

Group A represents participants who were familiar with the concepts of lifelong learning prior to the experiment. *Group C* consists of students who have not been using any kind of ePortfolio system to demonstrate their lifelong learning prior to the experiment. *Group B* represents an intersection of groups A and C and therefore consists of students familiar with lifelong learning, but who have not been using ePortfolio systems. In

this case, *Group A* also represents students who have used an ePortfolio system for lifelong learning purposes prior to the experiment. Variable n represents a number of participants in each group respectively.

According to such distribution of the participants into groups, the views on usefulness of the ePortfolio system concept mapping tools were following:

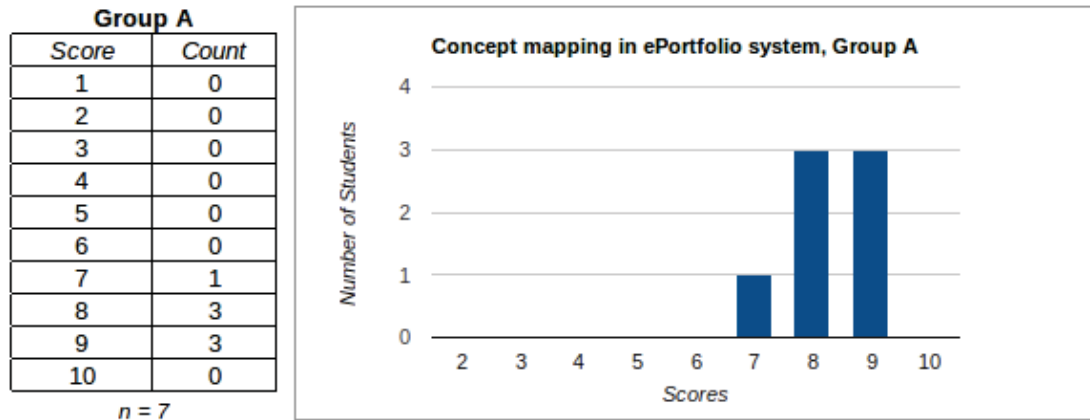


Figure 7.7: Group A views on usefulness of the used tools and methods

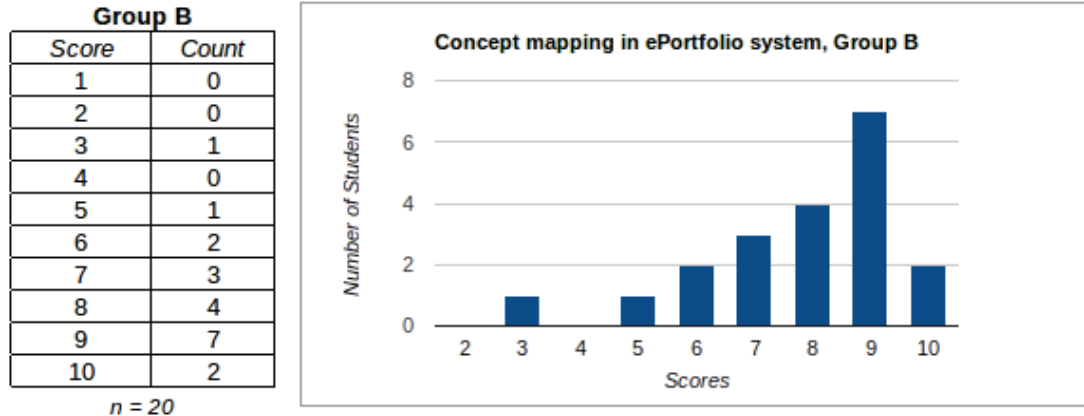


Figure 7.8: Group B views on usefulness of the used tools and methods

The student from Group B (Figure 7.8) who gave three points to the usefulness score of the used tools decided not to justify their choice by the exit questionnaire responses. The only comment they left was “*You can’t quite do what you want with it*” without an overall experience description, recommended improvements, or description of the least favoured parts.

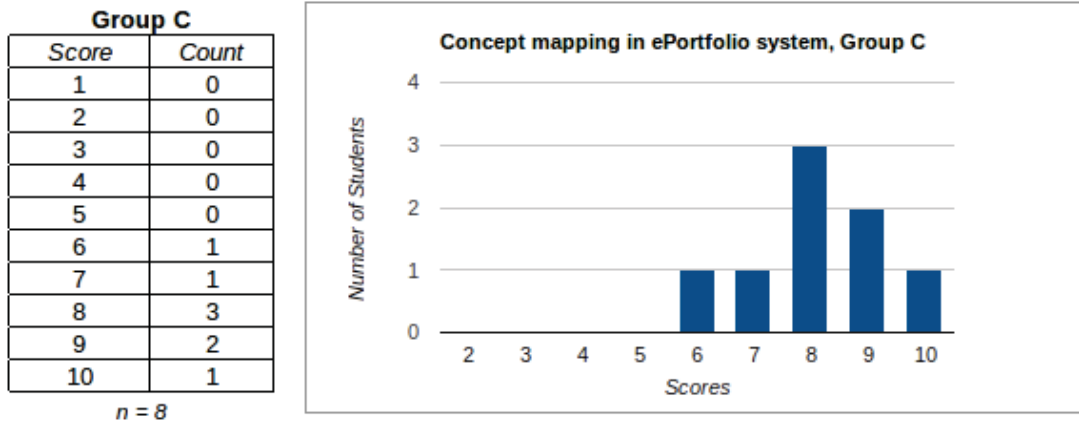


Figure 7.9: Group C views on usefulness of the used tools and methods

In general, it can be seen that participants of all groups gave high scores as a measure of usefulness of the concept mapping tools in the prototype system they had used. It can be also concluded that the previous experience with the overall concepts did not have substantial influence on the score distribution. However, it must be noticed that Group B (Figure 7.8) has a significantly larger number of students compared to Groups A (Figure 7.7) and C (Figure 7.9). Nevertheless, the conclusion drawn from this analysis can be that the novice users find the tools and methods that had been used during the experiment the same useful as the students familiar with either one or both concepts of lifelong learning and ePortfolios.

7.5.5.3 Concept Maps Created by Students in the ePortfolio System

As was requested by the exercise task, the majority of students transferred their hand drawn concept maps to the prototype. A small number of concepts had the examples attached to them that would demonstrate students' experience of the related concepts. Due to the fact that the participants had not been expected to bring any examples with them to the study, they were asked to think about what examples they would include and create empty files or short blog posts for these. As was explained to the students, understanding and evaluation of the general concept rather than content they create was in focus of this study.

Figure 7.10 demonstrates the examples of the graduate attributes maps created by the students using the prototype concept mapping feature during the experiment. On average, the concept maps developed by the participants were too large to be included as a full size illustration. Therefore, this figure shows the small fragments of such concept maps.

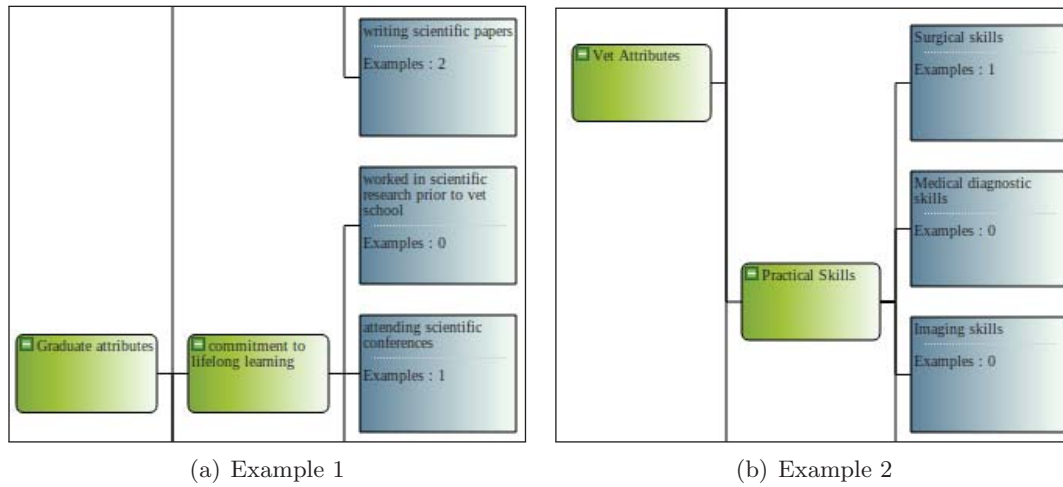


Figure 7.10: Fragments of the concept maps created by the participants

Figure 7.11 illustrates an example provided by one of the participants for the concept they had created.

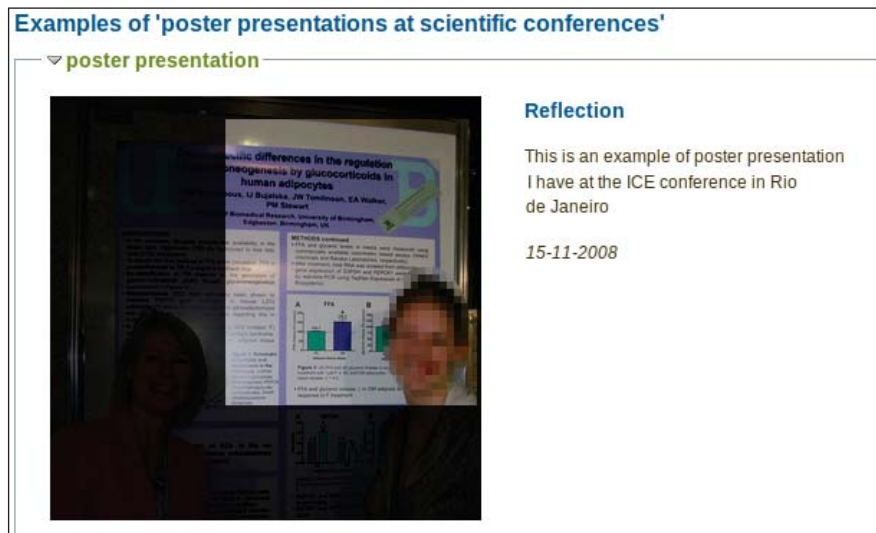


Figure 7.11: A concept example provided by one of the participants

Section F.4 of Appendix F provides more complete examples of the concept maps created by the students using the prototype tools during the experiment.

7.5.6 Conclusions

Overall, it can be concluded that the fundamental goal of this study to evaluate whether the students find the features implemented in the prototype tools helpful was accomplished. It showed that students perception of the concept mapping as a part of the prototype was positive and it provided a suitable means of addressing graduate attributes and lifelong learning skills.

Students who have had prior experience with using the prototype system to demonstrate their lifelong learning skills said that concept mapping was a great idea and worked better for them than the ePortfolio tools they had used before.

Although, usability was not in focus of the prototype requirements, a large number of students noticed that concept mapping was easy and straightforward to use. In contrast, extracting fragments of the artifacts and adding them as examples to the concepts was more complicated and less intuitive task and required detailed instructions. However, a common agreement among the participants was that with proper training and experience all tasks can be easily performed on daily basis.

A problem with the participants testing software rather than evaluating the overall method and its concepts was expected to be a potential threat to validity of the outcomes of this study. For this reason, in the introduction part of the experiment it was emphasized that the participants were going to use prototype version of functionality and therefore should not pay attention to the flaws of the user interface, but focus on the process and an overall idea. Unfortunately, it was impossible to avoid the responses that indicated that participants were looking at the software and its functionality instead trying to understand what stands behind it. This could be seen in such comments like *“Date format on the page is not right for New Zealand”*, *“I would like to have a choice of colour boxes”*, or *“Bigger, more approachable tool-bar would be nice”*. However, there were no more than four responses similar to these for each question. These responses can be considered useful in further improvements of the prototype features user interface.

Among the improvements suggested by the participants were:

- Simplification of the process of linking examples to the concepts;
- Improved maps formatting and reorganizing options for higher flexibility of the concepts and better delivery of owners message;
- Video tutorial and more detailed instructions on using concept mapping tools to ensure that even novice users can start on their own without external help;

- Options of linking items outside of the ePortfolio repository to bring other sources of learning to the ePortfolio system;
- More examples of the concept maps for students with various profiles – resembles the need of providing the students with a model ePortfolio example.

These recommendations can be used to design further improvements to the process and the overall concept to ensure that they are accepted by the students with diverse level of experience.

7.6 Study Three. System Validation by Experienced Students

The third study in the series of evaluation studies for this research project investigates whether the prototype features can be successfully employed by the mature students to provide support for their lifelong learning while not being guided by the lecturer or institutional requirements. This evaluation consists of a series of case studies which explore the processes and methods used in the prototype with postgraduate students to determine their opinion.

Case studies are commonly used as evaluation method (Yin, 2012). The role of a *case* in the classic case studies is usually played by individuals (Yin, 2009). However, the unit of analysis can be any entity other than a single individual: case studies can be done about events, programs, processes, organizations, etc (Yin, 2009; Patton, 2002). The unit of analysis for these case studies was a prototype of the Mahara ePortfolio system that provided support for lifelong learning in universities.

7.6.1 Goals

The goal for this study was:

To investigate how new features can help students track their learning progress, manage ePortfolio knowledge and content, demonstrate and share their achievements with others.

To support achievement of this goal, the main objectives were:

- To investigate how useful the students find the prototype features for the purposes they have been created for;

- To explore what are advantages and disadvantages of the implementations compared to the other ePortfolio features which the students have used before;
- To demonstrate how the new features can be used by the students for:
 - developing understanding of their personal and professional development;
 - effectively managing their ePortfolio knowledge and content;
 - sharing their achievements with others;
 - communication and getting feedback;
 - tracking own learning progress;

7.6.2 The Case Studies and Participant Profiles

This study was of exploratory nature and used a multiple case study approach as an instrument of the evaluation. Although, case studies are known for their poor generalisation (external validity) (Stake, 1995), this problem can be addressed using the strategies described further in this section.

People, places and times are identified by Trochim (2001) as three major threats to external validity. To overcome these threats and improve external validity, he suggests to do the study in *a variety of places, with different people, and at different times* [p. 43]. Due to the unit of analysis being a prototype system, place for the case studies in this research was not relevant.

On the other hand, time of the case studies would potentially matter as each of the participants was a student and therefore might have depended on the university semester schedule. In case of Study Three, all participants were postgraduate students who had their own research project schedule independent of the university semester. Therefore, due to no major schedule constraints for participating in this study, time of conducting the study was considered not relevant as well.

This study used a mixture of sampling methods to identify the suitable participants. First, a criterion sampling method was applied which identified potential cases who met the general criteria of being a postgraduate mature student and being familiar with the concepts of lifelong learning and ePortfolio.

Then, a *maximum variation (heterogeneity) cases* strategy of purposeful sampling (Flyvbjerg, 2006; Patton, 2002) was applied to narrow down the sample to three cases. According to this strategy, cases have to be different in at least one dimension (e.g., experience with using ePortfolio system, participant's age, area or program of study)

to gather information about influence of various circumstances on processes and outcomes of the case study. This strategy also follows the recommendation of Stake (1995) according to which researchers should try to keep balance between the uniqueness and the ordinariness in the process of case selection.

In summary, the three case studies were carried out with the mature students who varied in the areas of study and had different experience of using ePortfolio systems.

Table 7.4: Study Three participants profile (n = 3)

Characteristics	Participant One	Participant Two	Participant Three
Native English speaker	yes	yes	no
Age	over 30	20-30	over 30
Degree of study	Masters	PhD	PhD
Area of study	Arts	Computer Science	Education
Aware of lifelong learning	yes	yes	yes
Self-rated ePortfolio use experience (1-10)	8	6	8
Specialized ePortfolio systems used	MyPortfolio	OSP	OSP The Johns Hopkins DP
Purpose of previous ePortfolio use	Assessment C.V. Repository Teaching Aid	Research project C.V. Personal progress	Personal development Research project
Currently maintaining ePortfolio	yes	yes	no, but would like to

Table 7.4 shows the background characteristics of the three participants. As can be seen, together these characteristics were different from each other enough to address the issues of poor generalization property of the case studies as recommended by Flyvbjerg (2006). At the time of the evaluation, all three participants were pursuing postgraduate study degrees in various areas. Apart from being familiar with the lifelong learning concepts, this was the only common characteristics between all three participants.

A self-rated experience of using ePortfolio systems was relatively similar through all cases with two participants rating themselves as experienced (8) and one rating as above average (6) based on scale from one to ten.

Participant One had the longest experience of continually using ePortfolio system for various purposes: evidence of personal and professional development, repository of artifacts, and assessment. As well, they had experience of training others to use the ePortfolio system to demonstrate their professional development. At the time of study, Participant One reported maintaining both personal and professional ePortfolio.

Participant Two with above average experience of using the ePortfolio systems reported that they had started using a specialized ePortfolio system a while back before the study, but due to personal preferences had returned to their own ways of maintaining ePortfolio through the personal web-site. According to their opinion, this option provided them with more flexibility and independence from the institutionally supported, but also limited environments.

Participant Three, while having been actively involved with the ePortfolio systems development in their past research carrier, was not maintaining a personal ePortfolio at the time of evaluation due to the lack of time. As they explained during the discussion, it was also partly because they could not find a suitable ePortfolio system which would provide high-quality free services.

7.6.3 Research Protocol

The study was split into two sessions held in separate meetings with each of the participants. The main strategy for this study was to give the participants access to the prototype environment for a certain period of time so that they could try the new features on their own and in their own time.

The first session was an introductory meeting and was conducted to familiarize the participants with the environment they were going to evaluate. Before starting any study activity, each participant was provided with the information sheet which stated their rights and the consent form to sign in case they agree to participate under the conditions outlined in the information sheet. None of the students had objections to the study conditions.

After all ethics arrangements were finished, the researcher gave a brief presentation on the research project and the aim of the study. Participants were demonstrated each implemented feature that was in focus of the evaluation, explained its purpose and given the examples of potential use. Unlike in the experiment of the Study Two, in this study, the participants did not have exercises to complete or tasks to follow. Instead, they were given freedom to choose what activities to perform given a set of prototype features to evaluate. Each of the students had an access to the user manual for the features they were trying out.

For the evaluation time, the prototype was available 24 hours a day and could be accessed from outside of the university network. This was done so that the students could work with the system from home and did not depend on being in the university. To access the features of the system, each student had to create their personal account which they had to use till the end of the evaluation period.

All participants were told that the researcher would regularly check on their progress. As well, they were suggested to contact the researcher any time they required assistance or when they were ready to discuss the implementations they had used.

All students were given time to work with the prototype until the end of the calendar year when the evaluation stage was scheduled to finish. This arrangement would have given each of the participants on average four months of trial period. Participants Two and Three contacted the researcher in less than one month to schedule the second meeting. Participant One took one and a half months to get back to the researcher with their feedback.

The second session was a discussion meeting organized with each of the participants after they had finished their evaluations of the prototype. During the meeting they discussed the ways they employed the new features and how helpful these features were for the purpose. One of the participants showed what they had done and during the demonstration pointed out the problems they had while working with the system. Two other participants preferred to have a discussion while the researcher brought up a test account in the system. Where possible, each student was asked to describe advantages and disadvantages of the new features compared to the ePortfolio features they had used before. In addition, the researcher was asking questions based on the examples the students had done in the system. Lastly, they were offered to recommend any future improvements.

Discussion with each participant took on average 90 minutes and was audio recorded for the purposes of transcribing and analysis. At the end of the meeting, the participants were asked to complete a background questionnaire and provide any other comments that might be valuable for the research evaluations.

According to the participants' requests, they retained their access to the prototype system after the meeting for the duration of this research project.

All the documents related to Study Three, such as the research protocol, examples of potential questions for the discussions, and the background questionnaire, can be found in Appendix G.

7.6.4 Data Analysis and Results

Each of the case studies utilized multiple sources for data collection: background questionnaires, semi-structured as well as informal discussions, records made by the participants in the prototype, uploaded artifacts, and system logs.

While the participants had access to the prototype, it was possible to track their system

usage: how many times they logged into the system, what resources they uploaded, and what kind of records they created. However, this information did not provide the evidence of how long was spent by each of the participants working with the evaluated features. In this case, the researcher had to rely on what the participants said at the second meeting.

Based on the system logs, Table 7.5 shows statistics of the prototype usage by the participants:

Table 7.5: The prototype usage statistics

	Participant One	Participant Two	Participant Three
Length of access ¹	37 days	7 days	15 days
No. of logins	4	6	5
No. of records created	29	58	23
No. of files uploaded	8	6	4

During the second session, the researcher discussed system usage log information with the participants. According on their opinion, all participants considered that they had had sufficient time to explore the features.

In general, according to their feedback, all participants viewed the prototype implementations positively. At the end of the meeting, one of the students said: *“I’ve seen a lot of interesting ideas in this system and I would like to see them moving to the new version of the ePortfolio system.”*. This can be interpreted as one of the indicators of success of the prototype with the representatives of the mature student audience.

To take a closer look at the results of the evaluations, each feature is described further in this section as it was discussed with the students during the meeting. Direct quotes were taken from the audio recordings transcripts. Examples of the features usage are the snapshots from the students’ system account.

7.6.4.1 Concept Mapping Module

Participant One called the concept map module as *a really good visual way to navigate around the entire ePortfolio*. One of the drawbacks of concept mapping as described by Participant One was that they found it difficult or almost impossible to make complex concept maps. However, this limitation was due to the prototype level of implementations rather than shortcomings of the underlying concept. Participant One liked the idea of concept mapping as a part of the prototype. Although, they said that it should

¹Calculated based on the difference between account registration date and last access date

be expected that, as the users become more confident with the system, they would want to build more complex links between concepts which is not possible at the moment.

Participant One stated that they used the concept mapping feature and other features that were connected to it more than they used anything else in the prototype. They considered the idea of using concept maps for content and knowledge management as very promising, but it should be taken to another more complex level:

Participant One: An interesting idea would be to be able to aggregate anything that is added to ePortfolio by...let's say, tags. For example, I tag the blog post with this concept tag, and next time I open concept map, I can see it linked to that concept. I really would like the concept maps to practically build themselves.

When the researcher noticed that in this case the idea of meaningful linking of items in the ePortfolio system might be lost, Participant One agreed that there should be a balance between the things that are done automatically and the things that user would have to do manually.

As shown on Figure 7.12 (p. 130), Participant Two used concept mapping to organize knowledge accumulated and concepts learnt during their PhD studies. They said that using the tool for this purpose helped them to understand what has been already done and what would still have to be done in the future.

Participant Two, who had prior experience of using rubrics matrix in another ePortfolio system as a way of addressing lifelong learning skills, said that they found the concept mapping in the prototype as much more intuitive knowledge visualization tool and a tool for demonstration of understanding and achieving objectives.

Participant Two said that ePortfolio concept mapping was an *excellent tool*, though it required some further improvements of visual personalization. The main benefit of the feature for Participant Two was in organising and connecting the various threads that had been learnt.

Participant Two: It helps to organise and also display the current progress and review different ideas easily. I feel if the graduate attributes were there and the students gave examples of these attributes, it would make it easier to see why certain things were learnt.

Participant Three found that the idea of adding concept maps to the prototype was *very nice*. They had the long-term prior experience of using concept mapping technique as a

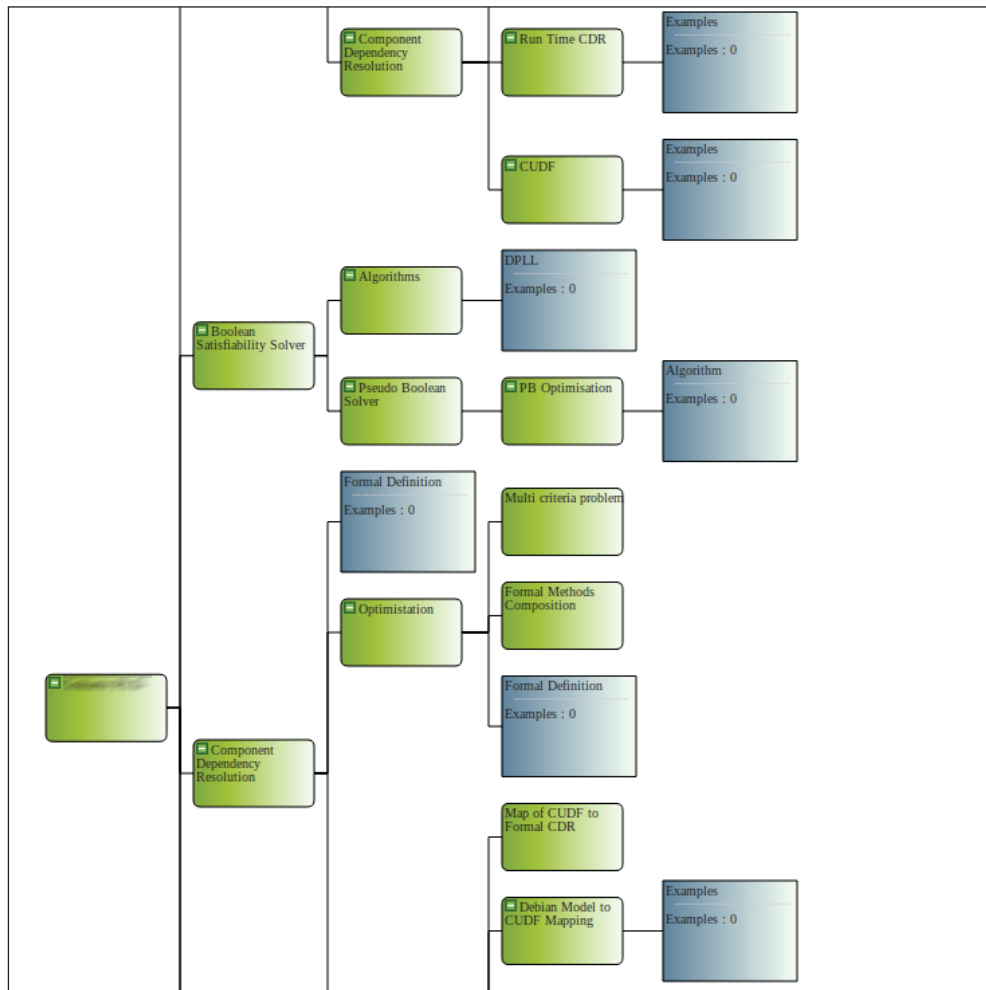


Figure 7.12: A fragment of a complex concept map created by Participant Two

teaching aid at school. Participant Three thought that linking concepts was particularly good principle in ePortfolio when learners could create connection between things they had done.

Participant Three also said that concept maps were user-friendly and their layout was as well easy for reading. However, similarly to Participant Two, they suggested that concept maps need more formatting options. While it was not a major improvement, it would add another level of personalization:

Participant Three: There is a lot of visual learning going on nowadays. Different learners have different ways of seeing things and being able to change...shape things according to their views is important if we want to have an ePortfolio that is really personal.

Among the suggestions for improvements to formatting of the concept maps named by Participant Three were:

- Adding labels to the links between concepts;
- Colour choice for concepts;
- Change of orientation of the maps;
- Concepts sorting within the maps;
- Reorganizing the concepts inside the map.

To justify these suggestions, Participant Three explained:

Participant Three: Although, I think the best way to read maps is when they are laid out like in the prototype, sometimes people just want to try out how it would look like another way. It might be useful to have an option of organizing concepts in the maps in their own way.

Overall, from the feedback given by all participants it can be concluded that concept mapping as a part of the prototype was accepted as a valuable tool to organizing ePortfolio knowledge, navigating through the ePortfolio concepts, demonstrating achievements of learning objectives, and evaluating of personal learning progress.

7.6.4.2 Artifacts' Fragments Extraction

Being an Art's student highly involved in design and visual arts, Participant One was particularly interested in this feature. They said that it would be an easy way of emphasizing fragments of a visual work and drawing attention of others to the particular elements of the displayed artifact.

Participant One: The idea of fragments is really interesting. I haven't seen it in the ePortfolio systems before.

Participant Two liked the idea of fragments in terms of viewing a single document from different perspectives to see what concepts had been learnt. They said that this feature could be used for splitting up artifacts into different examples to be presented in the concept map.

From the perspective of their professional field, Participant Two understood the difficulties of marking up or selecting fragments of the documents that had proprietary

format. However, they said that there could be an choice for users to open a document as a plain text file for fragment selection. Users generally know whether their document can be opened in plan text format. This would be very useful for the students in technical areas, such as Participant’s Two, where a lot of skills are demonstrated in programming and code samples.

Participant Three said that fragments of the artifacts might have a potential value of communicating ideas more clearly between a learner and a teacher. From this perspective, selecting an exact part of a picture or limiting a long video to just a number of time frames allows to be more specific about the things that students might want to share.

Compared to other ePortfolio systems, Participant Three liked that reflection could be directly attached to a potential evidence of any concept from a concept map. They said that it should be useful for students to be able to explain what and why they added to their ePortfolio.

It can be concluded that all three participants understood the general principle of working with this feature. Each of them saw the various ways of applying it together with the other prototype features for better reflection, sharing and emphasizing elements of one’s learning that contribute to the bigger picture of personal development.

7.6.4.3 Learning Progress Tracking

Each of the participants had a common view that timeline-based progress tracking feature was useful for discovering gaps in their learning and demonstrating improvements towards achievement of their learning goals. For example, Participant one said:

Participant One: The timeline is really useful actually in the way that I can get a really quick look at my progress and re-factor my gaps.



Figure 7.13: Progress tracking example by Participant Two

Figure 7.13 shows one of the examples of using progress tracking feature provided by Participant Two. According to them, the timeline functionality was an *excellent way of*

viewing progress which allowed to see achievements of the past and learning potential for the future:

Participant Two: It enables the view of what I have done and then I can also see areas for improvement.

Participant Two did not like the way custom time-frames were supposed to be created by the users. They found the implementations to be confusing and not straightforward, although the overall idea looked interesting to them. They suggested that this part would either require more detailed explanation to the learners who are just starting to use the ePortfolio system or considerable changes to the way custom timelines and time-frames are created.

Participant Three thought that together with the concept mapping tools timeline provided another perspective on learning. According to their opinion, if used properly, these features could be a very powerful tool for lecturers to perform assessment.

Participant Three: In the concept map, someone can see how I understand the knowledge concepts, while in timeline I can easily show what I have actually done to address these concepts [...] If I was teaching now, I would definitely use it with my students.

Participant One noticed that this feature did not require any manual input from the users. Although, timeline representation builds itself from the concepts and examples that learners provide in adjacent features, there might be a room for data manipulation on timeline level as well. For example, students should be able to drag examples between time frames which would allow them to easily update date of an example. Another potential improvements would be a color highlight of the elements on timeline based on the examples association with a concept.

Overall, all participants were satisfied with the feature and said that they could see it working for the purpose of learning progress tracking for students as well as for lecturers.

7.6.4.4 Version Control Elements

Version control feature was implemented through a simple page versioning in the ePortfolio repository. Participant Two really liked the idea of adding this kind of functionality to the prototype.

Participant Two: Everything in ePortfolio should be done with versions. It might be my Computer Science background, but for me it's a really good way of seeing own progress in work.

According to Participant's Three views, in addition to being able to show the changes that had been done in the process of developing a showcase ePortfolio page, this feature would also help to support discussion between a learner and other interested parties. An opportunity to justify the changes and communicate the improvements is a valuable addition to the conventional ePortfolio systems' functionality.

Participant Three: I think adding version control elements to the ePortfolio system is an excellent idea. It would be useful in many circumstances to view changes and improvement.

Participant One said that in the way it is implemented now, *the lecturers might enjoy this feature much more than students*. As they explained, traditionally version control features were used for an opportunity to go back and revert the changes rather than review the progress made between versions. In case of this implementation, it was more like a version release of a software when one can introduce improvements and share them with others. Participant One could not imagine going back and trying to compare versions of pages, but from the perspective of a lecture, their dialogue with a student that could be supported this way, and an opportunity to review students' progress, it seemed to be useful.

It can be concluded that all three participants found this feature useful for the purpose it was created. None of the students could not think of any other potential applications than the ones suggested by the researcher.

7.6.4.5 Shared Resources Management

Due to the system being a prototype with no social activity going on, none of the participants could properly test the all features implemented for the shared resources management. Participant One found the way out by registering another account and sharing resources between the two accounts. Other participants followed the descriptions in the user manual and looked at the feature's set ups without actually sharing resources with anyone. In some cases, they tried out giving feedback to their own artifacts and other items, or sharing resourced with the friends group and logged-in users.

Participant Two said that it might be difficult to measure the effectiveness of the

shared items management by just sharing something with others or compiling a C.V. for a potential employer. According to their point of view, the problem with this approach would be that there were already effective mechanisms in place that allowed sharing resources. However, the valuable benefit of this feature in the prototype would potentially be in combination with the version control feature in order to manage changes and feedback to the artifacts at the same time.

Participant One noticed that notifications about access to the shared resources in the ePortfolio system might not be positively accepted by some users. From the perspective of people outside of the ePortfolio community, such notifications might turn the ePortfolio system into another spam sending web-site. From their point of view, this feature required much more options to consider for both a sender and a person who would receive notifications.

Although, none of the students could evaluate full potential of this feature, they all said that they could see some of its options being helpful combined with other features for lifelong learning support. However, the participants were still in doubt about the effectiveness of some options, for example automatic notifications. Therefore, from the research perspective, any assumptions about this feature have to be tested by further investigations.

7.6.5 Conclusions

Overall, based on the evidence gathered during the case studies, it can be concluded that all three participants supported the prototype implementations and agreed that being properly utilized these implementations could be a part of a successful approach to lifelong learning support in universities.

Although, all three participants were generally satisfied with the implementations, they also suggested a number of improvements for each feature. These included the following:

- improvements to the concept mapping tool for better interaction, flexibility and user control;
- improvements to the artifacts' fragment extraction to provide users with more file options and better communicating their ideas;
- improvements to the shared resources management with more opportunities for a sender as well as a recipient;
- improvements to the progress tracking using more intuitive creating of custom timeline and time-frames;

- improvements to the version control feature with more ePortfolio artifacts having version property.

Due to some of the tested features' dependence on the social interactions between the users, it was not possible to evaluate the entire prototype in depth as it would be necessary before launching the system into the real world settings. Evaluation according to the thoroughly designed scenarios of potential use with a larger number of participants would decide strengths and weaknesses of the implementations performance and feasibility of their use in the social settings. This can be one of the tasks for the future research.

7.7 Summary

This section presented the evaluation design and the results of the evaluation of this research project's contributions. It was shown that despite the difficulties of evaluating lifelong learning described earlier in Section 7.2, a complex evaluation was conducted in this research.

Based on the results analysis, an apparent issue of the evaluation was in the fact that it was very difficult for some of the participants to give their opinion of the underlying concepts without paying attention to the shortcomings of the user interface. The evaluated system was a functional prototype and therefore was not aiming at providing highly attractive and usable user interface. However, this problem should be considered and addressed in any future research.

Three studies were carried out to understand how the new features can be utilized by the stakeholders to provide better support for lifelong learning in the universities. The results of these studies can be summarized as follows:

1. Lecturers see the ways of using the prototype and would be willing to incorporate the new features into their teaching to provide students with their guidance and help them to understand lifelong learning skills.
2. Based on the experiment results, concept mapping as a part of the prototype can be successfully used by undergraduate and more experienced students to demonstrate learning achievements and address institutional graduate attributes. It also can provide opportunities for targeted reflection and better feedback.
3. According to the case studies, students see the new features as helpful and useful for tracking their learning progress, managing ePortfolio knowledge and content,

demonstrating and sharing their achievements with others. Further improvements are still required to make the features more flexible, intuitive and user-friendly. This would also ensure that the evaluation of the underlying concepts have not been affected by the limits of implementations.

Chapter 8

Discussion

This chapter aims to bring together the knowledge developed during this research project. It looks back at the topics discussed earlier in the thesis in order to understand various aspects: whether the research questions were answered; what issues were faced in the course of this project and how they could be avoided in future research; what conclusions can be made about methodology employed in this project and what were the risks of the research bias; what implications for theory and practice should be considered; and how the outcomes of this research can be practically applied in the real world and in New Zealand context.

8.1 Reflections on Research Questions

At the beginning of this thesis, the overall research goal, the main driving force of this project, was stated as follows:

To suggest improvements to ePortfolio systems to offer university students a learner-centred e-learning environment that can provide them with support and facilitate their lifelong learning process.

To support achievement of this goal, four research questions were developed (Chapter 2) and systematically addressed in the course of this thesis. The current section reflects back on the questions posed in this research project.

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

According to reviews of the area described in Chapter 3, it can be concluded that the concept of lifelong learning is not a simple one. Lifelong learning has gone through various changes in its concept as well as meaning. Even now, there are debates about what the actual meaning of lifelong learning is (Griffin, 2002). The term used in this thesis follows the common understanding of the theories where lifelong learning consists of formal, informal and non-formal types of learning with long-term, life-wide and self-directed characteristics (Longworth, 2003; Rubenson, 2002; Schuetze and Casey, 2006). This concept puts the learner in charge of their learning and moves educational providers – universities in the context of this thesis – to the role of learning facilitators (Boshier, 2000).

What do universities have to do with lifelong learning anyway? Looking from the tertiary education perspective, time spent on studying in universities takes about 5% of all learning done by an average individual over their life span (calculated based on statistics provided by Dench (2010, pp. 28-37)). While this might not appear to be much, a university is still considered to be a place where professionals are prepared to join the world of global economics and an educated society. As a result, the pressure on universities to produce highly qualified graduates is high. Current economic and social agendas require these graduates to possess not only specific professional skills, but also skills that are called lifelong learning and are less likely to be developed by learning in just formal settings. This is where the need of incorporating other types of learning in addition to formal learning in universities comes from.

Currently, many universities are looking into ways of providing students with better support that would reflect their needs as lifelong learners. One of type of such support is providing a learning environment conducive to the principles of flexible, life-wide, and self-directed learning.

RQ2. How are available e-tools used to support lifelong learning within the university context?

Exploring the area of learning spaces (Chapter 4) shows that the field of ICT currently provides a large number of systems and tools available for supporting all types of learning. Some of these tools are provided by educational institutions while others are freely available online on the Internet. While all of them have benefits for various types of learning, the gaps that exist between these tools are difficult to bridge. While LMS dominates in the world of institutional learning spaces and provides support for formal learning according to university needs, the Web 2.0 tools with their high potential of supporting informal learning are almost completely neglected by the universities due to various reasons. These tools cannot offer the required degree of security and

regulation while at the same time providing opportunities for institutional control and management. Often learners themselves prefer a separation of these largely social tools away from their classroom.

The advent of ePortfolio systems in support of learning brings an opportunity to cover these gaps. They are learner-centred, provide users with private space and a space for collaboration, as well as opportunities for reflection and sharing. Although, ePortfolio systems were developed to meet the high demand of providing support for lifelong learning, this research showed that it is difficult to measure their success in doing so. The field of ePortfolio systems development is still rapidly changing. Therefore, further exploration of their potential was required.

RQ3. How can LMS and/or ePortfolio systems be extended to support students in the university context for lifelong learning?

An investigation through a series of interviews with the stakeholders resulted in development of requirements for better support of lifelong learning on a system level (Chapter 5). Providing support from a LMS perspective was abandoned at that point as improving of the ePortfolio system was considered more important. High priority requirements were translated into features (Section 5.4) and implemented in a system prototype as described in Chapter 6. The Mahara ePortfolio system was used as a base system for the development stage.

Looking back at the requirements development stage, it would be valid to ask whether the information gathered was enough to answer the posed question. The participant selection procedure showed that the pool of potential participants with suitable experiences was very small. No information was found in related software engineering literature that would say how many stakeholders was enough to start developing requirements. Therefore, the researcher followed common sense by examining the results of the interviews to understand whether data saturation had been reached. Having finished interviews with the participants of the initial sample, the conclusion was that this sample had been sufficient for the requirements extraction.

In addition, the elicitation of the requirements was conducted under the assumption that the stakeholders involved in this research were qualified enough to provide high quality information that could be used later. All lecturers were experienced in their field of teaching and had practice of utilizing the ePortfolio system in their work with students. In turn, the students they recommended for participation in this project were all mature individuals with experience of using ePortfolio systems in their learning. Measuring the stakeholders' expertise or maturity would go beyond the scope of this project. Notwithstanding, the premise that the stakeholders had a rich set of knowledge

and experiences should be considered as an underlying assumption behind this research stage.

RQ4. How does this extended environment meet the needs of stakeholders in university teaching and learning contexts?

The evaluation stage of this research, as described in Chapter 7, attempted to catch various perspectives of the stakeholders by developing a complex evaluation design that incorporated three studies, each using different evaluation approach. Through these studies, it was shown that the representatives of all of the stakeholder groups were overall satisfied with the new features supporting lifelong learning demonstrated in the prototype implementation. It can be concluded that in general their requirements were met.

Arguably, the artificial settings of all studies might have influenced the general reliability and validity of the outcomes of this evaluation. A real-life evaluation was not possible to conduct due to various reasons among which were the timeframes required for evaluating lifelong learning and missing framework of institutional support for students. This stage was conducted under the assumption that the conditions of the evaluations would resemble those of the real world situations. Taking into account that the evaluated system was a functional prototype and could not be launched into a real world setting, it was a reasonable trade between getting full scale evaluation results against getting no results at all. As was required, additional measures were undertaken to increase validity of the overall evaluation. However, the results of the evaluations have to be accepted with an understanding of the conditions and assumptions of the studies.

8.2 Reflections on Research Methodology

The research methodology used in this project was the Design Science Research approach. Based on the outcomes of this research, the use of current methodology can be considered successful and appropriate, and can be recommended for the projects of similar nature and scope. DSR being a methodology that does not require formal evaluations (Fidock et al., 2010) was very useful for the following reasons. At the time of evaluations, the artifact developed in the course of this project was still at the prototype stage. Therefore, evaluations undertaken in this research cannot be considered rigorous, formal evaluations of the effectiveness of the artifact. These evaluations were used rather as a way of identifying areas for further improvements.

Another aspect that should be discussed here is research bias. The researcher was responsible for making decisions about the research design, instruments, and methods used in this project. In addition, the fact that the researcher occupied the role of evaluator might have had some notable implications. The evaluation methods were primarily qualitative and the results required a lot of interpretations. While the researcher tried to eliminate potential bias through frequent meeting with supervisors, it should not be expected that the judgements made were completely objective. The researcher's background as a person who believed that learning technology had the potential for supporting lifelong learning certainly had its impact on this research project. However, the research process followed by this project remains open for other researchers to follow up and make their own judgements about the quality of the research.

8.3 Implications For Theory and Practice

This section discusses the lessons learnt and conclusions that can be drawn based on results of this research. It suggests the changes that could be made in various areas in order to improve the quality of lifelong learning support in universities.

8.3.1 Finding balance between what is good for teaching and good for learning

The conversations with lecturers over the course of this research has emphasized the challenges faced in doing justice to the varied demand of teaching, research and administrative responsibilities. It is not possible to infinitely add on the lecturers responsibilities every time a university administration decides to introduce a new solution for supporting learning. Even now, it is difficult for lecturers to find a balance in what should be used for teaching and learning. This research confirmed a common belief that different people usually have different perspectives. For lecturers it is especially important as they have to look at things not from only their own teaching perspective, but from the perspective of learners as well. It was easy to see that some of the participants had difficulties with understanding learners' needs due to not being able to put themselves into their students' place.

On the other hand, it would not be a reasonable decision to ask lecturers to employ technologies that might significantly affect their established teaching process in terms of producing high workloads. For example, changing the way lecturers give material to students or the way they mark learners' assignments might increase the time that has to be spent on these activities to get quality outcomes. Therefore, while introducing

new systems to the learning environment, university management should also perform a holistic review of approaches to teaching that balances new requirements or added workload with reduced effort in other areas.

8.3.2 Importance of cooperation in introducing new technologies or new teaching principles

A surprising to the researcher discovery made during the course of this project was that communication between various departments was in quite a poor state. If the lecturers were more engaged with teaching and learning projects carried out in their departments or schools, they were less likely to know about similar research projects in other areas of the university. However, it should be reminded here that these conclusions were made as the results of observations of practice at Massey University.

Work with the lecturers at various stages of this project showed the importance of communication and cooperation between the university departments. The lecturers who were research participants were usually highly surprised when they discovered that some other departments were using or had past experience of employing exactly the same technologies with their students. A lot of issues and troubles for new institutional developments could have been avoided if proper communication or presenting departments' research was done across the university.

8.3.3 Learning to use new technology

A curious fact was noticed in the course of this research: the students who participated in various studies of this project had practically no complaints about LMS used in their university. In contrast, the ePortfolio system raised criticisms and expressions of dissatisfaction, although LMS and the ePortfolio systems were discussed equally. How is it that the system that has been built for learners displeases these very learners so much? A possible explanation for this phenomena might be a lack of student teaching of how to use ePortfolio systems.

Looking at the current state of LMS use in universities, technology level help might be all that is required for students to master this type of system. Use of LMS is generally simple, and can be summarized in such activities as accessing and uploading files, and in some cases posting to forums or answering quizzes.

Due to long history of LMS being employed in universities, lecturers already have their own established strategies of using these systems, especially in relation to delivery of distance education. Furthermore, help for aspiring lecturers can be acquired from the

literature. For example, Packt e-Learning Library¹ currently publishes books covering Moodle, Blackboard, Sakai, and other LMS. In addition to numerous online resources and literature on how to use LMS to their full potential, there are staff trainings that are usually organized by many universities for those lecturers who need extra assistance.

With the support of university administration (Di Benedetto, 2005), lecturers now need to learn how to guide students through lifelong learning, and need to master new technology that supports it (Levin and Wadmany, 2008) – ePortfolio systems in the context of this thesis. Compared to LMS, work with ePortfolio systems is more complex. It goes beyond simple file management and requires understanding of the importance of reflection, purposeful selection of artifacts, and demonstration of personal achievements. Students who have never been taught all these things might not see the value of an ePortfolio system as well.

Understanding of these issues is currently developing in the universities around the world. For instance, based on the case studies presented at PebbleBash 2010 conference (Pebble Learning Ltd, 2010a), many universities in the UK and Australia have moved towards teaching students how to use ePortfolios, showcase skills and achievements, write meaningful reflections, and provide useful peer feedback.

In addition to the above issues, one of the lecturer-participants of this research noticed that students should start their learning journey with an ePortfolio system on early stages of their studying. Doing so, rather than trying to fit ePortfolios into the students' established way of learning, might result in more positive outcomes. This, in turn, might lead to higher acceptance of the ePortfolio concepts and systems among students. Although, this assumption needs to be carefully tested in the future.

8.4 Practical Applications

The results of this research can be applied to many domains. These can be education, employment and workplace, knowledge and information management, media sharing, etc. The principles and implementations of this research can be used in providing support for various learning processes in universities, such as development and understanding skills and learning concepts, demonstrating achievements, assessment of knowledge, and others.

Since its first release in 2006, Mahara – the system used as the base ePortfolio system for prototyping – gained a world-wide popularity. It is currently successfully employed in many colleges and universities in the UK, Australia, USA, and others (as can be

¹<http://packtlib.packtpub.com/e-learning> (Accessed April 16, 2012)

seen from the numerous case studies and examples described in the quarterly Mahara Newsletter²). In addition, the 4th MaharaUK conference³ is underway in July 2012 bringing an opportunity for educators, learning providers, and developers to share their ideas and experiences on how to enhance the use of ePortfolios in education. In light of such success, the Mahara developing community welcomes contributions that can help to improve this ePortfolio system.

The outcomes of this research project also have the potential for applications in the New Zealand context, in higher education as well as secondary. With additional improvements and necessary corrections based on the results of evaluations, the prototype implementations can be added to the official release of Mahara ePortfolio system which is currently becoming popular in New Zealand with an expectation of providing lifelong learning support for every New Zealand citizen.

As an example of ePortfolios gaining popularity in New Zealand, MyPortfolio service (based on the Mahara ePortfolio system) is currently available nationally for schools⁴. New Zealand Ministry of Education made it free for all schools in New Zealand and offered assistance with training school staff until the end of 2012 (New Zealand Ministry of Education, 2012). At the time of writing this thesis, other discussions were underway on the role which Ako Aotearoa⁵ – New Zealand’s National Centre for Tertiary Teaching Excellence – might be able to play in supporting similar ePortfolio service for the entire tertiary sector⁶.

8.5 General Applicability of the Prototype Features to the ePortfolio Systems

A number of ePortfolio systems – PebblePad, BlackBoard ePortfolio, Desire2Learn, eFolio, Mahara, and ELGG – were reviewed earlier in this thesis (Chapter 4) to understand what current ePortfolio technology can offer in terms of supporting lifelong learning. Although the prototype implementations were developed in one specific ePortfolio system, Mahara (described in Chapter 6), the ultimate goal was to suggest improvements that could be applied to any existing ePortfolio system. Due to the differences in the system architectures and programming languages, the prototype implementations cannot be directly reused without adaptation. Conceptually they can be adjusted to be used in other ePortfolio systems.

²<https://mahara.org/newsletter> (Accessed April 18, 2012)

³<http://maharauk.org> (Accessed April 18, 2012)

⁴<http://myportfolio.school.nz> (Accessed April 16, 2012)

⁵<http://ako.aotearoa.ac.nz> (Accessed April 16, 2012)

⁶<http://myportfolio.ac.nz> (Accessed April 16, 2012)

Adjusting the implementations for another ePortfolio system means that the system should be analysed against the guidelines for supporting lifelong learning. This had been attempted in the review of the existing ePortfolio systems (Chapter 4). Considering that in the course of this research these guidelines were translated into system requirements (Chapter 5), the gaps in the features offered by the majority of the existing ePortfolio systems can be identified. This can help the ePortfolio systems' developers to add new features and functionality to the existing systems with the aim of improving support for lifelong learning and learner experience. In addition to the improvements that can be done in the existing systems, the identified features can also be used as a guiding specification for the requirements management when a new ePortfolio system is developed.

It is possible that the features for supporting lifelong learning can be implemented in many different ways, other than described in this thesis. The prototype just demonstrated one of the ways of implementing these features. It does not claim to be the only or the best way of development. However, it is important to remember that the studies conducted to evaluate the implementations showed that these were positively accepted by stakeholders.

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

The main focus of this thesis has been on improving lifelong learning support for students in the universities by providing them with a better learning environment – an enhanced ePortfolio system. For this purpose, the requirements, design, development and evaluation of the prototype environment has been discussed in detail. This final chapter summarizes the outcomes of this research and its contributions to the related fields along with the opportunities for the future research projects.

9.1 Contributions and Outlook

Despite the narrow focus of this research project – developing a technical solution for supporting lifelong learning, – its contributions to the field and knowledge should not be underestimated. Among these were:

- *Identifying the requirements for the lifelong learning in universities based on academic literature:* the initial contribution of this research was the set of identified requirements to provide students with comprehensive support for their lifelong learning in universities. These requirements are aimed at better supporting reflection, communication and collaboration, development and showcasing of skills and achievements, and tracking of learning progress.

- *Development of the requirements specification:* Following the needs of the major stakeholders (students and lecturers), formal requirements for lifelong learning support in universities were developed. This formal specification based on the identified requirements can be used or adopted by the developing teams of the ePortfolio systems to improve existing systems in the context of providing support for lifelong learning.
- *Development of the functional prototype:* The Mahara ePortfolio system was modified to illustrate that these requirements can be successfully implemented. The functional prototype was developed to identify the strengths and weaknesses of the developed specification, and was an attempt to address primarily learners' needs rather than focus on institutional requirements.
- *Development of a multiple perspective evaluation design:* Design of a proper evaluation was an important task to understand whether the initial research goal was achieved. Due to the nature of lifelong learning, evaluating it within the scope of this project was a challenge. A multiple perspective evaluation was designed to address this issue. It included conducting separate evaluation studies using suitable for each study methods to ensure that the perspectives of all stakeholders were taken into account.

All these contributions were aimed at achieving the main goal of this research in providing a technical solution capable of supporting lifelong learning in universities. Based on the outcomes of the evaluation, the overall approach to the problem can be considered successful.

The value and impact of this research project goes beyond the technical solutions. When this project started just over three years ago, there were few active projects in the area of providing students with technical support for lifelong learning. At that time, a lot of studies from the first wave of an ePortfolio system implementation as a tool for supporting lifelong learning have already been finished (Batson and Peet, 2010). As a result, many universities around the world that had been trying to adopt ePortfolio systems for lifelong learning support discovered that incorporating these systems into institutional environment was not an easy task. To successfully introduce a new technology, it needs to be aligned with the views and policies of an institution. It also requires a significant investment of time and effort as well as adjusting curriculum, teaching and learning practice in accordance with the new standards of lifelong learning.

Due to the fact that the changes in academic environment occur slowly, especially if it involves incorporating new technologies (Molebash, 1999), suitable conditions did not exist at that time for an uptake of ePortfolio systems to happen. This might explain

why many ePortfolio adoption attempts did not pass the stage of pilot projects, and the system as such did not gain as much recognition as expected.

Despite these past issues, the developments in higher education over the recent years showed that important changes are happening. It would not be an exaggeration to say that many universities are now better prepared and more ready to address the challenges of adopting new technologies to support lifelong learning. This can be seen in numerous examples around the world, for instance development of Curriculum 2010 Project (C2010) as a part of *the Strategic Plan 2009-2013* at Curtin University which was aimed at curriculum renewal to utilise lifelong learning skills in the courses (Oliver et al., 2010); declaring support and expanding opportunities for lifelong learning in 2020 road-map at Massey University (Massey University, 2012) which started in 2006 as a small group initiative in one of the university departments and turned into an institutional policy six years later; making official statement to provide students with tools they need to become lifelong learners at the University of Ottawa in 2020 Strategic Goals (University of Ottawa, 2011).

In the road-maps for 2020, the European Commission is looking into increasing participation in lifelong learning, guaranteeing funding for education, implementing lifelong learning policies and supporting partnerships between higher education institutions, students, and employers (European Commission, 2010; European Union, 2009).

The notion of changes can also be seen in the recent criticisms of exclusively LMS-based learning in universities. These criticisms inspired the movement towards a new type of system called Personal Learning Environments (PLE) which are learner-centred and can provide support for informal learning (Calvani et al., 2007). In this context, ePortfolios are called *the DNA of the Personal Learning Environment* and considered to be a future of the systems supporting lifelong learning (Attwell, 2007a).

Following from the above described changes, another point has to be made here. Literature shows that teaching practice and educational policies can be influenced by new technology. However, this goes against the traditional belief that the use of technology is limited to fitting or serving teaching goals (Levin and Wadmany, 2008). The need for interaction between pedagogy and technology is emphasized by Savin-Baden and Wilkie (2006). They argue that technology is not just waiting to follow the established teaching strategies, but technology is on equal terms with teaching. Cousin (2005) claims that technology contributes to, or even leads, the teaching process. This can be seen in the outcomes of many research projects that show how technology influences teachers in the way they design and deliver their courses (Rutledge et al., 2012; Wang, 2002). Such research implies that the development of an effective technology can have broader impact than serving just current teaching practices.

To conclude, in light of many universities getting ready for changes to incorporate new technologies for supporting lifelong learning and an important role that technology can play in shaping teaching practice and institutional policies, this research can be considered increasingly relevant. By helping to introduce a better system, it can aid in further promoting lifelong learning in universities. The ways ePortfolio technology will be adopted and used in the future by universities may impact learning of many generations of students.

9.2 Future Research and Potential Extensions

The research presented in this thesis is one of the steps on the way to providing students with full support for their lifelong learning journey in universities. In the course of this research, a number of issues and questions were raised which creates potential for further investigations. Future research should aim at exploring and solving these issues to support the findings of the current research and extend the knowledge added. The following sections suggest potential future studies.

9.2.1 Enhancement of the prototype towards a production quality system

Due to the high interest in the outcomes of this project among the research participants, the next logical step for this research would be moving the ePortfolio system prototype to production level. Important part of this step would include putting the evaluation feedback into practice to improve the implementations based on stakeholder recommendations. In addition to the evaluation studies already carried out, a full user interface formal evaluation would need to be conducted taking into account existing usability issues.

Depending on which ePortfolio platform is used as a base system, this step would also require following the developer guidelines specific for the platform. Each developing community has their established methods and rules which need to be followed by any contributor. For example, to contribute code developed in this project to the official Mahara ePortfolio system release¹ would require such steps as using Mahara code guidelines in all implementations, adapting the implementations to the latest system version and submitting contribution to the Gerrit² review system. After code submission, it has to be independently reviewed by two developers from the core team, fixed

¹<https://launchpad.net/mahara> (Accessed April 18, 2012)

²<http://code.google.com/p/gerrit/> (Accessed April 16, 2012)

according to their feedback, properly tested, and documented for future maintenance purposes. Only after all these steps, the code can be included in the official system release.

The above example shows the complexity of contributing to an open-source project. Adding code to the proprietary system is most likely even more complicated process. A future project should look into these issues.

9.2.2 Optimal interface for the implementations supporting lifelong learning requirements

As this project was focusing on the development of a functional prototype for theory testing, user interface development was outside of the research scope. However, interface design plays an important role in acceptance of any system by users as well as it might influence users' productivity and users' satisfaction from using this system. Potential research project in the area of HCI would look into the problem of designing an optimal user interface for the features implemented in ePortfolio system supporting lifelong learning.

A challenge of developing an optimal user interface will remain an outstanding issue over time. The field of designing good and efficient Web interfaces will always be a *hot topic* due to the rapidly changing technologies aimed on improving user experience. From this perspective, it would be interesting to analyse whether the current interface implementations could have been done using other visual representations and how it would influence learners' perception of the system.

9.2.3 Further evaluations of the prototype

As was discussed earlier, evaluation of the prototype implementations in the real world settings was not feasible due to various reasons, such as short timeframe, resources constraints, and difficulties of evaluating lifelong learning. However, once the system is in its production version, a complex evaluation should be undertaken to support current findings. Although difficult and often costly, naturalistic evaluation, or evaluation with real users using real systems to solve real problems is considered to be crucial (Pries-Heje et al., 2008). In such evaluation, a lot of variables should be taken into account, but at the end it can be called a real *proof of the pudding* (Venable, 2010).

In addition to naturalistic evaluation, to check whether the findings can be generalized, evaluations of the ePortfolio system with a larger number of participants and using different sampling techniques where randomization of the sample is possible would be

required. This research used largely qualitative methods which are known for their poor generalizability (Trochim, 2001). Therefore, one of the potential future research projects would look into the issues of testing the findings of the current project from the perspective of generalizing them.

9.2.4 “Seamless” virtual learning environment for lifelong learning support

For any learning environment to provide comprehensive support for lifelong learning, it should take into account all the transitions that individuals make during their lifespan. Investigate how these transitions happen and how they are supported on a system level would be another potential research area. This could bring up the questions of improving existing interoperability standards, extending the range of environments that support data transfer between them, developing standards for trustworthy grades, certifications and qualifications export, and many others.

From another angle, it is possible that most of learning transitions would involve changes of learning environments, both physical and virtual. Does not matter whether these transitions are from school to university from college to workplace, or between workplace, it is less likely that systems used by learners in high school would look the same as systems used in universities. As a result, with every transition learners might need to learn how to master a new virtual learning environment, get used to the user interface and make use of the new environment in the most efficient for productive learning way. Can this process be improved or simplified? If yes, how it can be done to improve learning experience?

9.3 General Conclusions

This thesis has presented a research project aimed on the development of an ePortfolio aided learner-centred learning environment capable of providing comprehensive support for students’ lifelong learning in universities. Based on the work presented in this thesis, the following conclusions can be drawn:

1. It is possible to develop such a learner-centred virtual learning environment that can provide support for lifelong learning in universities, as has been demonstrated by the implementation of the stakeholders requirements in the prototype.
2. As has been shown by extending the Mahara ePortfolio system, it is feasible to

improve an existing ePortfolio system based on the formal requirements specification developed in the course of this project, and therefore to address the expectations of the ePortfolio systems to support lifelong learning.

3. The findings from the evaluation studies indicate that the prototype functionality meets the needs of the stakeholders in both learning and teaching contexts. However, these findings should be confirmed by the further research investigations suggested in the previous section.

It is important to note here that the questions raised in this research are not exhausted. This project only touched on the issues that exist in the area. There are still challenges in working towards a comprehensive support for lifelong learning in universities, but these go beyond technologies. Overall, this research showed how much can be achieved by encouraging cooperation between the stakeholders and listening to the learner's voice. With the rapidly changing world of technology, this is very important. Understanding the learners' needs will help universities to invest in the successful adoption of the suitable learning systems providing students with technology that would assist their lifelong learning journey anywhere and at any time.

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Appendix A

Ethics Documentation: Requirements Analysis

This appendix provides the ethics documentation used in the study of lifelong learning requirements described in Chapter 5. The following documents are:

- Letter of ethical approval for the study.
- Information sheet for lecturers.
- Information sheet for students.
- Participant Consent form.

A.1 Ethics Approval Letter



MASSEY UNIVERSITY

16 December 2009

Yuliya Bozhko
60A Victoria Avenue
PALMERSTON NORTH 4410

Dear Yuliya

Re: Lifelong Learning Supported by e-Portfolio Processes

Thank you for your Low Risk Notification which was received on 16 December 2009.

Your project has been recorded on the Low Risk Database which is reported in the Annual Report of the Massey University Human Ethics Committees.

The low risk notification for this project is valid for a maximum of three years.

Please notify me if situations subsequently occur which cause you to reconsider your initial ethical analysis that it is safe to proceed without approval by one of the University's Human Ethics Committees.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, e-mail humanethics@massey.ac.nz".

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to provide a full application to one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

John G O'Neill (Professor)
**Chair, Human Ethics Chairs' Committee and
Director (Research Ethics)**

cc Dr Eva Heinrich
School of Engineering and
Advanced Technology
PN321

Prof Don Cleland, HoS
School of Engineering and
Advanced Technology
PN456

Massey University Human Ethics Committee
Accredited by the Health Research Council

Te Kūnenga
ki Pūrehuroa

Research Ethics Office, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand
T +64 6 350 5573 +64 6 350 5575 F +64 6 350 5622
E humanethics@massey.ac.nz animalethics@massey.ac.nz gtc@massey.ac.nz
www.massey.ac.nz

A.2 Information Sheet for Lecturers



Massey University
COLLEGE OF SCIENCES

SCHOOL OF ENGINEERING
AND ADVANCED TECHNOLOGY
Private Bag 11 222
Palmerston North 4442
New Zealand
T 64 6 350 5574
F 64 6 350 5604
www.massey.ac.nz

Lifelong Learning Supported by ePortfolio Processes

INFORMATION SHEET

My name is Yuliya Bozhko. I am a PhD student in information technology at Massey University. This research is being conducted under the supervision of Dr Eva Heinrich, A/Prof Mark Brown and Dr David Parsons, also of Massey University.

The aim of this information sheet is to inform you of a study undertaken at Massey University in which you are invited to participate.

The overall aim of my research is to develop a concept and prototype of a learner-centered e-learning environment which will provide comprehensive support for lifelong learning of students in universities. This environment will be built on an institutionally focused Learning Management System (LMS) and a learner focused ePortfolio system. However, to know what the requirements for such an environment are, it is important to find out the needs from both, lecturer (teaching) and student (learning) sides. This is where I need your help.

Your name has been given to me by my supervisor as a name of an academic who has experience in using ePortfolio systems in teaching and learning contexts.

I will initially approach to seven academics at Massey University to invite to participate in this research. Seven participants from the lecturer side should be enough to generate the data I need for the current study.

I will as well involve students and university graduates in interviews to cover the requirements from the learner side.

If you agree to participate in my study, I will interview you to investigate the requirements for an environment that can support lifelong learning in universities.

This will involve face to face semi-structured interviews guided by a set of scenarios and open-ended questions. I expect the entire process to take up to one hour to complete. To facilitate the interviews analysis I would like to record the interview in audio format. The interview recordings will be transcribed and you will be presented with a copy of this transcript.

To protect the privacy of participants, all the data collected will be reported in anonymous form. Yet, due to the nature of my sample it might be possible to infer your identity. Results will appear in a thesis and academic publications. Quotations from your answers may also be used.

The consent forms and audio records will be stored for a period of five (5) years. At the end of this period, both consent forms and the audio records will be destroyed.

The results of this study will be used to help develop a concept and prototype of a system that can support and facilitate students' lifelong learning at universities.

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any time before your interview or before data analysis was conducted;
- ask any questions about the study at any time during participation;

- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- be given access to a summary of the project findings when it is concluded;
- ask for the recorder to be turned off at any time during the interview.

Project contacts:

Office: AgHort A3.68, Turitea Campus, Massey University

E-mail: y.bozhko@massey.ac.nz or e.heinrich@massey.ac.nz

Phone: Yuliya (06) 356 9099 ext. 2625 or Eva (06) 356 9099 ext. 2466

Please feel free to contact either me or my supervisor if you have any questions about the project.

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, email humanethics@massey.ac.nz.

A.3 Information Sheet for Students



MASSEY UNIVERSITY
COLLEGE OF SCIENCES
TE WĀHANGA PŪTAIAO

Lifelong Learning Supported by ePortfolio Processes

INFORMATION SHEET

My name is Yuliya Bozhko. I am a PhD student in information technology at Massey University. This research is being conducted under the supervision of Dr Eva Heinrich, A/Prof Mark Brown and Dr David Parsons, also of Massey University.

The aim of this information sheet is to inform you of a study undertaken at Massey University in which you are invited to participate.

The overall aim of my research is to develop an e-learning environment which will provide comprehensive support for your lifelong learning in the university. To do this I want to use systems that are already familiar to you such as Learning Management System (like Stream or WebCT) and an ePortfolio system (like Mahara). However, to know what the requirements for such an environment are, it is important to find out the needs from both, lecturers and students, which is where I need your help.

I have already conducted interviews with the lecturers. And now I am looking for students who have experience in using ePortfolio system in studying. I will initially approach up to fifteen other students at Massey University to invite to participate in this research. I will try to select participants from various years of study and various programs. Fifteen participants from the student side should be enough to generate the data I need for the current study.

If you agree to participate in my study, I will interview you to investigate the requirements for an environment that can support your lifelong learning in the university.

This will involve face to face semi-structured interviews guided by a set of scenarios and open-ended questions. The entire process will take no more than one hour to complete. To facilitate the interviews analysis I would like to record the interview in audio format. The interview recordings will be transcribed and if you want, you will be presented with a copy of this transcript.

To protect the privacy of participants, all the data collected will be anonymous. But due to the nature of my sample it might be possible to infer your identity. Results will appear in a thesis and academic publications. Quotations from your answers may also be used.

The consent forms and audio records will be stored for a period of five (5) years. At the end of this period, both consent forms and the audio records will be destroyed.

For your information: you are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any time;
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- be given access to a summary of the project findings when it is concluded;
- ask for the recorder to be turned off at any time during the interview.

Project contacts:

Office: AgHort A3.68, Turitea Campus, Massey University
E-mail: y.bozhko@massey.ac.nz or e.heinrich@massey.ac.nz

Phone: Yuliya (06) 356 9099 ext. 2625 or Eva (06) 356 9099 ext. 2466

Please feel free to contact either me or my supervisor if you have any questions about the project.

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, email humanethics@massey.ac.nz.

A.4 Participant Consent Form



Massey University
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SCHOOL OF ENGINEERING
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Private Bag 11 222
Palmerston North 4442
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T 64 6 350 5574
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www.massey.ac.nz

Lifelong Learning Supported by ePortfolio Processes

PARTICIPANT CONSENT FORM

This consent form will be held for a period of five (5) years

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree to the interview being sound recorded.

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature:

Date:

Full Name - printed

Would you like to receive a summary of the findings of this study? YES / NO

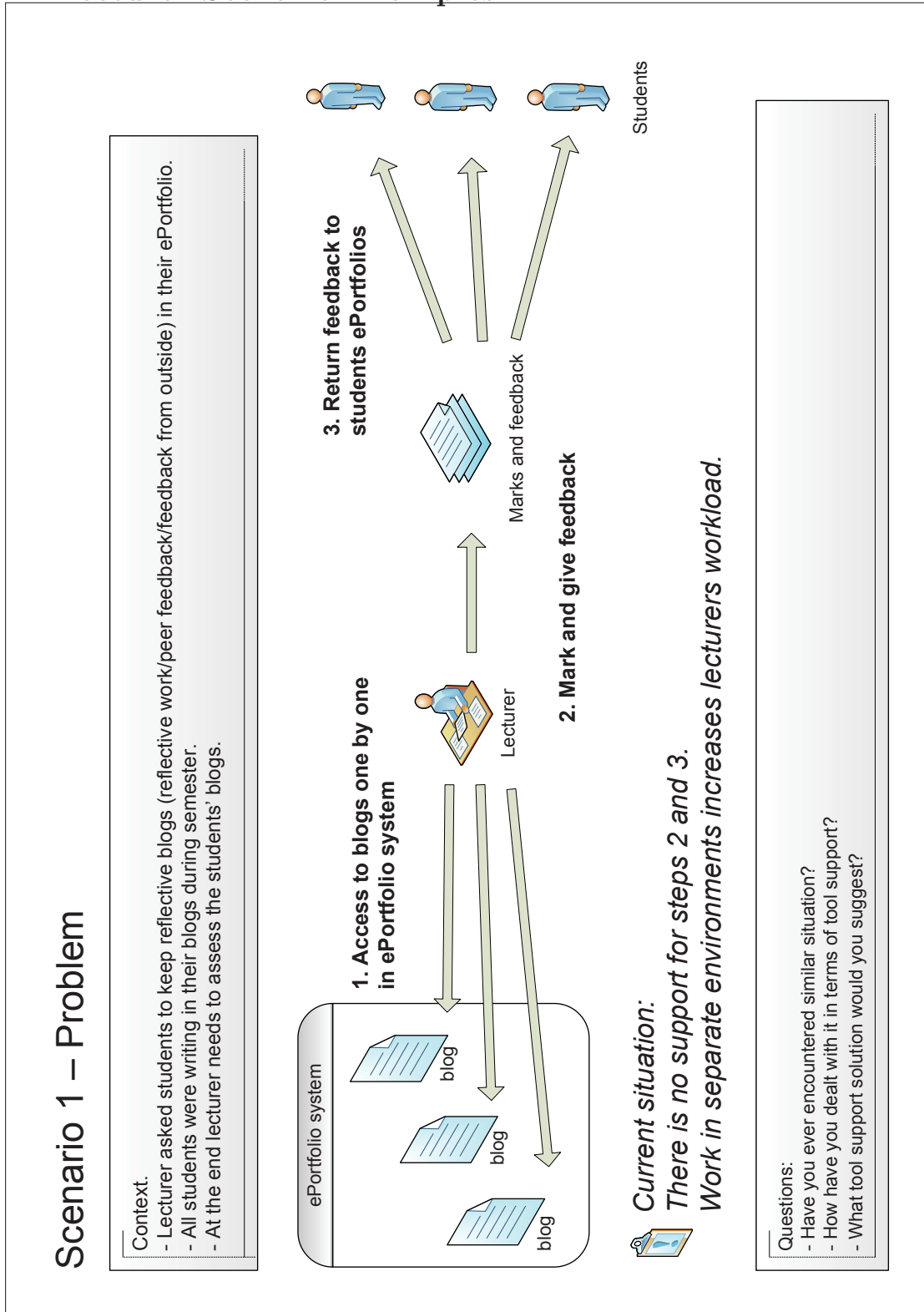
Appendix B

Interviews Documentation

This appendix provides the supporting documents used in the study of lifelong learning requirements described in Chapter 5. The following documents are:

- Scenarios used in interviews with lecturers.
- Questions used in interviews with lecturers.
- Scenarios used in interviews with students.
- Questions used in interviews with students.

B.1 Lecturer Scenario Examples

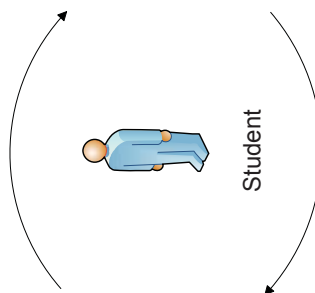
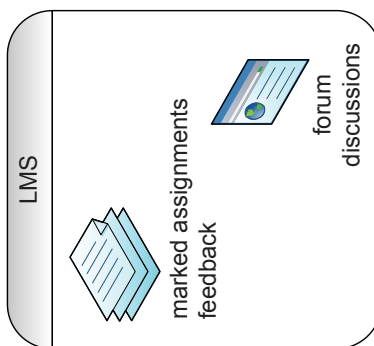


Scenario 2 – Problem

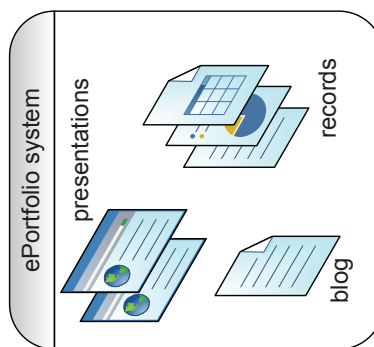
Context.

- Graduate profiles state that students should develop lifelong learning skills.
- Lecturer suggests to students to copy their forum discussions/ marked assignments into their ePortfolio as an evidence of such skills.

**Potential for valuable examples/
evidence of lifelong learning skills**



Evidence of achievements



Current situation:

There is no support for import/export of records between systems

Questions:

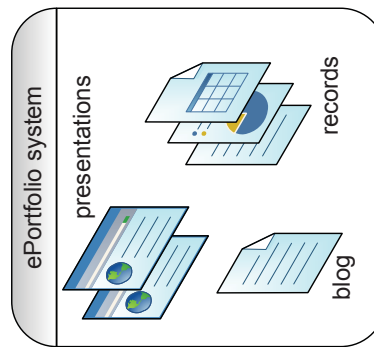
- Have you ever encountered similar problem with your students?
- What tool support solution would you suggest?

Scenario 3 – Problem

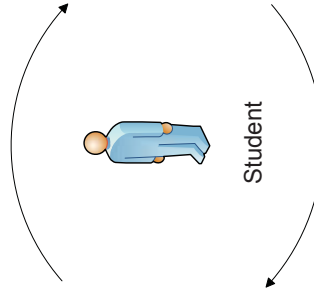
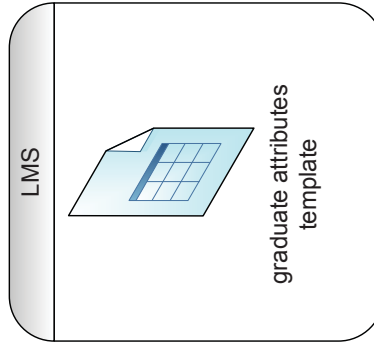
Context.

- Lecturer/course administrator creates a programme graduate attributes/outcomes template in LMS
- Students are asked to fill in the template with the examples of their achievements during study period
- Students collect their examples in the ePortfolio system as it is a more suitable tool with long term access

Evidence of achievements



Graduate attributes template



Current situation:



There is no support for import/export of records between systems

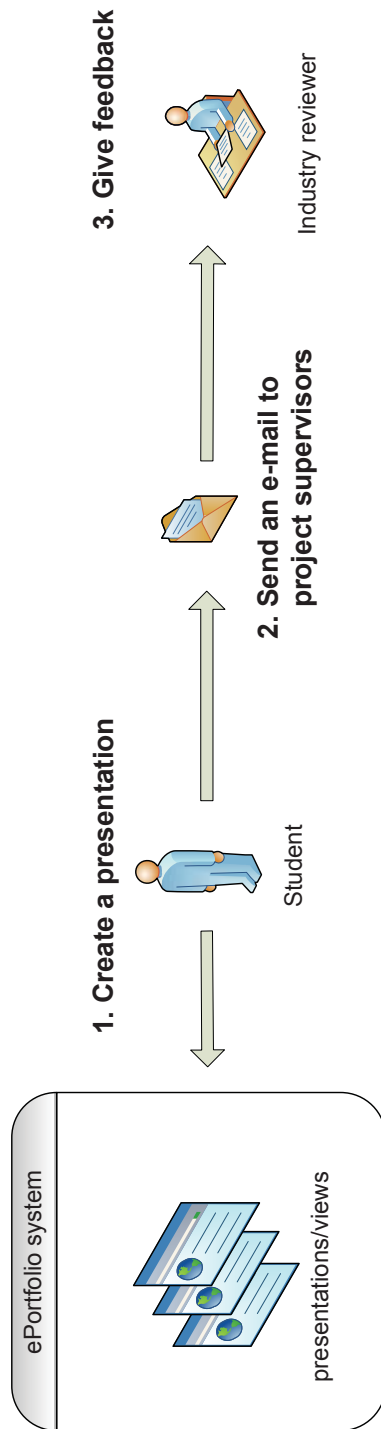
Questions:

- Do you think it is a realistic scenario?
- What tool support problem do you see here?
- What tool support solution would you suggest?

Scenario 4 – Problem

Context.

- Student created a ePortfolio presentation on his project progress and sent to his supervisors for feedback
- Supervisors don't have an account in ePortfolio system.



Current situation:

*There is no support for steps 2 and 3 in ePortfolio system.
Users outside of the system can see only publicly accessible views.
There are no convenient tools for leaving their feedback.*

Questions:

- Have you ever encountered similar problem?
- What system feature would you like to have to solve it?

B.2 Guiding questions for the interviews with lecturers

- What is your role as a teacher within the ePortfolio system at the university?
- What is your experience of using LMS and ePortfolio systems with students at the university?
- What do you see as the biggest problems or inefficiencies with using these systems?
- Can you describe some specific areas of strengths and weaknesses of the ePortfolio system you have used?
- What do you think you need to be able to accept an ePortfolio system? What would be your conditions for its use by students?
- Looking at LMS from a different perspective, could you add anything to it which is outside its core functionality that would support students in lifelong learning?
- What would you like to do that your ePortfolio system does not allow you to do now, so that it could become more useful and relevant to lifelong learning support in universities?
- What would you expect a system designed for supporting lifelong learning provide for students?
- What other features would you like to see in environments which support students in lifelong learning in universities?
- To sum up, we discussed such features as Which of them do you think are the most important for a student-centred lifelong learning environment?

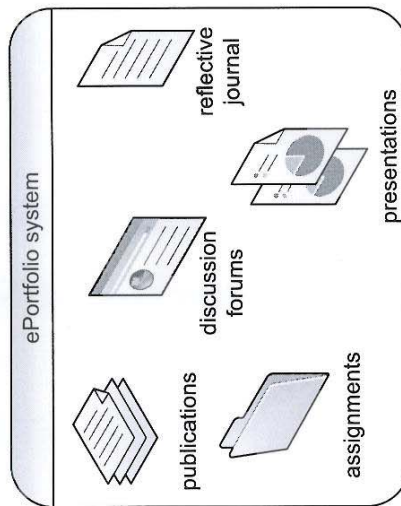
B.3 Student Scenario Examples

Scenario 1 – Problem

Context.

- Student was collecting records from various areas in ePortfolio.
- Student wants to track personal progress by developing a structure that will encompass such three dimensions as time, activities/skills, proficiency.
- Student wants to include it later into presentations, sent for feedback, add to job application.

1. Collecting records from various areas



2. Tracking personal progress



Current situation:
There is no support for step 2

Questions:

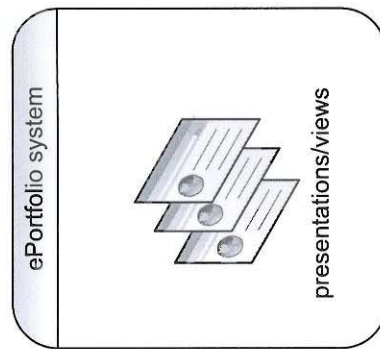
- Have you ever encountered similar problem?
- What tool support solution would you prefer?

Scenario 2 – Problem

Context.

- Student creates presentation about his research project.
- He wants to share it with research community for feedback.
- Members of these community don't have accounts in the ePortfolio system.

1. Create a presentation



2. Send a presentation to a research community



3. Give feedback



Current situation:

There is no support for steps 2 and 3.

Users outside of the system can only publicly accessible views.

There are no convenient tools for managing access to views.

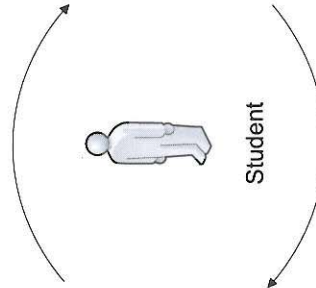
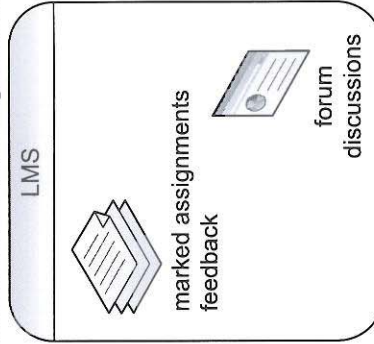


Scenario 3 – Problem A

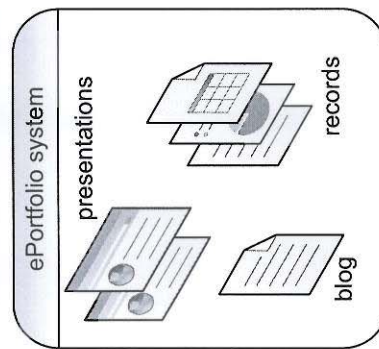
Context.

- Graduate profiles state that students should develop lifelong learning skills.
- Lecturer suggests to students to copy their forum discussions/ marked assignments into their ePortfolio as an evidence of such skills.

Potential for valuable examples/ evidence of lifelong learning skills



Evidence of achievements



Current situation:

There is no support for import/export of records between systems

Questions:

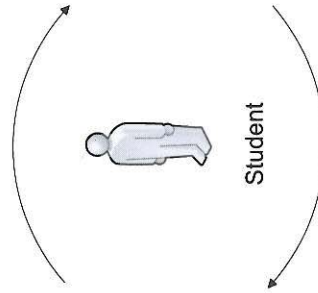
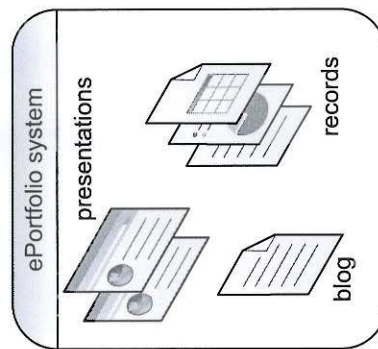
- Have you ever encountered similar problem with your students?
- What tool support solution would you suggest?

Scenario 3 – Problem B

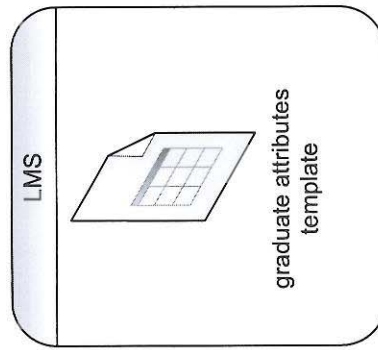
Context.

- Lecturer/course administrator creates a programme graduate attributes/outcomes template in LMS
- Students are asked to fill in the template with the examples of their achievements during study period
- Students collect their examples in the ePortfolio system as it is a more suitable tool with long term access

Evidence of achievements



Graduate attributes template



Current situation:

There is no support for import/export of records between systems

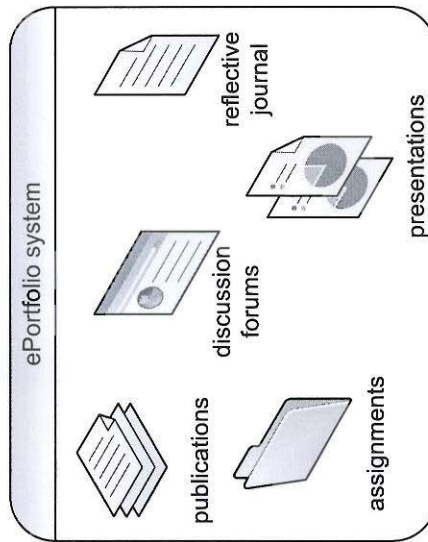
Questions:

- Do you think it is a realistic scenario?
- What tool support problem do you see here?
- What tool support solution would you suggest?

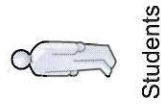
Scenario 4 – Problem

Context.

- Students collect a lot of information from various sources in their ePortfolio throughout their study at the university.
- Students can add tags to some records, but there are no other means to structure information.
- When students want to search through the set of records, they can get a list of records which are related to the search as well as not related.



Collecting records in ePortfolio system



Current situation:

Information in ePortfolio is poorly structured and evolves in time.

Questions:

- Do you see an issue in this scenario?
- How do you structure information in your ePortfolio?
- Is current approach sufficient for you?

B.4 Guiding questions for the interviews with students

- What is your experience of using LMS and ePortfolio systems at the university?
- Can you describe some specific areas of strengths and weaknesses of the ePortfolio system you have used?
- What would you like to do that your ePortfolio system does not allow you to do now, so that it could become more useful and relevant to lifelong learning support in universities?
- What do you see as the biggest problems or inefficiencies with using ePortfolio systems?
- What features would you like to see in environments that could support your lifelong learning at the university?
- To sum up, we discussed such features as Which of them do you think are the most important for an environment that provides support for your lifelong learning?

Appendix C

Component Requirements

C.1 User Stories

User stories were used in this thesis for representing requirements of the implemented features. They are an easy way of stating functional requirements and communicating them in a way that can be understood by end users (Crispin, 2003).

Each user story tells a story about user interacting with the system. It is not necessary to capture everything at once in user stories. Usually, some most valuable aspects of the system features are described.

A standard way of capturing user stories is in the following form (Cohn, 2004; Coplien and Björnvig, 2010):

As a [role/actor] I can [function/action] so that [rationale/achievement].

For example,

As a student I can perform a search on concept maps to help me find the concepts.

Each user story can be accompanied by its acceptance criteria. Acceptance criteria or tests are used to confirm that a story is completed, fully implemented, and works as expected (Cohn, 2004). They also provide more details of a user story. The tests for the requirements described in this appendix were a part of the prototype implementation and testing process.

The purpose of each of the components has already been described in Chapter 5.

The following sections of this appendix outline the requirements of the implemented components in the form of user stories.

C.2 Version Control Elements

Table C.1: Implemented requirements for version control elements

Component: Version Control Elements	
1.01	<p><i>User can create a new version of a page</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – A page has one (first) version by default – Page is not a system type or group type – Page is not submitted for review – Name for the new version of the page satisfies the requirements for page names – Content of the latest version is copied to the new version
1.02	<p><i>User can remove a version of a page</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – Only one version at a time can be removed – If all versions are removed, the page is removed as well – Verify that links between versions are properly established when a version that has next version is removed
1.03	<p><i>User can remove a page</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – Verify that all versions are removed if the page is removed completely
1.04	<p><i>User can edit any version of the page</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – User can edit page names of any version of the page – User can edit page content of any version of the page
1.05	<p><i>User can share a page with other users</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – User can share a specific version of the page – User can share all versions of the page – Verify that other users have proper permissions to view the page
<i>continued on next page</i>	

<i>continued from previous page</i>	
Component: Version Control Elements	
1.06	<p><i>User can navigate between page versions</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – User can navigate to a specific version – User can navigate through the versions using a navigation menu
1.07	<p><i>User can leave feedback on the page</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – User can leave feedback on any version of the page

C.3 Concept Mapping Module

Table C.2: Implemented requirements for concept mapping module

Component: Concept Mapping	
2.01	<p><i>User can create a concept map</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – User cannot create a map without completing all the mandatory fields of the form – An additional custom timeframe can be selected from the list
2.02	<p><i>User can load a concept map in a diagram perspective</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – Nodes of different type have different colours – Verify that the hierarchy is displayed properly – Number of examples attached to each definition node is displayed – User can switch to another perspective at any time – User expand or collapse any node – User expand or collapse an entire diagram
2.03	<p><i>User can add nodes to concept map</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – User can add concept nodes – User can add definition nodes – Verify that concept-type node cannot be added to the definition-type node – Node is created if the mandatory field of the form is completed – Verify that the page is dynamically reloading to display changes
<i>continued on next page</i>	

<i>continued from previous page</i>	
Component: Concept Mapping	
2.04	<p><i>User can edit nodes</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - User can rename a concept node - User can rename a definition node - Verify that the page is dynamically reloading to display changes
2.05	<p><i>User can delete nodes</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - User can delete a concept node - User can delete a definition node - Verify that the key concept node cannot be removed - Verify that all sub-nodes are removed together with the parent node - Verify that all examples are detached - Verify that the page is dynamically reloading to display changes
2.06	<p><i>User can change type of a concept map element</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - A definition-type node can be changed to a concept-type node - A concept-type node can be changed to a definition-type node - Verify that all examples are detached from definition-type node if its type is changed - Verify that the page is dynamically reloading to display changes
2.07	<p><i>User can create examples from artifacts from in an ePortfolio repository</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - User cannot create an example without completing all the mandatory fields of the form - By default, a new example is listed as a free fragment - By default, a date of an example is a date of an artifact
2.08	<p><i>User can add examples to the map from a diagram perspective</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - User can load a list of free fragments when adding example - User can select one or more free fragments as examples for the concept map - Verify that examples can be added to a definition-type node only - Verify that the page is dynamically reloading to display changes
<i>continued on next page</i>	

<i>continued from previous page</i>	
Component: Concept Mapping	
2.09	<p><i>User can view examples</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - Examples have to be listed in descending date order - Verify that correct examples are displayed across a hierarchy - Examples list can be collapsed/expanded
2.10	<p><i>User can manage examples</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - User can edit examples - User can delete examples - User can copy examples - Verify that all content is copied to a new example - Verify that an example is copied as a free fragment
2.11	<p><i>User can share a concept map</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - Map can be shared through e-mail, user-name, group-name, and secret URL - User can allow/restrict comments on map and/or examples
2.12	<p><i>User can perform a search on a concept map</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - User can find a node through search field - Search result is highlighted on the map - If there are more than one result, they are displayed in turns when user selects search again

C.4 Artifact Fragments Extraction

Table C.3: Implemented requirements for artifact fragments extraction

Component: Artifact Fragments Extraction	
3.01	<p><i>User can see fragments of a file</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - Number of fragments for each file is displayed in repository manager - User can see a list of all fragments with their details for each file
<i>continued on next page</i>	

<i>continued from previous page</i>	
Component: Artifact Fragments Extraction	
3.02	<p><i>User can extract a fragment from image file</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - Image file has to have JPEG, PNG, or GIF extension - An appropriate part of an image is selected - Entire image is saved as a fragment if no part is selected
3.03	<p><i>User can extract a fragment from video file</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - Video file has to have OGV, MP4, 3GP, WEBM extension - Start time of the fragment has to be specified - End time of the fragment has to be specified - End time cannot be longer than the entire video file
3.04	<p><i>User can extract a fragment from text file</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - Text file has to have TXT extension - An appropriate text fragment is selected
3.05	<p><i>User can extract a fragment from blog</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - Verify that blogposts are not drafts - More than one blogpost from the list can be selected - At least one blogpost from the list has to be selected
3.06	<p><i>User can extract a fragment from non-supported files</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - User gets the warning that this file type is not supported for fragment extraction - An entire file is added to the fragment for download
3.07	<p><i>User can extract a fragment from a bookmark</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - An entire URL is selected as a fragment - User has to specify last access date to a URL

C.5 Learning Progress Tracking

Table C.4: Implemented requirements for progress tracking

Component: Progress Tracking	
4.01	<p><i>User can load a concept map in a timeline perspective</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – Default timeframe view is year-month – Default available timeframes are year and year-month – Verify that items are loaded in correct order – User can scroll the timeline if it over-floats the web page
4.02	<p><i>User can apply custom filter to the timeline</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – Default concept level is key concept – User can select any concept from the concept hierarchy – When a concept is selected, a timeline is dynamically reloaded to display examples related to the selected concept and its sub-concepts – Verify that filter is applied to the concepts only and is not changing selected timeframe
4.03	<p><i>User can see examples on the timeline</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – User can select an example for displaying – User can display only one example at a time
4.04	<p><i>User can create a custom timeframe</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – User cannot create a custom timeframe without completing all the mandatory fields of the form – Verify that timeframes are properly formatted and parsed
4.05	<p><i>User can manage custom timeframes</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> – User can see the list of concept maps to which timeframes belongs – User can edit a custom timeframe – User can delete a custom timeframe – If timeframe is removed, it is detached from the concept map
<i>continued on next page</i>	

<i>continued from previous page</i>	
Component: Progress Tracking	
4.06	<p><i>User can apply a timeframe to the timeline</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - Custom timeframes are added to the list of available timeframes - User can select a custom timeframe - When a custom timeframe is selected, a timeline is dynamically reloaded to display examples grouped according to the custom timeframe - Verify that filter is applied to the timeframes only and is not changing selected concept

C.6 Shared Resources Management

Table C.5: Implemented requirements for shared resources management

Component: Shared Resources Management	
5.01	<p><i>User can see a page access/sharing history</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - User can access sharing history through a page settings - User actions are recorded every time a page access settings are changed - User cannot remove records from the sharing history
5.02	<p><i>User can re-share pages through the sharing history</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - User can select re-share option from the sharing history - By default re-sharing starts from the current date - By default re-sharing end field is empty - User can specify other access dates
5.03	<p><i>User can control a level of feedback provided for concept maps</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - User can allow/restrict comments on a concept map - User can allow/restrict comments on examples
5.04	<p><i>Users are notified about access expiry</i></p> <p>Acceptance Criteria:</p> <ul style="list-style-type: none"> - User can set up notification date - User can select automatic notification - Verify that system sends a system message to the users registered in the system - Verify that system sends an email to the users not registered in the system

Appendix D

Interface Screenshots

D.1 Version Control Elements

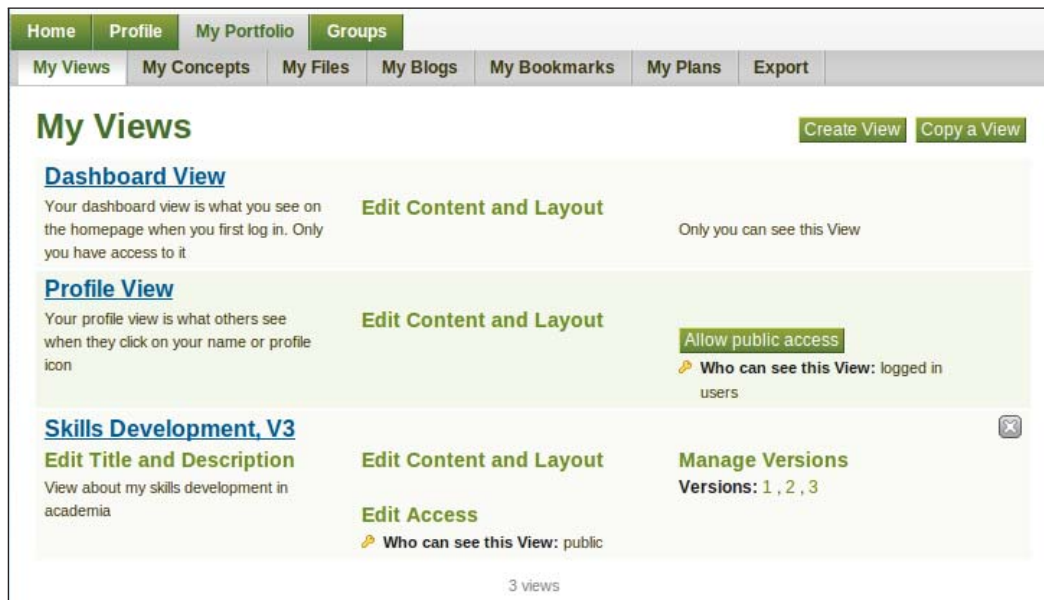


Figure D.1: Views list. The last view on the list has three versions



Figure D.2: Navigation between versions



Figure D.3: View versions management

D.2 Concept Mapping Module

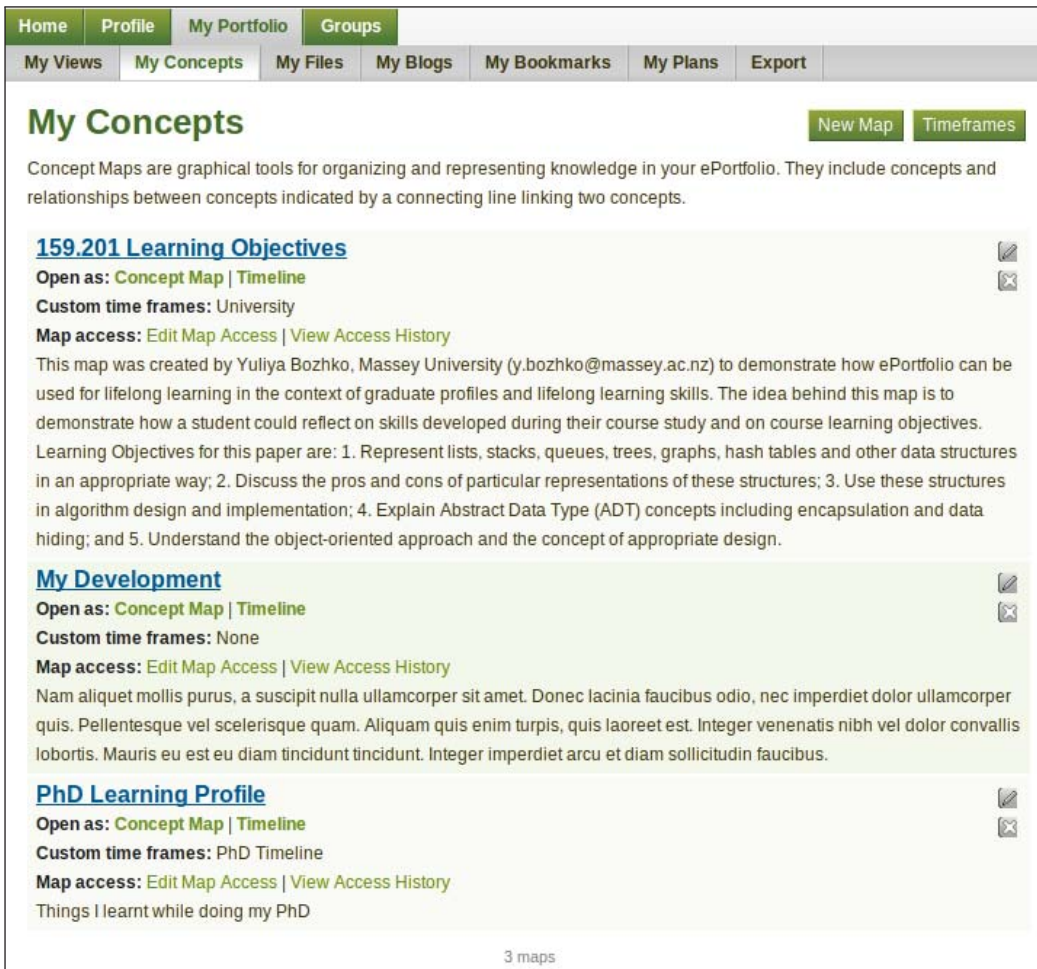


Figure D.4: Concept maps list

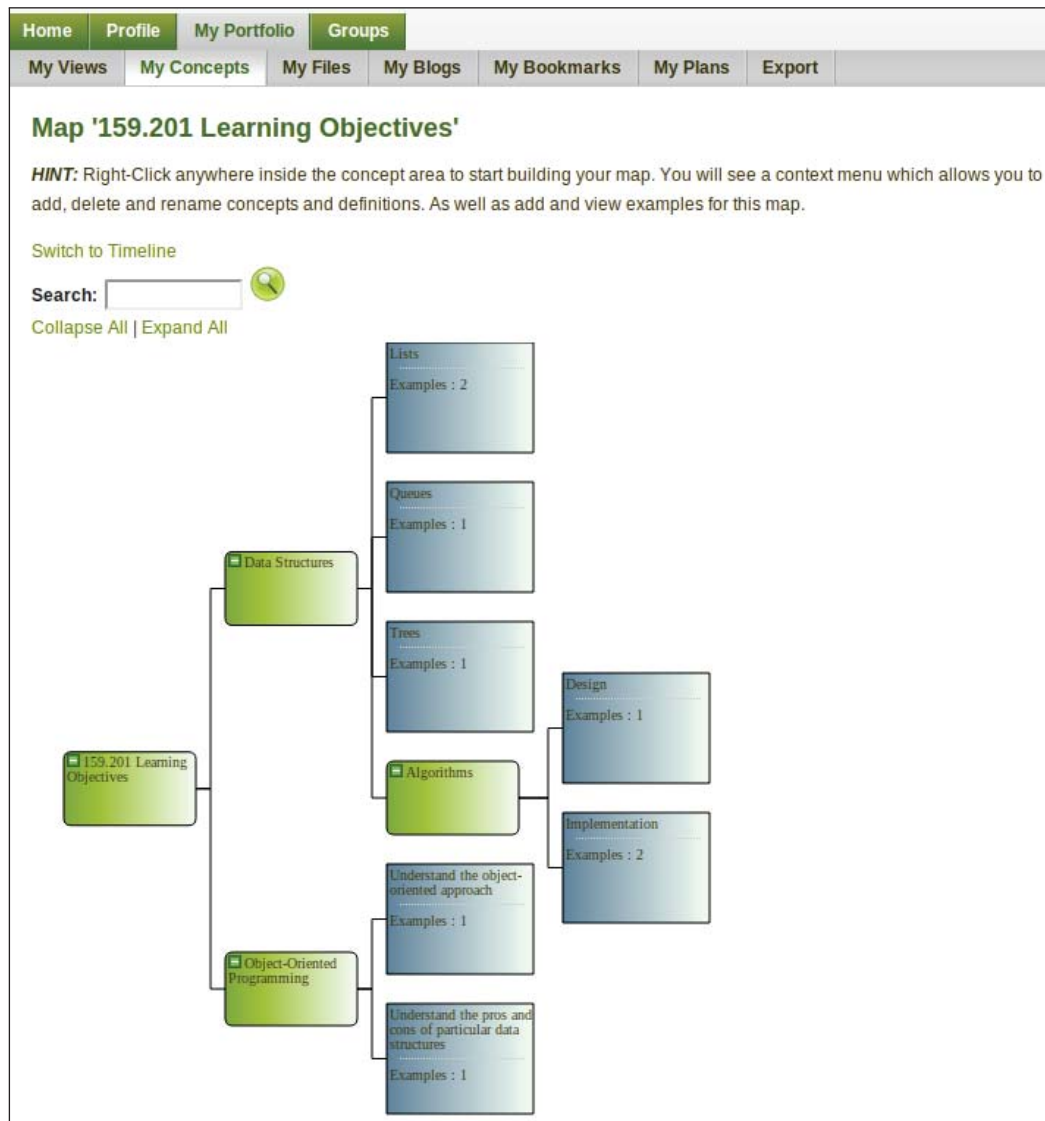


Figure D.5: Concepts layout in the form of map

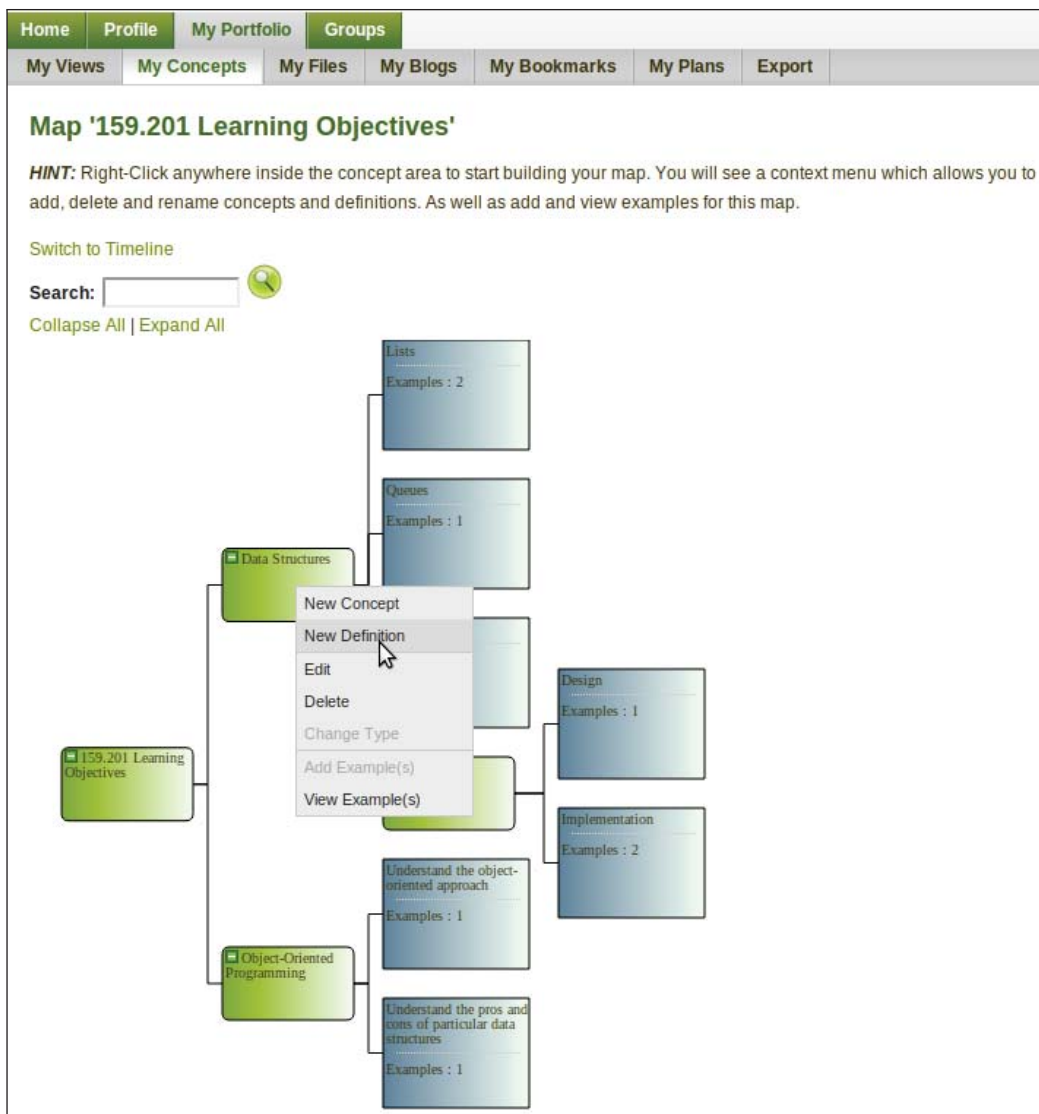


Figure D.6: Adding new items through the context menu

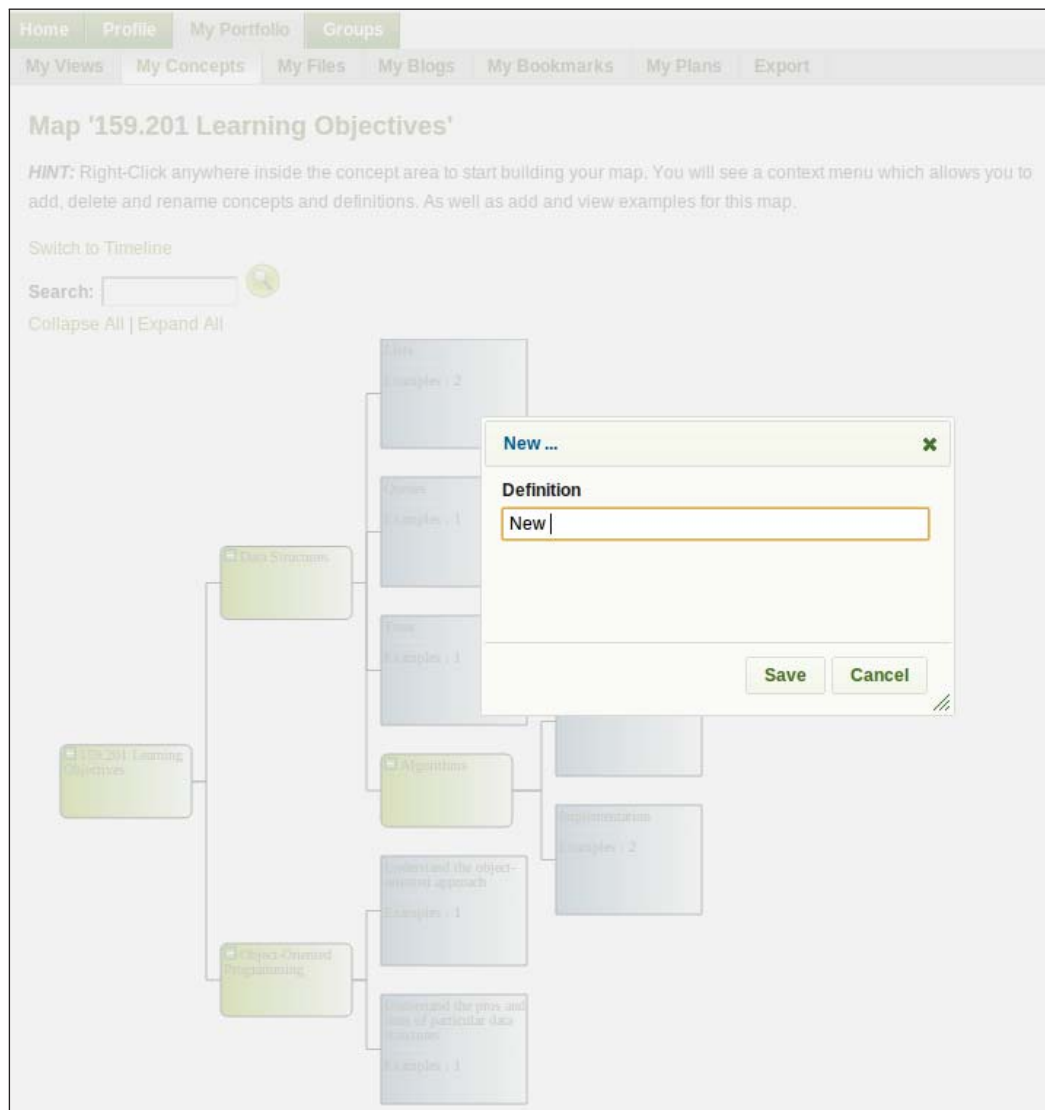


Figure D.7: Adding new definition to the map

Home Profile My Portfolio Groups

My Views My Concepts My Files My Blogs My Bookmarks My Plans Export

Examples of 'Object-Oriented Programming'

[Back to map](#)

- Pros and cons
- OOP
 - ```

graph TD
 OOP((OOP)) --- CLASSES[CLASSES]
 OOP --- DataAbstraction[Data Abstraction]
 OOP --- Encapsulation[Encapsulation]
 OOP --- InformationHiding[Information Hiding]
 OOP --- Inheritance[Inheritance]
 OOP --- Polymorphism[Polymorphism]

```
  - Reflection**

[Edit](#) | [Delete](#)

This semester I started learning about object-oriented programming (OOP). It looks pretty interesting. I understand now how cool it is and will try to perfect my skills in this area by the end of semester. An object-oriented program will usually contain different types of objects, each type corresponding to a particular kind of complex data to be managed or perhaps to a real-world object or concept such as a bank account, a hockey player, or a bulldozer. A program might well contain multiple copies of each type of object, one for each of the real-world objects the program is dealing with. For instance, there could be one bank account object for each real-world account at a particular bank. Each copy of the bank account object would be alike in the methods it offers for manipulating or reading its data, but the data inside each object would differ reflecting the different history of each account.

[Download entire file](#)

27-02-2011

Figure D.8: A list of examples attached to the map

## D.3 Artifact Fragments Extraction

### Edit Fragment

**Step 1. Select image fragment**

```

graph TD
 OOP((OOP)) --> CLASSES[CLASSES]
 OOP --> DA[Data Abstraction]
 OOP --> ENC[Encapsulation]
 OOP --> IH[Information Hiding]
 OOP --> INH[Inheritance]
 OOP --- POL[Polymorphism]

```

You can select an image fragment in a usual way: press the left mouse button, drag cursor, release the button.

**Enable downloads**  Check this box if you want others to be able to view and download an entire file

**Step 2. Write reflection**

**Title \***

Title of your example

**Fragment date \***  Use the format YYYY/MM/DD

**Reflection \***

This semester I started learning about object-oriented programming (OOP). It looks pretty interesting. I understand now how cool it is and will try to perfect my skills in this area by the end of semester.

An object-oriented program will usually contain different types of objects, each type corresponding to a particular kind of complex data to be managed or perhaps to a real-world object or concept such as a bank account, a hockey player, or a bulldozer. A program might well contain multiple copies of each type of object, one for each of the real-world objects the program is dealing with. For instance, there could be one bank account object for each real-world account at a particular bank. Each copy of the bank account object would be alike in the methods it offers for manipulating or reading its data, but the data inside each object would differ reflecting the different history of each account.

Reflection is an important aspect of your ePortfolio presentation. Describe why you think this fragment is important, what it represents, etc.

**Step 3. Select concept**

**Concept** 159.201 Learning Objectives : Object-Oriented Programming : Understand the object-oriented approach

Select a concept related to this example

Figure D.9: Artifact fragment layout



Figure D.10: Taking image file fragment

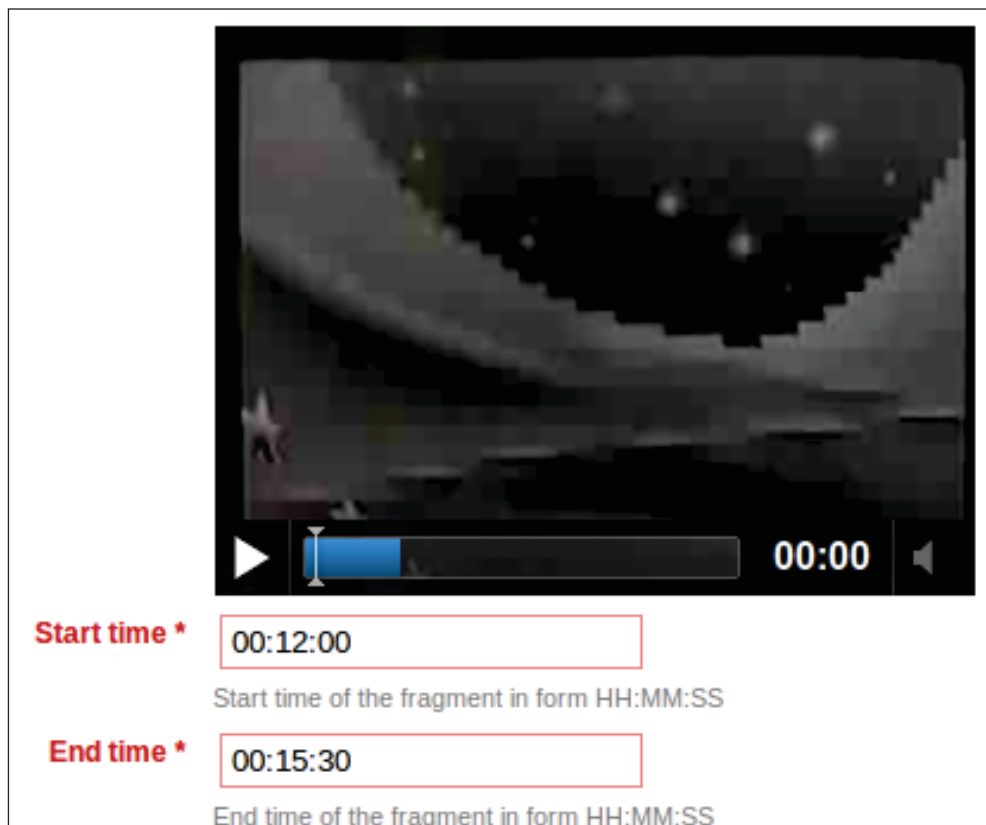


Figure D.11: Taking video file fragment

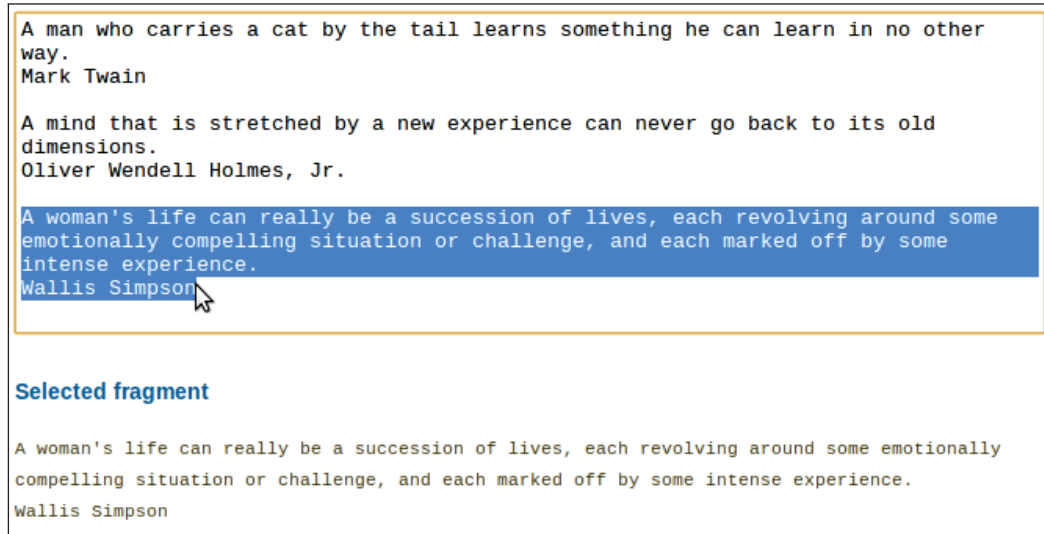


Figure D.12: Taking text file fragment

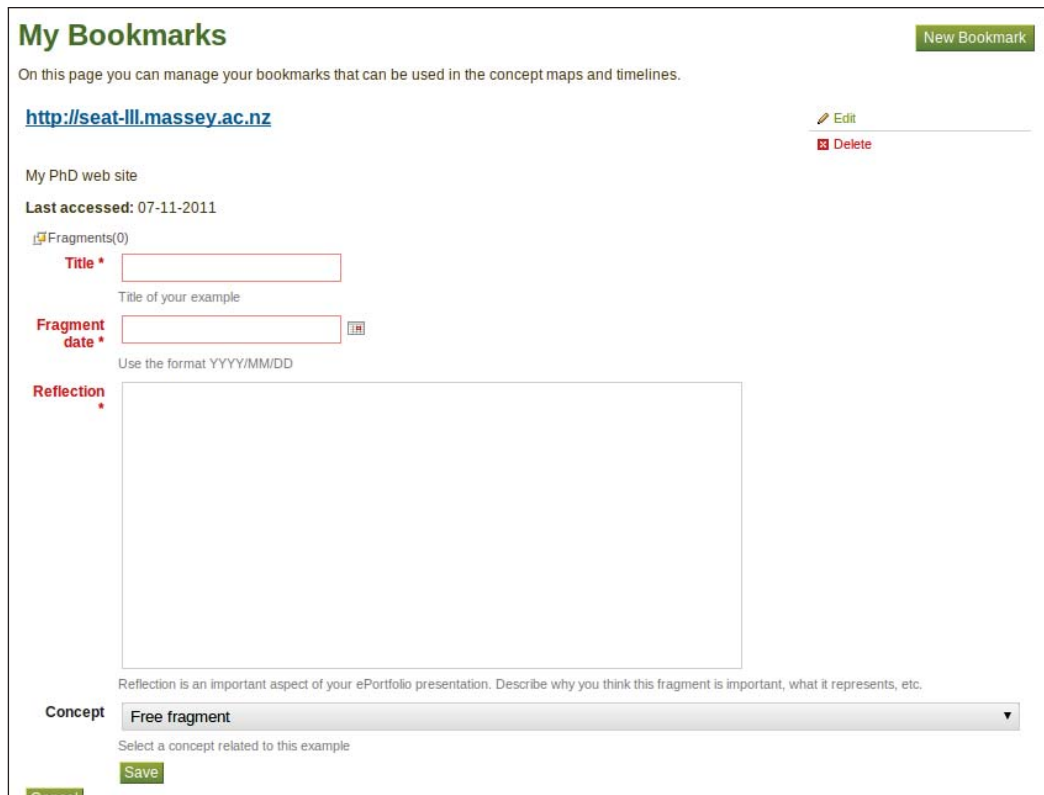


Figure D.13: Working with bookmarks

## D.4 Learning Progress Tracking



Figure D.14: Timeline layout of a map

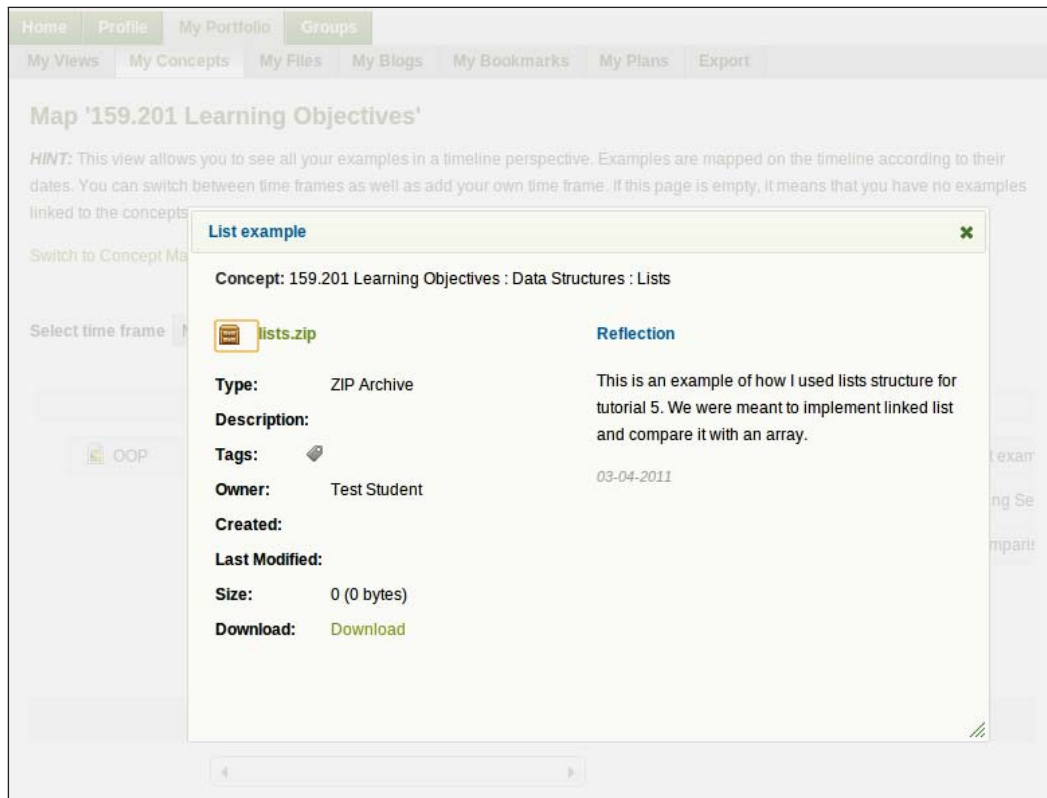


Figure D.15: An example window from a timeline page

On this page you can manage your custom timeframes that can be used in the timeline

**University** [New Timeframe](#)

[Edit](#)  
[Delete](#)

**Used in maps: 159.201 Learning Objectives**

|                    |            |            |
|--------------------|------------|------------|
| Semester 1, Year 1 | 2010-02-23 | 2010-06-12 |
| Semester 2, Year 1 | 2010-07-13 | 2010-11-20 |
| Semester 1, Year 2 | 2011-02-22 | 2011-06-14 |
| Semester 2, Year 2 | 2011-07-12 | 2011-11-19 |
| Semester 1, Year 3 | 2012-02-20 | 2012-06-03 |
| Semester 2, Year 3 | 2012-07-18 | 2012-11-16 |

---

**PhD Timeline** [Edit](#)  
[Delete](#)

**Used in maps: PhD Learning Profile**

|             |            |            |
|-------------|------------|------------|
| First Year  | 2009-02-01 | 2010-01-31 |
| Second Year | 2010-02-01 | 2011-01-31 |
| Third Year  | 2011-02-01 | 2012-01-31 |
| Final Year  | 2012-02-01 | 2013-01-31 |

Figure D.16: Custom timeframes set-up page

Select time frame **University** Select concept **159.201 Learning Objectives**

**Semester 1, Year 2**

- OOP
- Thoughts on A1
- Pros and cons
- Learning about lists
- Queue
- List example
- String Search Implementation
- Comparison Results
- Assignment 3

Figure D.17: Timeline filtered according to the custom timeframes

## D.5 Shared Resources Management

**Access History: 159.201 Learning Objectives**

Here you can see with whom your map was previously shared.

| Access Type             | Details              | Start Date   | Stop Date    |                      |
|-------------------------|----------------------|--------------|--------------|----------------------|
| Access by email         | email@example.com    | Jun 13, 2011 | Aug 31, 2011 | <a href="#">Copy</a> |
| Public access           |                      |              |              | <a href="#">Copy</a> |
| Access by secret URL    | 9Wenx8as4qLwHc7DhPKK |              |              | <a href="#">Copy</a> |
| User access: Admin User |                      |              | Jan 1, 2012  | <a href="#">Copy</a> |

[Edit Map Access](#)

Figure D.18: History access log for a view



## Appendix E

# Ethics Documentation: Prototype Evaluation

This appendix provides the ethics documentation used in the evaluation described in Chapter 7. The following documents are:

- Letter of ethical approval for the study.
- Information sheet for group experiment participants.
- Information sheet for case study participants.
- Group experiment participant consent form.
- Case study participant consent form.

## E.1 Ethics Approval Letter



MASSEY UNIVERSITY  
TE KUNENGA KI PŪREHUROA

1 September 2011

Yuliya Bozhko  
18 Manawatu Street  
Hokowhitu  
PALMERSTON NORTH 4410

Dear Yuliya

**Re: Lifelong Learning Supported by ePortfolio Processes**

Thank you for your Low Risk Notification which was received on 26 August 2011.

Your project has been recorded on the Low Risk Database which is reported in the Annual Report of the Massey University Human Ethics Committees.

The low risk notification for this project is valid for a maximum of three years.

Please notify me if situations subsequently occur which cause you to reconsider your initial ethical analysis that it is safe to proceed without approval by one of the University's Human Ethics Committees.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

**A reminder to include the following statement on all public documents:**

*"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.*

*If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, e-mail humanethics@massey.ac.nz".*

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to provide a full application to one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

John G O'Neill (Professor)  
**Chair, Human Ethics Chairs' Committee and  
Director (Research Ethics)**

cc Dr Eva Heinrich  
School of Engineering and Advanced Technology  
PN321

Dr David Parsons  
Institute of Information and Mathematical Sciences  
Albany

Prof Anthony Norris, HoI  
Institute of Information and Mathematical Sciences  
Albany

Assoc Prof Mark Brown  
National Centre for Teaching and Learning  
PN141

Prof Don Cleland, HoS  
School of Engineering and Advanced Technology  
PN456

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Massey University Human Ethics Committee  
Accredited by the Health Research Council

Research Ethics Office, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand  
T +64 6 350 5573 +64 6 350 5575 F +64 6 350 5622  
E humanethics@massey.ac.nz animalethics@massey.ac.nz gtc@massey.ac.nz  
www.massey.ac.nz

## E.2 Information Sheet for Case Study Participants



MASSEY UNIVERSITY  
COLLEGE OF SCIENCES  
TE WĀHANGA PŪTAIAO

### ***Lifelong Learning Supported by ePortfolio Processes***

#### **INFORMATION SHEET**

My name is Yuliya Bozhko. I am a Ph.D. student in information technology at Massey University. My research project is being conducted under the supervision of Dr Eva Heinrich, A/Prof Mark Brown and Dr David Parsons, also of Massey University.

The aim of this information sheet is to inform you of a study undertaken at Massey University in which you are invited to participate.

The overall aim of my research is to develop a concept and a prototype of a learner-centered e-learning environment which will provide comprehensive support for lifelong learning in university. This environment will be built on an institutionally focused Learning Management System (LMS) and a learner focused ePortfolio system. Based on the interviews with lecturers and students, I identified the requirements for such an environment at an earlier stage of the project. Some of these requirements were implemented in an ePortfolio system prototype. Now it is important to evaluate whether the implementation meets the needs of lecturers and students, which is where I need your help.

I am looking for mature postgraduate students who have experience in using ePortfolio systems while studying. For this part of the evaluation, I will initially approach up to five postgraduate students at Massey University inviting them to participate in this research. Five participants from the postgraduate students should be enough to generate the data I need for the current study.

I will as well involve undergraduate students, lecturers and administration staff from Massey University in interviews and a group experiment, to evaluate the prototype from their perspective.

If you agree to participate in my study, I will provide you with access to the ePortfolio system prototype until December 31, 2011 to try out enhanced features and new functionality. Afterwards, I will interview you to get your feedback and analyse whether the prototype meets your needs as a lifelong learner and can provide support for students' lifelong learning in universities. I expect the entire interview process to take up to one hour to complete. To facilitate interview analysis, I would like to record the interview in audio format.

To protect the privacy of participants, all the data collected will be reported in anonymous form. Yet, due to the nature of my sample, it might be possible to infer your identity. Results will appear in a thesis and academic publications. Quotations from your interview answers and the data created by you in the prototype system may also be used.

The consent forms and audio records will be stored for a period of five (5) years. At the end of this period, both consent forms and the audio records will be destroyed.

The results of this study will be used to evaluate a prototype of an ePortfolio system that can support and facilitate students' lifelong learning at universities.

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any time before your interview or before data analysis was conducted;
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to

- the researcher;
- be given access to a summary of the project findings when it is concluded.
- ask for the recorder to be turned off at any time during the interview.

Project contacts:

Office: AgHort A3.68, Turitea Campus, Massey University

E-mail: [y.bozhko@massey.ac.nz](mailto:y.bozhko@massey.ac.nz) or [e.heinrich@massey.ac.nz](mailto:e.heinrich@massey.ac.nz)

Phone: Yuliya (06) 356 9099 ext. 2625 or Eva (06) 356 9099 ext. 2466

Please feel free to contact either me or my supervisor if you have any questions about the project.

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director, Research Ethics, telephone 06 350 5249, email: [humanethics@massey.ac.nz](mailto:humanethics@massey.ac.nz).

## E.3 Information Sheet for Group Experiment Participants



MASSEY UNIVERSITY  
COLLEGE OF SCIENCES  
TE WĀHANGA PŪTAIAO

### *Lifelong Learning Supported by ePortfolio Processes*

#### INFORMATION SHEET

You are invited to participate in a research project experiment. This information sheet provides background information to the experiment.

##### **Introduction**

The overall purpose of this research is to develop a learner-centered e-learning environment which will provide comprehensive support for lifelong learning in universities. The concept of this environment is built on an institutionally focused Learning Management System like Stream and a learner focused ePortfolio system. Based on interviews with lecturers and students at an earlier stage of the project, the requirements for such an environment were identified. Some of these requirements were implemented in an ePortfolio system prototype. You are invited to participate in the experiment that will evaluate this prototype.

The goals for this experiment are:

- to evaluate whether concept maps embedded into ePortfolio are suitable for supporting learning reflection;
- to understand whether the concept map tool can be successfully used for addressing graduate attributes/learning objectives;
- to analyse whether the concept map tool can help students develop understanding of their knowledge and learning experiences.

This research is being conducted as a part of doctoral studies by the researcher Yuliya Bozhko under the supervision of Dr Eva Heinrich, A/Prof Mark Brown and Dr David Parsons.

Participation in this project is voluntary. Students will not be penalized for not agreeing to participate in this research.

##### **Participant Involvement and Support**

As a participant of this experiment you will be asked to complete two exercises. First – using pen and paper, and second – using an ePortfolio system. Prior to the exercises you will be provided with the instructions on how to use an ePortfolio system and the concept mapping tool in particular. The researcher will be available at all stages of the experiment for technical support and for answering your questions. During the session the researcher might ask you some questions to understand the way you are thinking. At the end you will be asked to complete an exit questionnaire.

To facilitate data analysis, the session will be recorded in audio format. You will be asked to complete a consent form and an exit questionnaire. These forms and recordings will be collected and kept secured for five (5) years.

The findings of this study will be made available on request to the students who have participated in the experiment.

##### **Data Collection**

The data for this experiment will be collected in the following ways:

- System logs to get statistical information about the prototype usage;
- Concept maps created in the system;
- Exercise sheets. These will be anonymised when reported in a thesis or any publication;
- Exit questionnaire

No data will be collected from individuals who have not consented to participating in this experiment.

**Participant's Rights**

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any time before data analysis was conducted;
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- be given access to a summary of the project findings when it is concluded;
- ask for the recorder to be turned off at any time during the interview.

**Project contacts**

Office: AgHort A3.68, Turitea Campus, Massey University  
E-mail: [y.bozhko@massey.ac.nz](mailto:y.bozhko@massey.ac.nz) or [e.heinrich@massey.ac.nz](mailto:e.heinrich@massey.ac.nz)  
Phone: Yuliya (06) 356 9099 ext. 2625 or Eva (06) 356 9099 ext. 2466

Please feel free to ask any questions about the project.

**Note**

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director, Research Ethics, telephone 06 350 5249, email: [humanethics@massey.ac.nz](mailto:humanethics@massey.ac.nz).

## E.4 Group Experiment Participant Consent Form



MASSEY UNIVERSITY  
COLLEGE OF SCIENCES  
TE WĀHANGA PŪTAIAO

### ***Lifelong Learning Supported by ePortfolio Processes***

#### **PARTICIPANT CONSENT FORM**

**This consent form will be held for a period of five (5) years**

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree to participate in this study under the conditions set out in the Information Sheet.

**Signature:** ..... **Date:** .....

**Full Name - printed** .....

Please leave your email below if you would like to receive a summary of the findings of this study.

## E.5 Case Study Participant Consent Form



MASSEY UNIVERSITY  
COLLEGE OF SCIENCES  
TE WĀHANGA PŪTAIAO

### ***Lifelong Learning Supported by ePortfolio Processes***

#### **PARTICIPANT CONSENT FORM**

**This consent form will be held for a period of five (5) years**

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree to the interview being sound recorded.

I agree to participate in this study under the conditions set out in the Information Sheet.

**Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Full Name - printed** \_\_\_\_\_

## Appendix F

# Study Two Documentation

This appendix provides documentation related to Study Two of the evaluation stage described in Chapter 7. The documents included in this appendix are:

- Invitation poster for students to participate in the experiment.
- Study protocol followed by each group.
- Background and Exit questionnaire for the participants.
- Screenshots of the concept maps created by the participants during the experiment.
- Exit questionnaire responses.

## F.1 Invitation Poster



MASSEY UNIVERSITY  
COLLEGE OF SCIENCE

### *Using Electronic Portfolios for Lifelong Learning*

**Would you like to take part in a study trying out new tools to help you learn?**

- We are recruiting undergraduate students to participate in this study;
- We invite you to join us in the College of Science for a 90min session where you will be introduced to an electronic portfolio system and concept mapping;
- We will offer you two exercises to complete: one – using pen and paper and another – using electronic portfolio system;
- You will be asked to fill up a questionnaire and give us your feedback on the tools that you used;
- Complimentary refreshments will be available during the session.

We are planning on starting sessions in the middle of October and will try to make times as flexible as possible. If you are an undergraduate student and would like to take part or find out more about the study please contact:

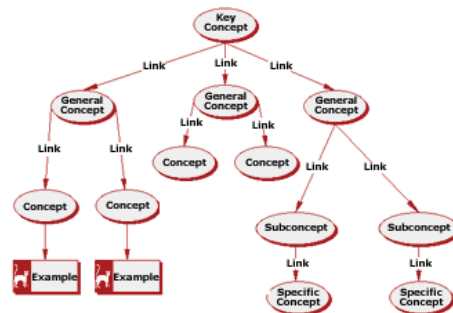
**Yuliya Bozhko**  
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**Phone: (06) 356 90 99 ext. 2625**

**Mobile: 021 025 22318**

**E-mail: [y.bozhko@massey.ac.nz](mailto:y.bozhko@massey.ac.nz)**



This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director, Research Ethics, telephone 06 350 5249, email: [humanethics@massey.ac.nz](mailto:humanethics@massey.ac.nz).

## F.2 Study Protocol

**Project: Lifelong Learning Supported by ePortfolio Processes in Universities**

Experiment Study Protocol  
 Total time – up to 2 hrs

| Activity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Time   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| <p><b>--- Preparation ---</b></p> <p><i>NOTE: Make sure that you have paper, pen, computer with Massey network or Internet access and browser Firefox or Chrome installed, questionnaires, and a watch.</i></p> <p>Brief introduction to the research.</p> <p>Ask participant to study information sheet.</p> <p>If participant agrees to take part in the research then:<br/>                     - Sign consent form</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 10 min |
| <p><b>--- Introduction ---</b></p> <p>Discuss with participant lifelong learning, skills, graduate attributes, ePortfolios, concept maps.</p> <p>During discussion show examples of graduate attributes/learning outcomes/learning objectives:<br/> <a href="#">Paper outline for 228.485 Engineering Project</a><br/> <a href="#">Graduate Attributes for Mathematics Major</a><br/> <a href="#">Paper outline for 141.471 Food Process Design and Safety</a><br/> <a href="#">Paper outline for 122.102 Biochemistry of Cells</a><br/> <a href="#">Paper outline for 159.201 Algorithms and Data Structures</a></p> <p>Describe or show the examples of ePortfolios use (e.g. for job applications as CV, for feedback on experiences or achievements, for assessment at uni, etc).</p> <p>Discuss and show examples of concept maps.<br/> <a href="#">The Theory Underlying Concept Maps and How to Construct and Use Them</a><br/> <a href="#">Wikipedia article on Concept maps</a><br/> <a href="#">Classroom Assessment Techniques Concept Mapping</a></p> | 15 min |
| <p><b>--- Exercise One ---</b></p> <p>On Massey Stream, find with participant any paper they are/were studying. Open paper outline and find a section on learning outcomes or objectives.</p> <p>If not studying any paper at the moment, think about you skills as a professional _____ (engineers, designer, lawyer).</p> <p>Ask a participant to create a concept map of the learning outcomes/skills using pen and paper. Ask them to think about what kind of examples they could provide to support their achievement of these outcomes/skills.</p> <p><i>NOTE: would be good to capture behaviour or take pictures of working process (with permission).</i></p>                                                                                                                                                                                                                                                                                                                                                                                           | 30 min |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <p><b>--- Exercise Two ---</b></p> <p>Provide participants with ePortfolio login and password from the prototype accounts spreadsheet.<br/> <i>NOTE: When providing an account, update spreadsheet that account is used.</i></p> <p>Show the ePortfolio system and show how to use:</p> <ul style="list-style-type: none"> <li>- Concept maps</li> <li>- Fragments</li> <li>- Timeline</li> <li>- Timeframes</li> </ul> <p>Show the manual on <a href="http://seat-lll.massey.ac.nz/redmine/projects/ep4lll/wiki/Concept_Maps">http://seat-lll.massey.ac.nz/redmine/projects/ep4lll/wiki/Concept_Maps</a></p> <p>Show the example on <a href="#">Example for 159.201 learning objectives</a></p> <p>Ask participant to transfer their concept map from Exercise One to the system. They can create dummy examples that support their concepts. Content is not important as soon as they are following the conceptual ideas.</p> <p>Review the results and ask for explanations if necessary.</p> | <p>30-40 min</p> |
| <p><b>--- Final notes ---</b></p> <p>Ask participant to complete all sections of exit questionnaire.</p> <p>If necessary, ask for explanation of observed behaviours.</p> <p>Collect questionnaire and exercise sheets.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <p>5-10 min</p>  |

## F.3 Background and Exit Questionnaire

### **Project: Lifelong Learning Supported by ePortfolio Processes in Universities**

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#### **Section A. Background Information**

1. Circle age range: under 20 / between 20 to 30 / over 30

2. Circle gender: M / F

3. Which Degree Program (e.g. BA, BSc, BE, DipInfSci, PhD, MA) are you currently enrolled in?

4. Before doing these exercises, did you know anything about:

- lifelong learning? - Y/N
- graduate attributes? - Y/N
- concept mapping? - Y/N
- ePortfolios? - Y/N

*If yes, please briefly indicate what you knew.*

**Section B. Concept Mapping for Addressing Graduate Attributes.**

1. What was your experience of using concept maps with ePortfolio system?

2. Indicate what you consider the impact of concept mapping might have on the development understanding of personal learning achievements and graduate attributes?

3. What do you like the most about it?

4. What do you like the least about it?

5. What further improvements would you recommend?

6. How useful do you consider the tools that you have used?  
(Please circle one where 10 is highly useful and 1 is not useful at all)

1    2    3    4    5    6    7    8    9    10

7. Please add any other comments you may have about using concept mapping within ePortfolio system.

## F.4 Concept Map Examples Created by Students

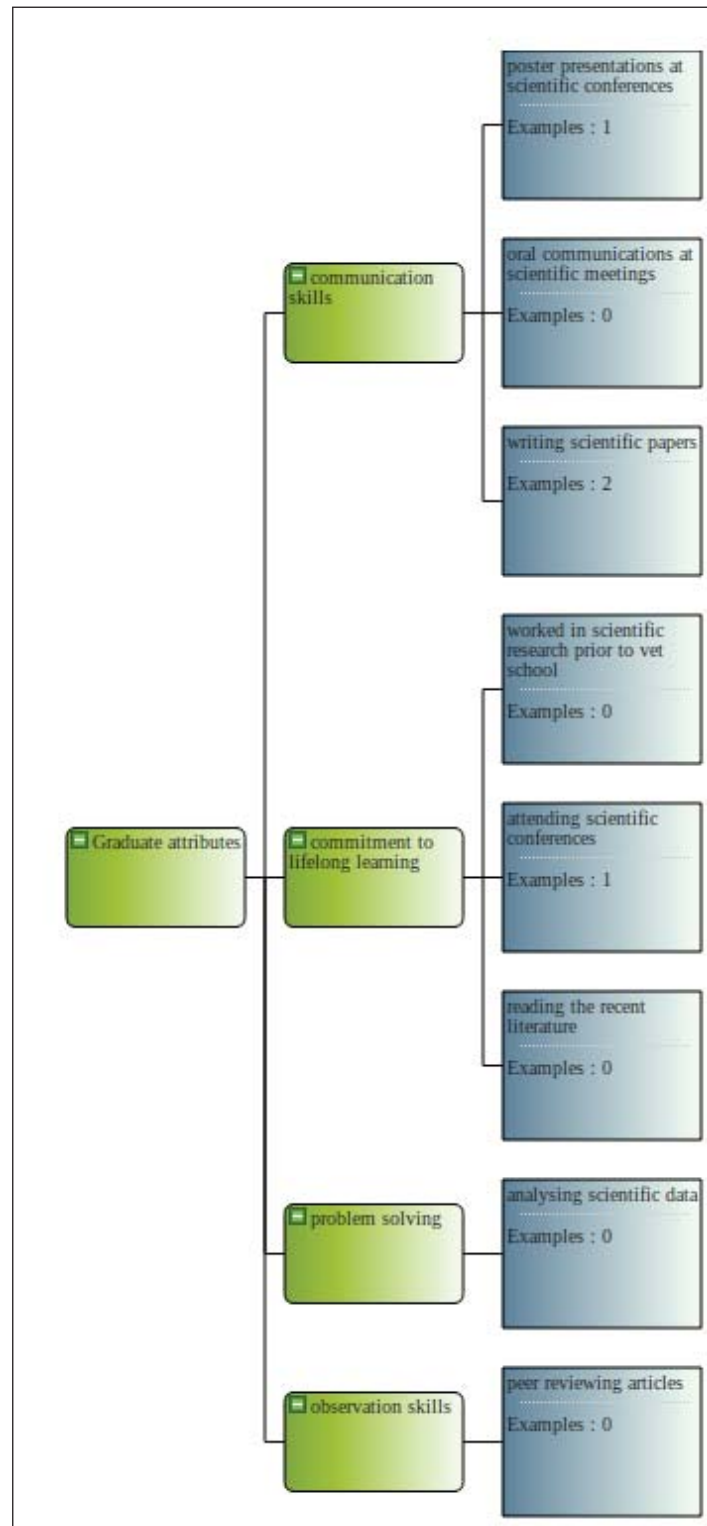


Figure F.1: Example 1

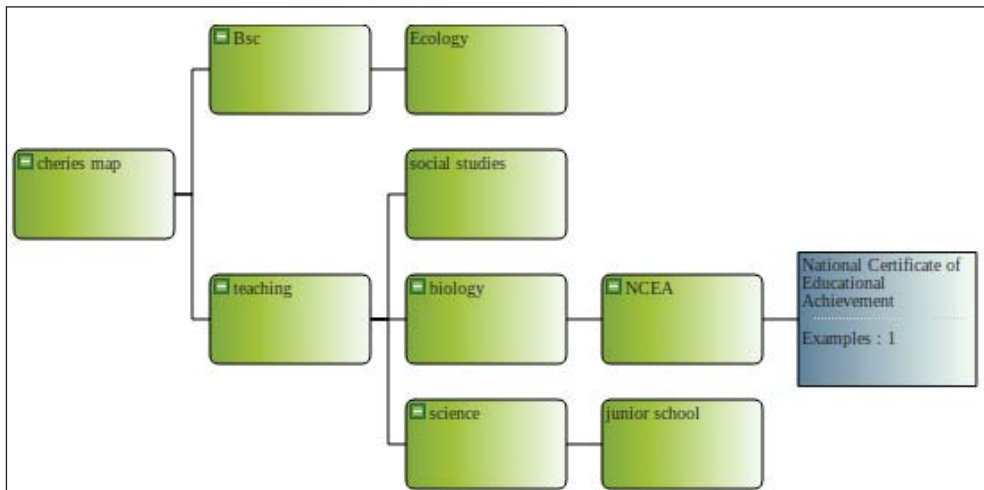


Figure F.2: Example 2

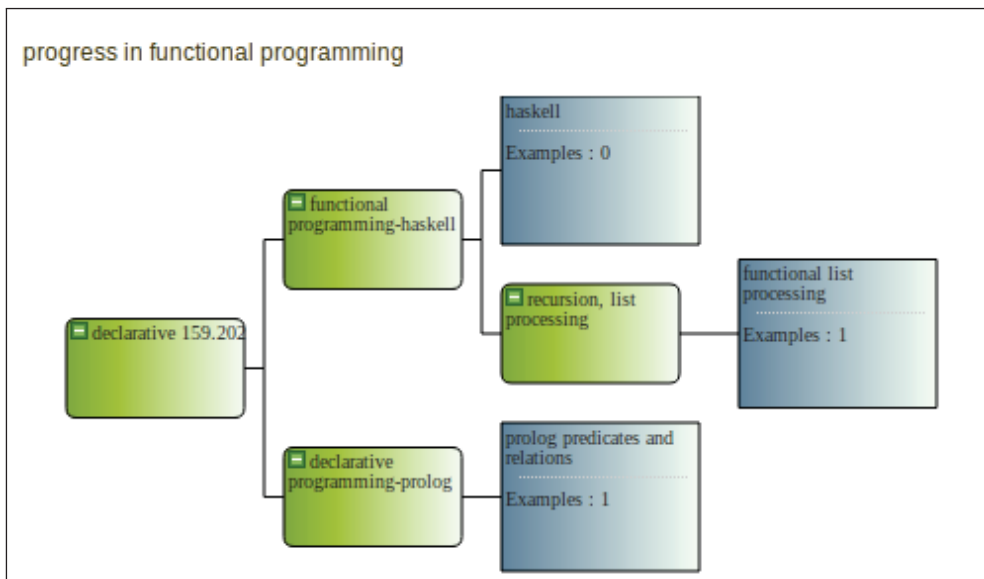


Figure F.3: Example 3

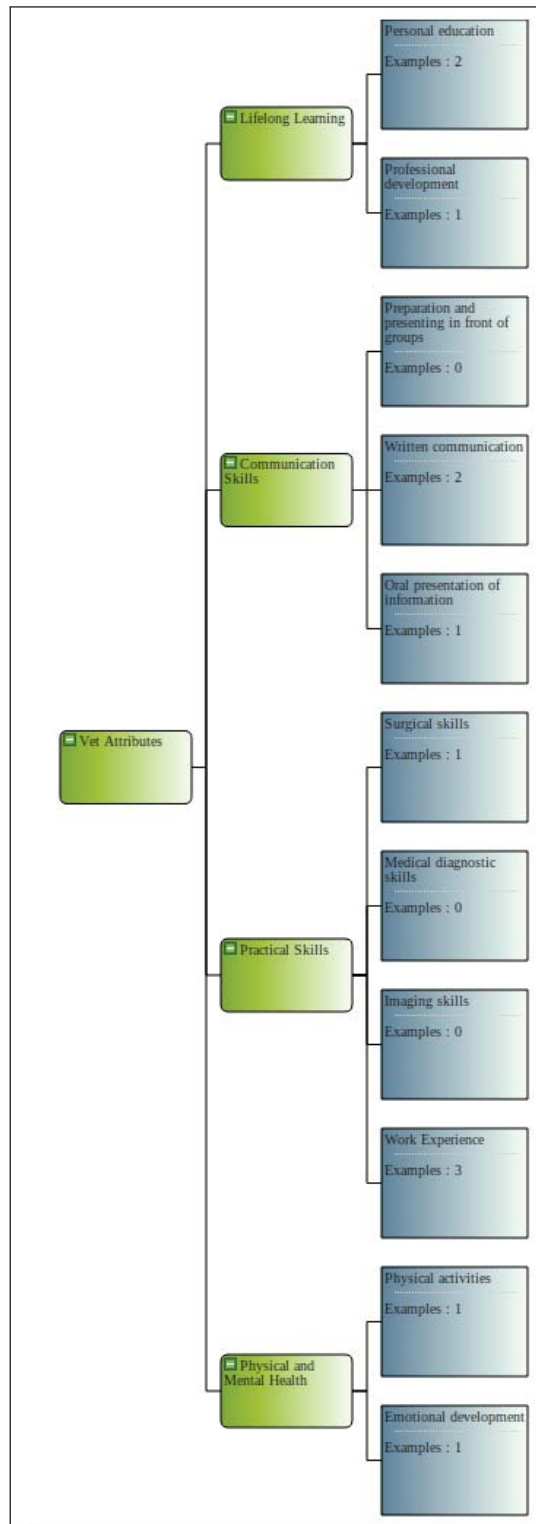


Figure F.4: Example 4

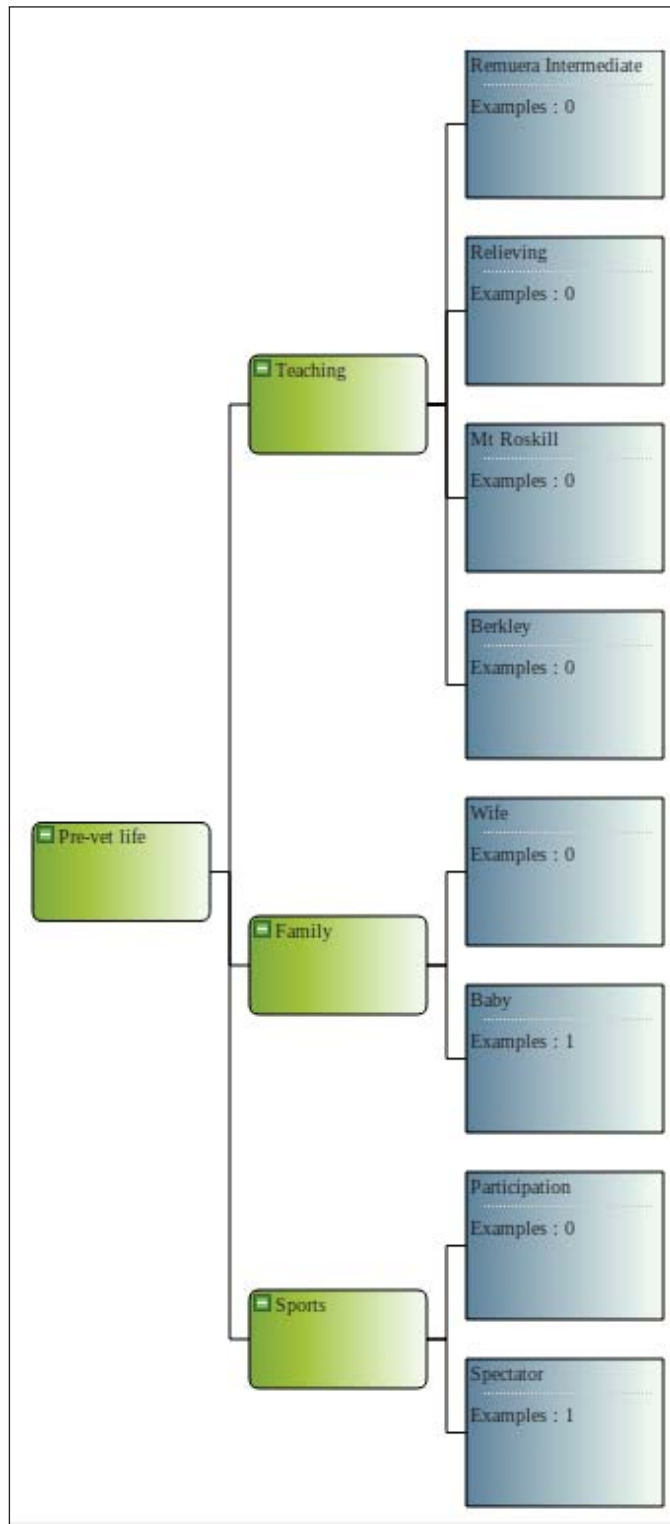


Figure F.5: Example 5

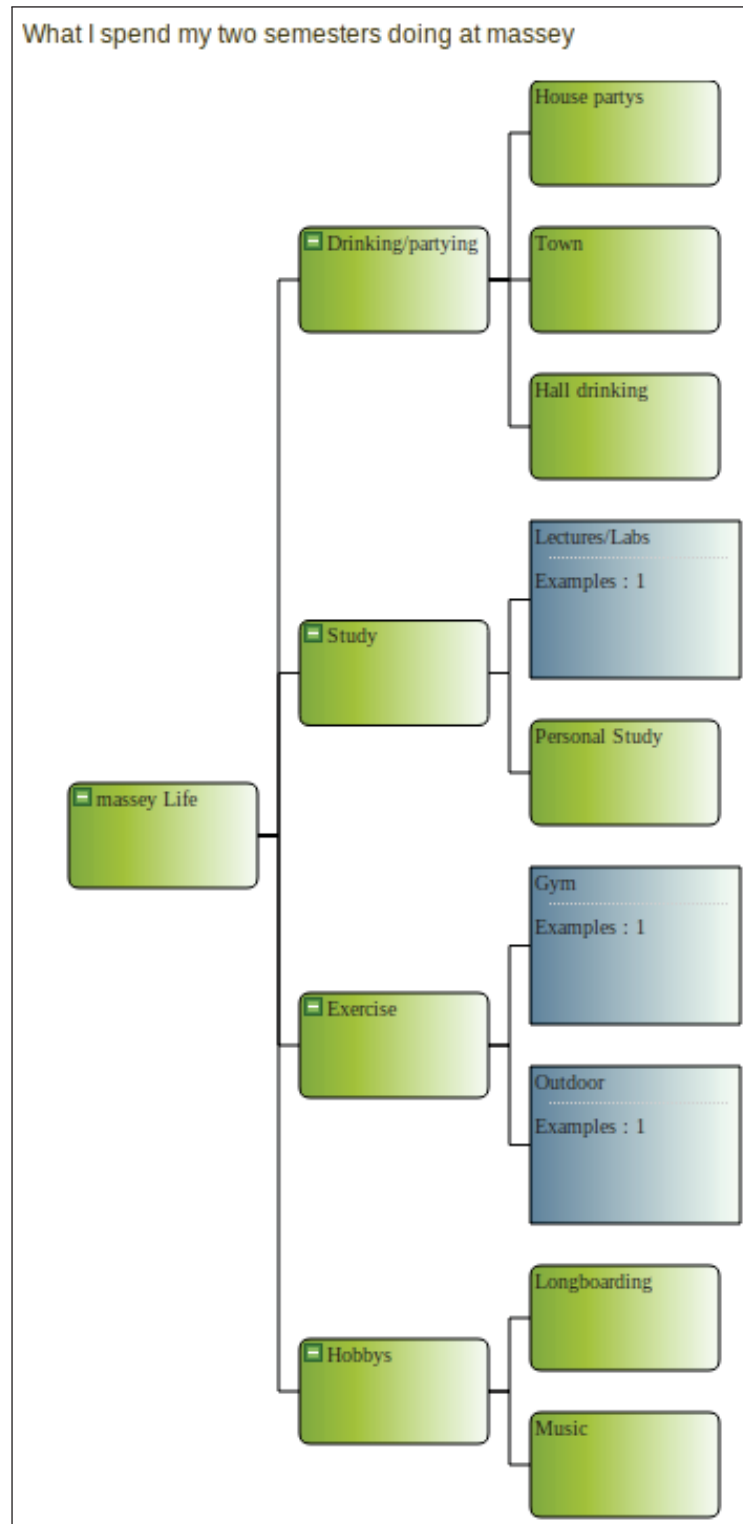


Figure F.6: Example 6

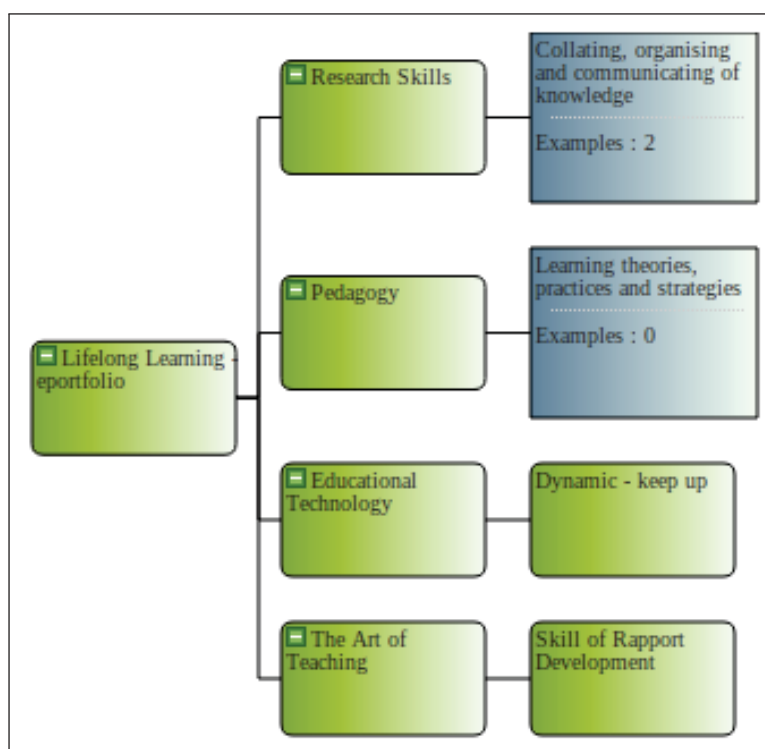


Figure F.7: Example 7

## F.5 Exit Questionnaire Responses

The comments have been combined and re-organised for easier reading of the related ideas.

### F.5.1 Potential impact of concept mapping on the development and understanding of personal learning achievements and graduate attributes.

*I think that being able to layout concepts in a clear structure like you can here with definitions and examples would help to cement an understanding of the significance of what a student has learnt in a specific subject and how it links to other subjects.*

*It helps to bring in to focus the actual results of studies. Graphical representation is much easier to recognize and it helps to sort the ideas. Helps to think about skills over marks.*

*It will help to create clarity in your learning and makes it easier to learn by breaking things down and being able to see how others are doing this as well.*

*Would be excellent for creating interactive CV which could be useful for self-reflection and future employers.*

*It gives a visual understanding of what someone wishes to achieve if the key concepts are set up before undertaking a course. Over time these concepts can be modified to reflect on the many experiences gathered. It is a fluid and flexible system which allows for reflection of anything learnt when people would normally not realise.*

*Logical system that allows checking of what have been done and what yet to achieve.*

*Accountability for own learning.*

*I think concept mapping will really help in these ideas – I actually use similar methods in my learning/revision – just didn't realise what it was called.*

*A good way of recapping previous work.*

*Simplifies process and makes it much cleaner and more well organized, so learning achievements and GA are more effective.*

*Makes it easier to follow [own progress], helpful reference that could be used to supplement written explorations.*

*Great assignment tool – shows actual development in progress and thinking.*

*A good way to encourage higher thinking and also communicate thinking and learning to teachers.*

### **F.5.2 Most favoured part about concept mapping in the ePortfolio system**

*User-friendly. Logical, not fragmented like systems I used before.*

*To use artefacts/fragments from our own experience.*

*Presentation – very informative and clear.*

*So easy to use the concept maps.*

*Opportunity for targeted reflection.*

*Gets the thinking process going.*

*Being able to add link and examples to the concept maps.*

*It shows learning in a logical, visual way. This is better than writing an essay with footnotes as we have been doing.*

*Clear flow effect.*

*Easy to use and information is projected in an attractive way.*

*Allows you to make connection between different graduate attributes.*

*Most of all I like that it allows me to can see bigger picture of my learning and development.*

*The fact that examples can be fragmented and inserted into a particular subconcept and the date added to remind or show other people the “proof” of the experience.*

*Good way to keep track of life progress.*

*I like how you can share your thoughts/developments with others and they can provide you with feedback. I also like how you can branch out as far as you want to and use bits and pieces of fragments in different places*

*A visual representation makes it easier to think about outcomes (without actually considering marks).*

*I like that you can separate ideas out into different concepts, each with definitions and examples and that you can clearly see what would have been learnt in a specific area and what might extend from this.*

*I liked how easy it is to use. Most software in this area is complicated and frustrating to use.*

*The way you can show how extracurricular activities count towards your learning achievements.*

### **F.5.3 Least favoured part about concept mapping in the ePortfolio system**

*Fragment part was not very user-friendly*

*That you are restricted to url bookmarks, blogs and uploaded files. For me, code snippets, twitter and other social networking integration would be great.*

*Being picky, I would have liked the option to have the concept map going from top to bottom as well as left to right. Some more explanation about exactly what each item does and how to add to it and why you would do so would also be helpful.*

*A little bit confusing at first glance. Easy if you know what you are doing.*

*Takes a lot of time to construct sometimes.*

*I think, it is rather tricky to navigate through the adding of examples which certainly can only be done after having a description.*

*Perhaps a little bit difficult starting with a new concept – just get a blank page and not sure where to start.*

*Difficult to add examples, but this would come with experience.*

#### **F.5.4 Recommended improvements**

*Would be nice if a box/window popped up with your examples if you hover the mouse over a definition box.*

*Could be more straightforward when it comes to adding files.*

*Perhaps a step-wise guide to navigating through how to build concept maps would assist someone who would like to build concept maps on their own.*

*Being able to import files or blogs from other sources (e.g. facebook).*

*Just further explanation about what each part of the system means and why you would use it. I was able to come away with an understanding because I was actively trying to understand, but the average user is likely to just want to be told more explicitly what to do.*

*To create concepts you need to right click. In a web environment this is rarely used and most users will probably get stuck unless further information is given. A tutorial on how to setup a basic concept and add files would be useful.*

*Drag and drop in the map would be great as it would add another level of flexibility.*



## Appendix G

# Study Three Documentation

This appendix provides documentation related to Study Three of the evaluation stage described in Chapter 7. The documents included in this appendix are:

- Study protocol followed by each case study
- Guiding questions for the follow-up discussion
- Background questionnaire for the participants

## G.1 Study Protocol

| Activity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Time   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| <b>--- Session 1 ---</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |        |
| <p><b>--- Preparation ---</b></p> <p><i>NOTE: Make sure that there are paper, pen, audio recorder, and computer with Massey network or Internet access and browser Firefox or Chrome installed.</i></p> <p>Brief introduction to the research.</p> <p>Ask participant to study information sheet.</p> <p>If participant agrees to take part in the research then:<br/>– Sign consent form</p>                                                                                                                                                      | 10 min |
| <p><b>--- Introduction ---</b></p> <p>Discuss with participant lifelong learning support requirements, skills, graduate attributes, ePortfolio system improvements.</p> <p>If necessary, discuss and show examples of concept maps.<br/><a href="#">The Theory Underlying Concept Maps and How to Construct and Use Them</a><br/><a href="#">Wikipedia article on Concept maps</a><br/><a href="#">Classroom Assessment Techniques Concept Mapping</a></p>                                                                                         | 15 min |
| <p><b>--- Demonstration ---</b></p> <p>Demonstrated implemented features that are in focus of the evaluation.</p> <p>Explain purpose of each feature and give the examples of potential use.</p> <p>Explain how to register a new account in the system for trial period and Internet browser requirements for the prototype.</p> <p>Provide the participant with the manual in paper and electronic form at <a href="http://seat-ill.massey.ac.nz/redmine/projects/ep4lll/wiki">http://seat-ill.massey.ac.nz/redmine/projects/ep4lll/wiki</a></p> | 30 min |
| <p><b>--- Final Notes ---</b></p> <p>Reach agreement on how the participant will be contacted for the follow-up session.</p> <p>Send a follow-up email with all required information.</p>                                                                                                                                                                                                                                                                                                                                                          | 5 min  |

| <b>--- Session 2 ---</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <p><b>--- Preparation ---</b></p> <p><i>NOTE: Make sure that there are paper, pen, audio recorder, computer with Massey network or Internet access and browser Firefox or Chrome installed, and a background questionnaire.</i></p> <p>Ask participant to complete the background questionnaire.</p>                                                                                                                                                                               | 10 min    |
| <p><b>--- Interview ---</b></p> <p><i>Note: Use guiding questions for the interview. Remember to audio record it!!!</i></p> <p>Discuss the ways the participant employed the new features during trial period. Ask how helpful these features were for the purpose.</p> <p>Discuss potential issues and improvements.</p> <p>Review the results of the use of the prototype and ask for explanations if necessary.</p> <p>Ask for access to the examples of the prototype use.</p> | 60-90 min |
| <p><b>--- Final notes ---</b></p> <p>If necessary, ask for explanations of observed behaviours.</p> <p>Collect questionnaire</p> <p>Thank the participant</p>                                                                                                                                                                                                                                                                                                                      | 5 min     |

## G.2 Guiding Questions for the Follow-up Discussion

- Now, that you have tried [list the features] which were added to standard ePortfolio features, what was your experience?
- What do you think about concept mapping as a part of ePortfolio system for developing understanding of your skills or addressing graduate attributes?
- What do you think about mapping examples on timeline for progress tracking?
- What do you think about using fragments of your repository?
- What are advantages and disadvantages of the new features offered to you compared to the other eePortfolio features you have used before for a) learning progress tracking, b) ePortfolio management, c) sharing, d) communication, ...?
- What further improvements would you recommend?

### G.3 Background Questionnaire

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**Project: Lifelong Learning Supported by ePortfolio Processes in Universities**

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***Background Information***

Circle age range: under 20 / between 20 to 30 / over 30

Circle gender: M / F

1. Which Degree Program (e.g. BA, BSc, BE, DipInfSci, PhD, MA) are you currently enrolled in?

2. How competent do you consider yourself in using ePortfolio?  
(Please circle one where 10 is highly competent and 1 is not competent at all)

1    2    3    4    5    6    7    8    9    10

3. What ePortfolio systems did you use before?

4. What was the purpose of your previous ePortfolio use? (e.g. assessment, CV, professional development, personal development, repository)

5. Do you currently maintain your ePortfolio?