AN E-LEARNING ENVIRONMENT FOR ENTERPRISE RESOURCE PLANNING SYSTEMS

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An e-Learning Environment for Enterprise Resource Planning Systems

By

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Summary

Enterprise Resource Planning (ERP) education can positively impact the success of an ERP implementation. Incorporating new tools and technologies into the learning process can potentially alleviate the evident problems with ERP education. Blended learning and e-learning environments both offer opportunities for improvement in education. However, there are various factors and components that need to be in place for such an environment to be successful.

The aim of this research is to provide an ERP e-Learning Environment (ERPeL) that can assist with ERP education in terms of creating an integrated and comprehensive learning environment for novice ERP users. In order to achieve this aim, this study followed the Design-Based Research (DBR) methodology which is specific to educational technology research and was applied in iterative cycles where various components of the environment were evaluated by different participants. Quantitative and qualitative data was collected by means of field studies (interviews, focus groups and questionnaires). The proposed ERPeL underwent several iterations of feedback and improvement.

In order to determine the success of e-learning, various critical success factors and evaluation criteria were investigated. Field studies were conducted in order to validate the theory in a real-world context. An initial field study was conducted with third year Nelson Mandela Metropolitan University (NMMU) students who were enrolled in the 2014 ERP systems' module in the Department of Computing Sciences. Many of the problems identified in theory were found to be prevalent in the real-world context.

One of the DBR process cycles involved the implementation of specific components of the ERPeL at the Developing and Strengthening Industry-driven Knowledge-transfer between developing Countries (DASIK) introduction to ERP systems course. Participants were either NMMU students, academic staff or industry delegates. The components evaluated included videos, learning content, badges, assessment and the SYSPRO Latte m-learning application. Additional components of a leader board, live chats, peer reviewing, expert reviews, user generated content, consultancy with experts and SYSPRO ERP certification were implemented in the subsequent cycle where participants were 2015 third year NMMU ERP systems students.

The criteria used to evaluate the success of the ERPeL and its e-learning components were adapted from literature and a new set of evaluation criteria for e-learning was proposed. The ERPeL is made up of Moodle, the SYSPRO ERP System, the SYSPRO e-Learning System, the SYSPRO Latte m-learning application, learning content and components. Overall the ERPeL was positively received by the various sample groups. The research results indicate that the use of an e-learning environment for ERP systems was positively received. The most positive aspects reported were the implementation of e-learning components such as the interactive videos, simulations and m-learning.

In support of this Masters dissertation, the following three papers have been published and presented at two local conferences and one international conference:

1. SACLA 2014, Port Elizabeth (South Africa);
2. SAICSIT 2015, Stellenbosch (South Africa); and
3. IDIA 2015, Zanzibar (Tanzania).

Keywords: e-learning, blended learning, ERP education, success factors, evaluation criteria, learning components.

Declaration of Own Work

I, Alyssa Morgan Whale, 210055685, hereby declare that the dissertation, *An e-Learning Environment for Enterprise Resource Planning Systems,* for MCom Computer Science and Information Systems is my own work and that it has not previously been submitted for assessment or completion of any postgraduate qualification to another university of for another qualification.

Miss Alyssa Morgan Whale

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The views and opinions expressed in this dissertation are those of the author and do not necessarily reflect the official views of SYSPRO Pty Ltd.

For publication purposes written consent must be obtained from SYSPRO Pty Ltd.

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Glossary

ADDIE	Analysis, Design, Development, Implementation, Evaluation
ADL	Advanced Distributed Learning
BYOD	Bring Your Own Device
CBTs	Computer Based Trainings
CMS	Content (Course) Management Systems
DBR	Design-Based Research
DSR	Design Science Research
ERP	Enterprise Resource Planning
ERPeL	ERP e-Learning Environment
F2F	Face-to-face
HE	Heuristic Evaluation
HEI	Higher Education Institution
LMS	Learning Management System
LO	Learning Object
LORI	Learning Object Review Instrument
Moodle	Modular Object-Oriented Dynamic Learning Environment
OLE	Online Learning Environment
PEOU	Perceived Ease of Use
PU	Perceived Usefulness
SCORM	Shareable Content Object Reference Model
TAM	Technology Acceptance Model
TELEs	Technology-Enhanced Learning Environments
UTAUT	Unified Theory of Acceptance and Use of Technology
VCT	Virtual Classroom Training
VILT	Virtual Instructor-Led Training
WBTs	Web Based Trainings

Chapter 1. Introduction

1.1 Background

An Enterprise Resource Planning (ERP) system, also known as an Enterprise System, can be defined as a software package that permits seamless integration of all company information, including data and information pertaining to the several business units in an organisation, such as finance, accounting, manufacturing and human resources (Davenport, 1998). An ERP system intends to integrate all departments and functions across an entire organisation and still serve each department's individual needs (Forcht, Ieschnick, & Aldridge, 2007).

ERP systems have many benefits, but primarily these are related to the integration of data and processes and improved business efficiency (Beheshti, 2006; Huang, Huang, Wu, & Lin, 2009). Recent reported benefits of ERP systems are cost reductions specific to inventory costs, raw materials costs, customer lead time, production time and production costs (Leyh & Muschick, 2013). It is due to these benefits that the majority of businesses all around the world use and implement ERP systems. However, it is still noticed for having continued levels of failure (Kimberling, 2013; Panorama Consulting Solutions, 2014). The *2014 ERP Panorama Report* reported that 54% of projects exceeded projected budgets and 72% exceeded planning durations, with 66% receiving only 50% of the measurable anticipated benefits (Panorama Consulting Solutions, 2014). It is also predicted that ERP failure rates will not slow down in the near future (Kimberling, 2013).

ERP systems are known for being profoundly complex and the implementation of these systems requires large capital outlay in terms of money, time and expertise (Beheshti, 2006; Davenport, 1998; Kouki, Poulin, & Pellerin, 2009). The *2014 ERP Panorama Report* reported that the average cost of an ERP implementation over the last four years has been $6.5 million dollars and the average duration is 16.1 months (Panorama Consulting Solutions, 2014). A large portion of ERP system implementation costs include training costs (Beheshti, 2006). These training costs also include travelling and accommodation expenses which will allow users to attend training workshops in designated locations (Kanthawongs & Kanthawongs, 2010).

Whilst training is noticeably an expensive endeavour, superior training of both staff and management is a key success factor in ERP system projects (Helo,

Anussornnitisarn, & Phusavat, 2008; Kimberling, 2014; Leyh & Muschick, 2013; Seo, 2013; Thomas, Babb, & Spillan, 2012). However, training is not only costly in the monetary form, but it is also considered to be expensive in terms of time (Kouki et al., 2009). Training is one of the first things or costs to be cut when budget problems arise, thus limiting the success of an ERP implementation (Forcht et al., 2007; Noudoostbeni, 2010).

In addition to industry training of ERP systems, there is a need for Information Technology (IT) graduates with ERP competencies (Ram, Wu, & Tagg, 2014; Scholtz, Calitz, & Cilliers, 2013; Seethamraju, 2007; Seymour, Dawood, Mandengu, & Mokobori, 2004). As a result of this need for ERP competencies, several universities are including ERP courses in their IT curricula. These graduates should have good-quality skills and an understanding of business and ERP systems (Muscatello & Chen, 2008; Scholtz, 2011). Thus it can be seen that the implementation of an ERP system typically requires two forms of learning: ERP systems' education in Higher Education Institutions (HEIs) and training of users within organisations (Muscatello & Chen, 2008).

Education can be considered as a discipline concerned with the methods of teaching and learning, specifically in schools or school-like environments (Britannica Encyclopedia, 2008). Comparative training is more practically orientated and is more about learning to do, usually under supervision and focusing on an art, trade or profession (Dictionary.com, 2014b). The terms education and training are often used interchangeably, but from the above definitions it can be seen that there are differences (Helo et al., 2008). In this study the term learning will refer to both the education of HEI students and the training of industry delegates.

Learning approaches have shifted from traditional forms of face-to-face (F2F) learning to focusing on the use of technology and devices as communication tools in an authentic setting that promotes learning (Steinbronn & Merideth, 2007). With this shift towards technology, e-learning systems have gained popularity since they facilitate collaborative learning, knowledge sharing as well as relationship building (Lin & Wang, 2012). The evolution of education means that what was once exclusively available to the elite is now easily available to everybody (Nordin, Embi, & Yunus, 2010).

Predictions by Tagoe (2012) indicate that courses that are solely web-dependent will become more widely used and sought after in the future. Technologies and online learning are welcomed to a greater extent amongst students of this generation because they can identify with the benefits of convenience and independence (Kyalo & Hopkins, 2013). Learning is self-paced and this and other such characteristics are responsible for the increase in motivation and performance.

Engaging in e-learning is often confused as being simple interaction with technology, but it is more than that (Steinbronn & Merideth, 2007). Engagement in e-learning often relies on engagement through interaction, in order for it to be successful. Based on various definitions, online education and e-learning can be considered as one and the same thing, since learning and education occur with the assistance of online technology. The learning process is shifted to the learner and the instructor takes on new roles such as facilitator, strategist and coordinator. e-Learning as a platform can be seen as a medium for the gathering, construction and sharing of knowledge; however, sometimes e-learning on its own can be overwhelming and hence a more blended approach is adopted (Lin & Wang, 2012). Blended learning combines two methods, mainly traditional F2F learning and e-learning into a unique learning experience.

The term learning environment usually refer to the tools used within the environment or the kind of learning that is conveyed through the learning system (Moore, Dickson-Deane, & Galyen, 2011). An e-learning environment is defined as a web application including tools which can be used to support activities of teaching and learning (Da Silva, Freire, & De Arruda, 2013). A fundamental characteristic of learning environments is the design methodology, where courses, programs and learning objects can either be self-paced, self-directed or instructor-led (Moore et al., 2011). A basic and important component of learning environments lies in how the environment is designed. Components can take various forms and have varying degrees of aspects and activities. Therefore, the definition for an e-learning environment can be extended to include the e-learning material, learning objects, content and interactive components. For the purposes of this study an e-learning environment will consist of various elements such as components and criteria. The e-learning components will refer to the practical components which are implemented in practice, for example videos.

HEIs need to take full advantage of e-learning by integrating various learning tools which can develop and enhance learning for the future (Raj, 2011). Teaching and learning which makes use of technology can be seen as an educational process that aims to develop the ability of learners to learn from the creation of specific conditions that are supported by Information and Communication Technology (ICT) and favour it (Elizondo, Daniel, Cabrero, & Avila, 2012). Thus, education and learning which supports the use of technology for educational purposes is seen to be beneficial to learners and their learning process.

1.2 Problem Statement

According to News24 (2014), the Adcrop Employment Index for November and December 2013 indicated that South Africa's skills shortage is extensive and that it is not being met by the local supply of highly-skilled workers. South Africa has a significantly high university drop-out rate and therefore many people are lacking in qualifications, skills and knowledge. Thus, the number of university graduates in certain careers is unable to meet the demands of industry which impacts the economy. Companies which have the ability to learn faster than their competitors are considered and recognised as having a sustainable competitive advantage (Bologa & Lupu, 2014). With regard to ERP systems, the time spent on learning before an individual is able to start working autonomously is much longer than with alternative industries and systems.

In the Panorama Consulting Solutions *2014 ERP Report* one of the top reasons why projects were delayed and/or ran over budget was identified as being a result of training issues (Kimberling, 2014). According to research conducted by Leyh and Muschick (2013), user training was ranked as the third highest factor impacting the success of an ERP implementation. Skills, knowledge and expertise were ranked sixteenth.

The problem addressed in this study is the fact that there is a lack of cost-effective ERP training and education programmes. Traditional F2F programme costs are expensive, specifically taking travel costs of large groups of people/employees to ERP training venues into consideration. There is a need for e-learning environments for ERP systems and criteria for evaluating the success of these environments. Learning

Management Systems (LMSs) are often implemented especially at HEIs without any form of evaluation taking place (Palmer & Holt, 2009).

SYSPRO is known for being one of the longest standing and largest independent, international ERP business solution vendors (SYSPRO, 2014a). SYSPRO is an ERP vendor which has tried to address the problems with ERP training and education by providing an e-learning system in order to make the ERP learning experience as accessible and as cost-effective as possible (SYSPRO, 2014b). However, there is still a shortage of ERP e-learning systems which are integrated into a comprehensive, effective e-learning environment. The SYSPRO e-Learning System does not integrate with the e-learning tools used in HEIs and it is not known whether or not the system is successful, effective or accepted by the users.

1.3 Relevance of Study

Nelson Mandela Metropolitan University (NMMU) has adopted a blended learning strategy, which is to be approved and adequately resourced (Nelson Mandela Metropolitan University, 2010); thus signifying the significance and importance of this study. Extensive and appropriate user training is considered to maximise the benefits of ERP systems as well as increase user satisfaction (Seo, 2013). A gap exists between HEI curricula and the needs of industry which are ever increasing, which suggests that graduates are not job ready (Department of Communications, 2014). The fact that corporations are outsourcing their software development needs confirms the scarcity of such skills locally. In recent years, e-learning has become very popular, with a greater demand for e-learning from business and HEIs (Liaw & Huang, 2013). The aim of this study is to design, implement and evaluate an e-learning environment to support ERP education.

1.4 Research Questions

Taking into consideration the purpose and relevance of this research project and its objective, the main research question (RQ_M) is:

> ***What are the elements of a successful e-learning environment for supporting ERP education?***

Additional research questions need to be asked and addressed in order to be able to successfully and efficiently answer the main research question of this study:

RQ_1: What problems are evident in ERP systems education?

RQ_2: What factors make e-learning of ERP systems successful?

RQ_3: What criteria can be used to evaluate the success of e-learning environments?

RQ_4: Which e-learning components can be used to assist with ERP education?

RQ_5: What combination of components can present an e-learning environment which has the highest levels of success for introductory ERP systems education?

RQ_6: How successful is the proposed ERP e-Learning Environment (ERPeL)?

RQ_7: What design principles and guidelines can be proposed for e-learning of ERP education?

1.5 Research Objectives

The main research objective (RO_M) for this study is:

To implement a successful e-learning environment for ERP education.

The main research objective is to be complemented by the following secondary research objectives:

RO_1: Identify problems with ERP systems education.

RO_2: Identify success factors for e-learning of ERP systems.

RO_3: Identify evaluation criteria that can be used to evaluate the success of e-learning environments.

RO_4: Explore e-learning components that can be used to assist with ERP education.

RO_5: Design and propose an e-learning environment for introductory ERP systems education.

RO_6: Evaluate the success of the proposed ERP e-Learning Environment (ERPeL).

RO_7: Propose a set of recommended e-learning design principles and guidelines for ERP education.

1.6 Scope and Limitations

The focus of this study is not on pedagogy and will not consider the F2F aspects of the ERP course. However, some aspects of the classroom will be covered. The student participant sample might be limited in size and this could affect the extent to which statistical analysis can be done. It is impossible to address all types of e-learning technologies. Two categories of e-learning are therefore considered beyond the scope of this study due to time and cost restrictions, and they are:

- Virtual Learning and Massive Open Online Courses (MOOCs); and
- Social Media.

The main focus of this study is on HEIs and the design of an ERP e-learning environment which is suitable for introductory ERP systems for HEIs students who are novice users. It is believed that the concepts can be extended to industry learners.

1.7 Ethical Clearance and Considerations

There will be two main groups of participants for this study. The first group of participants for this study will be students in the Department of Computing Sciences (CS) who are in the third year of studies and who are registered for the ERP modules (student group). The second group will consist of a small number of participants from organisations in industry in South Africa. The NMMU research ethics and policies will be adhered to throughout this study. The ethics reference number is H14-SCI-CSS-001 (Appendix A).

1.8 Research Methodology

In the Information Systems (IS) discipline design research is known as Design Science Research (DSR) and within the specific domain of educational technology the Design-Based Research (DBR) methodology is proposed (De Villiers & Harpur, 2013). Thus, DBR is considered to be the educational technology variant of DSR, the research paradigm of choice for e-learning. DBR is recognised for blending empirical educational research with that of theory-driven design of learning environments (The Design-Based Research Collective, 2003). *"Importantly, DBR goes beyond merely designing and testing particular interventions"* (The Design-Based Research Collective, 2003, p. 6). DBR also emphasises the importance of theory building and

developing design principles that guide, inform and improve practice as well as research in the context of education (Anderson & Shattuck, 2012).

For the purposes of this study, the DBR methodology will be used and will follow an iterative approach that will revolve around the definition and identification of a problem and the design and development of an artefact, in this case an e-learning environment. The research methodology for this study and how it will be applied is discussed in more detail in Chapter 2.

1.9 Outline of Chapters and Thesis Structure

The DBR methodology will be followed throughout this study and the structure of this dissertation will thus be based on the five phases of the DBR methodology. It is noted that the DBR methodology as well as its supporting characteristics, features and principles will be used to guide the structure and overview thereof. The five phases of DBR are (Van Wyk & De Villiers, 2014):

- Phase 1: Problem analysis within context;
- Phase 2: Design solution;
- Phase 3: Develop solution;
- Phase 4: Evaluate in practice; and
- Phase 5: Reflection, leading to dual outcomes.

This study as a whole will follow the five phases of DBR. Within each design and development iteration, which for the purposes of this study are called cycles, the five DBR phases will also be addressed. Thus, within each evaluation cycle, the five DBR phases will be adhered to. The structure of this study will consist of 8 chapters (Figure 1-1) which are:

Chapter 1: Introduction

This chapter will introduce the topic of the study as well as background information, relevance and importance. The initial problem will be identified (problem statement) in this chapter.

Chapter 2: Research Design and Methodology

This chapter will identify and discuss the research methodology to be used throughout this research study, why it was selected and how it will be applied. The

research methodology and design for this study will also be discussed and reported on.

Chapter 3: A Theoretical Review of ERP Education and e-Learning

This chapter will be based on the first phase (problem analysis within context) of DBR and it will identify and analyse problems with ERP systems' education. A comparison of F2F learning, e-learning and blended learning will also be presented. A classification of e-learning systems will be conducted and a list of Critical Success Factors (CSFs) for e-learning will be proposed together with a discussion on the various components of an e-learning environment. This chapter will identify problems related to evaluating the success of e-learning and will investigate principles and guidelines for design and evaluation. The chapter will conclude with a proposed environment based on theory discussed in the literature review.

Chapter 4: Problem Identification of ERP Education: A Case Study Approach

Chapter 4 discusses phase one (problem analysis within context) of DBR in this study and expands on the theoretical problems identified in the previous chapter by empirically validating these by using a case study approach. The chapter will also make use of research rigour in identifying and exploring the problem in greater detail from the perspective of student, lecturer and industry by using field studies, focus groups, interviews and questionnaires (feedback forms). The results collected from these investigations will be discussed.

Chapter 5: The Design of an ERP e-Learning Environment

Chapter 5 will be based on phase two (design solution) of DBR and will discuss topics and concepts pertinent to the various e-learning tools and components which are known to assist with education and training. The high-level objectives and tools specific to e-learning and ERP systems in educational environments will be identified. The evaluation plan and design considerations will be presented.

Chapter 6: Development and Evaluation (Cycle 4)

Chapter 6 will be based on the third (develop solution) and fourth (evaluate in practice) phases of DBR. It will describe the stages in the development and evaluation of a proposed ERPeL. This is where the artefact (environment) and how it was developed will be described in detail. Research rigour will also be applied in

this chapter in the construction of the environment of the most suitable combination of tools to promote effective and efficient education and learning of ERP systems. The artefact (environment) will be demonstrated to participants and evaluated. The analysis of results will be discussed in this chapter.

Chapter 7: Development and Evaluation (Cycle 5)

Chapter 7 will also report on phases three (develop solution) and four (evaluate in practice) of DBR which were followed in this study. It will describe the stages in the development and evaluation of an improved ERPeL. Feedback from the evaluations will be used to improve the proposed ERPeL. An updated environment will be presented based on the results obtained from the evaluations conducted in Chapters 6 and 7. The artefact (environment) will be demonstrated to participants and evaluated. The analysis of results will be discussed in this chapter.

Chapter 8: Conclusions and Recommendations

Chapter 8 will be based on phase five (reflection, leading to dual outcomes) where the findings of the study will be discussed in detail and where dual outcomes in terms of a practical solution implemented in real-world settings as well as the theoretical outcome of generic design principles will be explicitly conveyed. Since this is the concluding chapter, it will also tie everything together as well as recommend future work to be conducted.

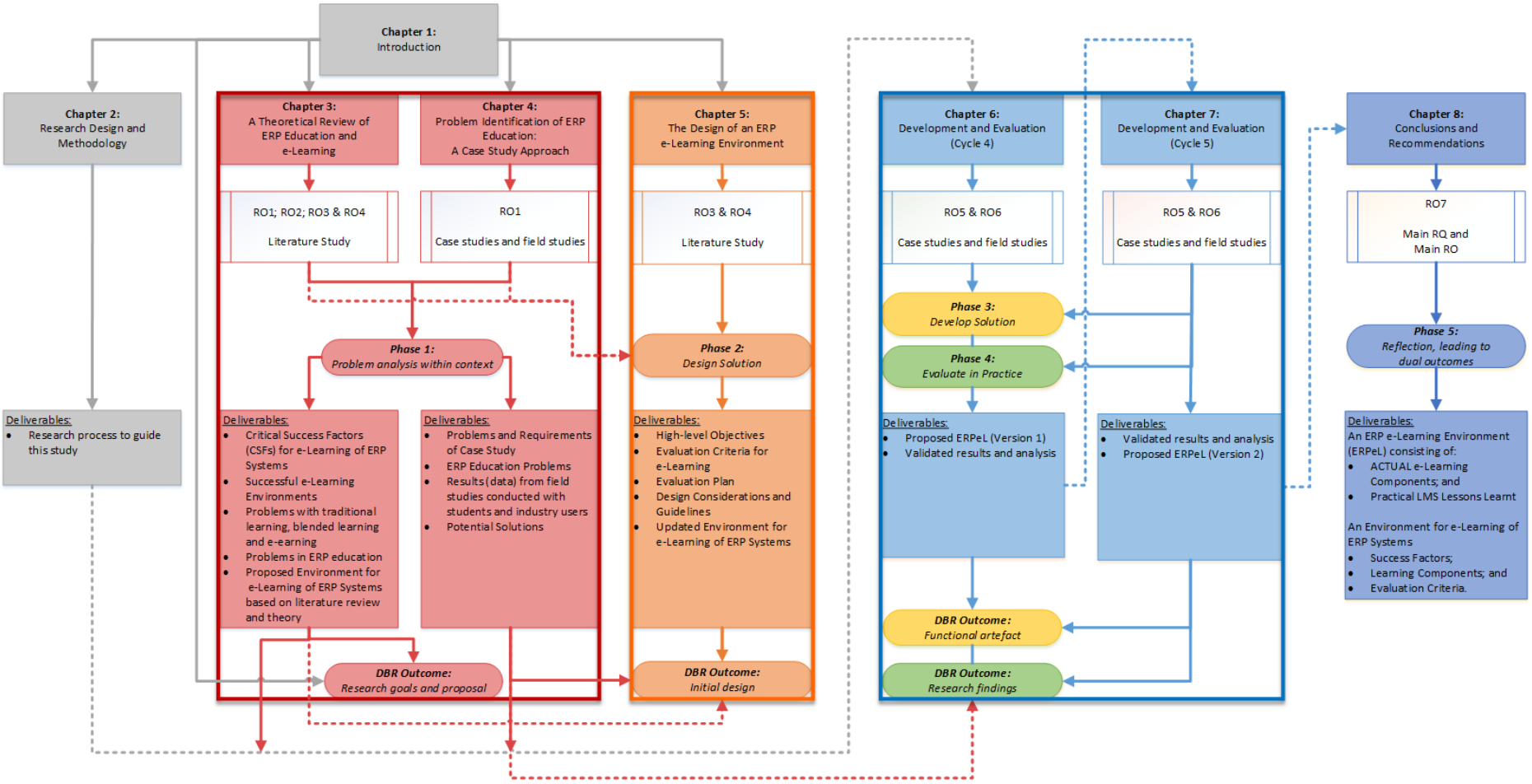

Figure 1-1: Chapter Layout Combined with Design-Based Research Methodology (Author's Own Contribution)

Chapter 2. Research Design and Methodology

2.1 Introduction

In Chapter 1 the research problem was introduced. This chapter investigates and motivates the selected research methodology for this study. Design-Based Research (DBR) is the educational technology alternative to Design Science Research (DSR) (Section 2.2). DBR is selected as the most suitable choice for this research study since it uses technology in the education process (Section 2.3). Several features, characteristics and models of DBR have been proposed (Section 2.4). DBR will be applied and followed for the duration of this project (Section 2.5). Various research materials that are to be used in this study are also discussed (Section 2.6). The chapter is summarised by motivating the choice of research methodology and its application (Section 2.7). A layout of Chapter 2 and the deliverables achieved from this chapter are shown in Figure 2-1.

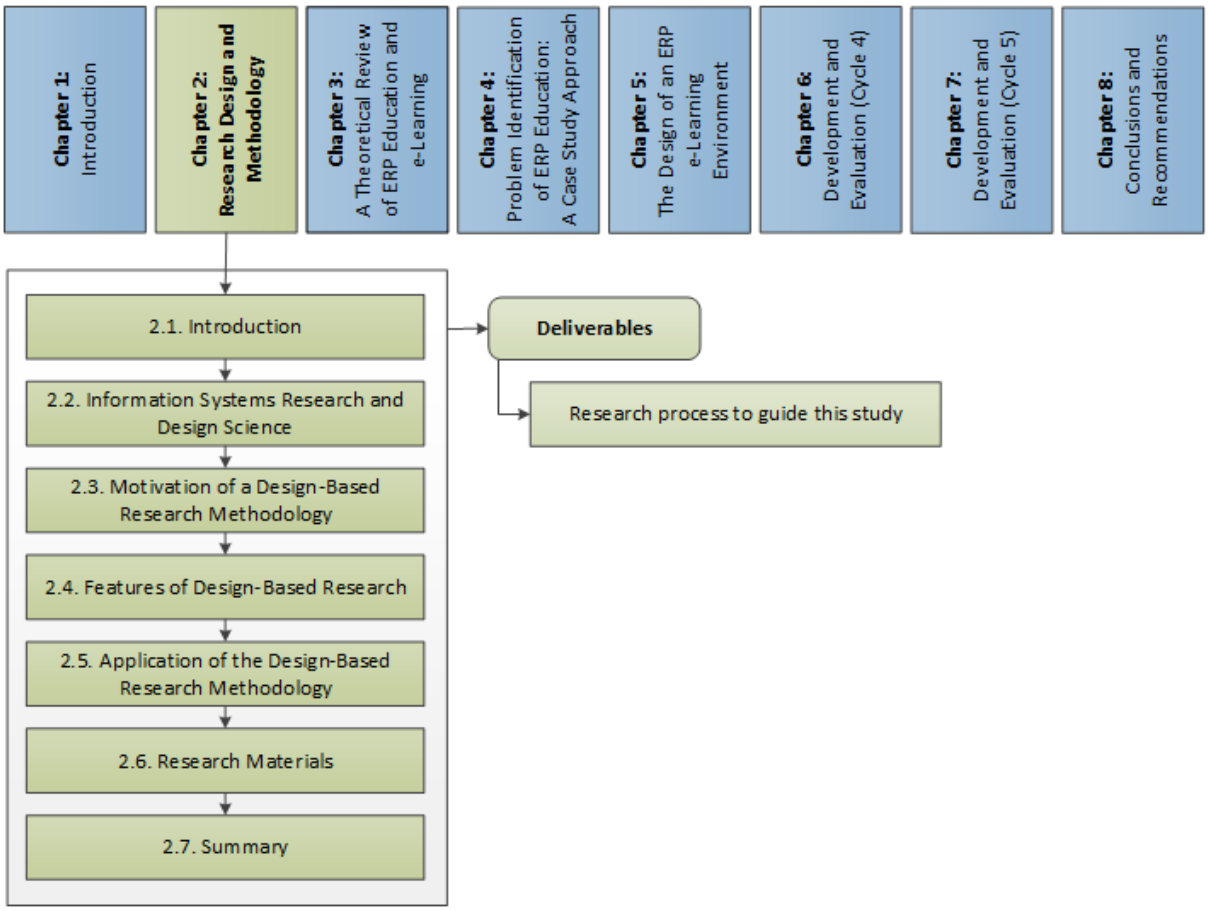

Figure 2-1: Chapter 2 Layout and Deliverables

2.2 Information Systems Research and Design Science

It is often the case that a particular research question will not fall neatly and completely into a single philosophical domain as suggested in the research 'onion' (Figure 2-2) (Saunders, Lewis, & Thornhill, 2009). The research 'onion' proposed by Saunders et al. (2009) looks at the larger research field, whilst DSR is a research paradigm that originates in IS, IT and CS. Therefore it is a suitable option for this research study. DSR allows for the formation and assessment of IT artefacts which are envisioned to solve recognised problems (Hevner, March, Park, & Ram, 2004). DSR not only describes, explains and predicts; it also aims to improve and create by developing artefacts that can satisfy needs, overcome problems and grasp new opportunities (Johannesson & Perjons, 2012). DSR aims to create innovation in these industries (Johannesson & Perjons, 2012) and is seen to be a constructive approach to research concerned with the design of artificial constructs (Hinkelmann & Witschel, 2013). Technological advances are often seen to be a result of innovative and creative DSR processes (Hevner & Chatterjee, 2010).

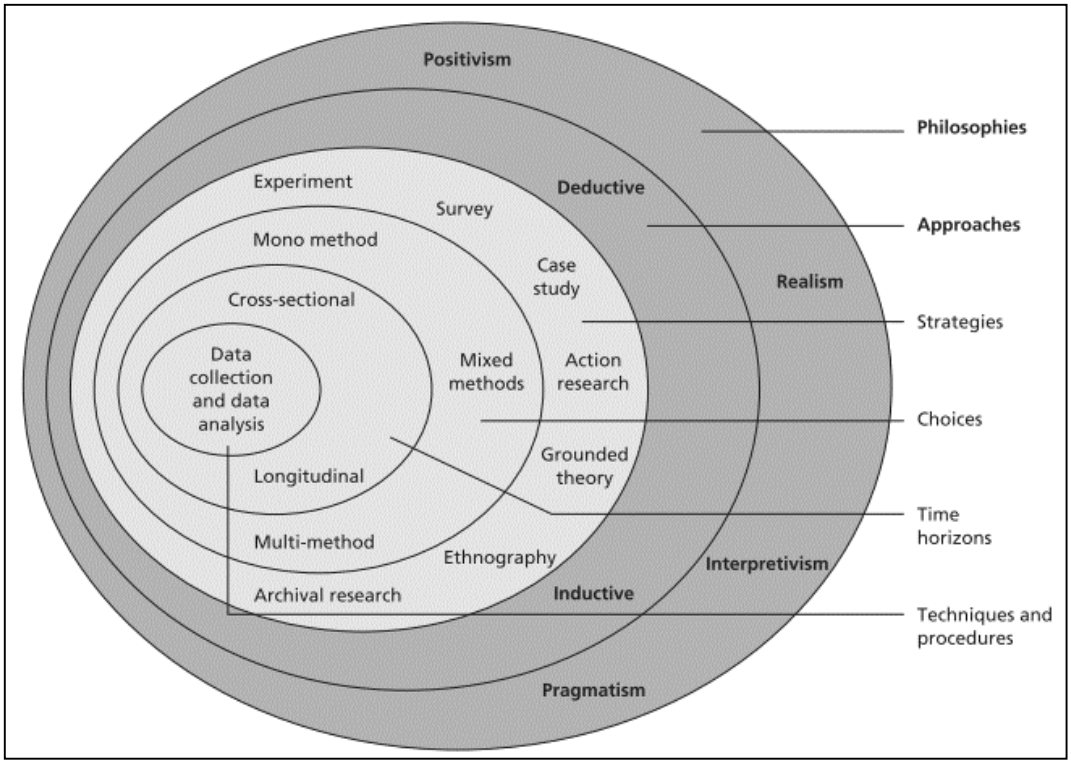

Figure 2-2: The Research Onion (Saunders et al., 2009, p. 108)

2.3 Motivation of a Design-Based Research Methodology

It is noted that both DSR and DBR address complex, real-world problems by giving support to the iterative design of innovative solutions which can be used to do real work in a specified context (De Villiers & Harpur, 2013). However, DBR does have different methodologies and frameworks to those of DSR which is pure IS-based with roots in software engineering. DBR was founded on pragmatic philosophies and inquiry which focus on practical applications within educational institutions such as schools and HEIs. Conversely, DSR highlights formal theoretical frameworks, prescriptive design theories and methodologies which are expected to impact uniformity as well as rigour of research. There are also noticeable differences in outputs. DSR has varying types of outputs in the form of constructs, models, methods and instantiations, whereas DBR explicitly encourages dual outcomes as part of the research process. The practical output of DBR should be an implementation or interventions that change practice in reality as well as a theoretical outcome which can be considered a framework style or conceptual artefact. A comparison of DSR and DBR is presented in Table 2-1.

DBR is a practical research methodology that can effectively bridge the gap between research and practice in formal (higher) education (Anderson & Shattuck, 2012). DBR is noted for being a suitable research methodology in Technology-Enhanced Learning Environments (TELEs). TELEs are technology-based learning and instructional systems which can be and are used by students in the acquisition of skills and knowledge, typically with assistance from teachers and/or facilitators, learning supported tools and technological resources (Wang & Hannafin, 2005). DBR is a research methodology for education research that was designed by and for educators that wish to intensify the impact, transfer and translation of education research into enhanced practice.

Table 2-1: Comparison of DSR and DBR (De Villiers & Harpur, 2013, p. 259)

	Design Science Research (DSR) in IS	Design-Based Research in educational technology
Goals and ethos	• Design of new man-made artefacts to solve complex problems: constructs, models, methods, instantiations. • Problem-solving via intention, evaluation, measurement and impact studies. • Work based on existing design theories. • Generic process models and methodologies are proposed. • Communication to academics and professionals.	*Dual outputs of each study.* • *Practical outcome:* Implementation of novel educational-technology solutions in complex situations. New products and practices in real-world settings. • *Theoretical/scientific outcome:* Development/extension of models and contextual design theories/design principles. • Design principles shared with practitioners and designers.
	• Both are pragmatic, approaching design from a practical perspective. DBR does so as a primary consideration. • Both contribute to knowledge, but it is not an integral requirement that each DSR study should make a theoretical contribution. • Both reflect on the nature and role of theory.	
Distinct features	• Rooted in engineering approaches. • Problems in ill-defined, complex areas, approached by creativity and teamwork. • Solutions appropriate to the environment. • Use of novel artefacts to change real-world states. • 'Satisficing' findings, obtaining satisfactory solutions, but sacrificing exhaustive search.	• Rigorous and reflective analysis of real problems in education and training. • Multi-disciplinary expertise. • 'Design experiments' that result in innovative designs and prototypes, as well as theoretical outputs. • Contextually-sensitive approach.
Processes	• 'Design' relating to both products and processes. • *Products:* complete systems and building blocks, i.e. constructs, models, methods and instantiations. • *Processes:* complementary activities of construction-in-context and cyclic evaluation in which criteria and metrics are developed in context.	• Convergence of research, design and feedback. Continuous cycles of analysis, design, development, enactment, evaluation and redesign. • Pragmatic inquiry, evidence-based claims, validation by use. • Interpretive paradigm, qualitative studies and mixed methods.
	NB Both have iterative cycles of design, rigorous evaluation/testing and refinement.	
	IS traditionally took positivist stances, but is tending to employ interpretive paradigms as well.	DBR methodologies and frameworks apply interpretive paradigms, qualitative studies and mixed methods research.

2.4 Features of Design-Based Research

Design-Based Research (DBR) is said to have originated from the work of Brown (1992) and Collins (1992) and is not really considered an approach, but rather a series of approaches with the intention of producing new theories, artefacts and practices that constitute and potentially influence learning and teaching in natural settings (Barab & Squire, 2004). Originally referred to by Brown (1992) and Collins (1992) as *design experiments*, DBR suggests relationships of synergy among researching, designing and engineering (Wang & Hannafin, 2005). 'Design experiments' patent scientific as well as educational values through dynamic participation of researchers in learning and teaching procedures and through scientific processes of discovery, exploration, confirmation and dissemination.

It has been stated that DBR is said to challenge the assumption that research is contaminated by the external influence of the researcher, however, it rather focusses on supervising the research processes in collaboration with participants, design and interventions (Wang & Hannafin, 2005). These processes are instigated methodically in order to enhance and expand designs and evidently pursue advancements in pragmatic and theoretical aims affecting practice that has been adopted. According to De Villiers and Harpur (2013), who have reported adoption of DBR in several studies in higher education and/or schools, DBR emphasises producing theoretical and scientific outcomes, even though it is said to be pragmatic. There are various characteristics and features of DBR (Section 2.4.1) together with supporting processes which can be used to present a DBR process model (Section 2.4.2).

2.4.1 Design-Based Research Characteristics and Features

Due to the fact that DBR addresses imperative issues, shows substantial effect and has noteworthy results, it can be considered appropriate for complex environments (Van Wyk & De Villiers, 2014). Since DBR discovers real-world, practical issues and can be used in the development of new solutions, it is profoundly considered as a problem-solving paradigm. Numerous practitioners and researchers are usually involved with DBR research and thus collaboration and participation are promoted. DBR is also innovative since it seeks to find solutions to unique, unsolved problems and is iterative because various methodical processes are conducted in designing, developing, implementing and evaluating. DBR is pragmatic because principles are used to inform and improve practice in order to resolve identified problems and challenges. Authentic artefacts are produced as a result of DBR which are purposeful and have functional and practical interventions.

Educational technologies can be identified as independent variables in a study addressing student learning and the integration of these technologies into the classroom leads to various changes (Amiel & Reeves, 2008). The main characteristics of DBR are: 1) interventionist; 2) iterative; 3) process oriented; 4) utility oriented and 5) theory oriented. DBR interventionist research needs to be conducted in a real-life context since acceptance is complex. DBR is iterative since it warrants iterative evaluation cycles that result in improved understanding of the intervention (process oriented). Iterations encourage the identification of critical variables, limitations and generate more transferable and useful results (utility oriented). Iterations also allow for

design changes, improvements and testing with a variety of participant groups. If designs are implemented and evaluated in a systematic manner they have the potential to generate theories as well (theory oriented).

DBR is appropriate for complex environments because it deals with research of important issues and provides significant results (Van Wyk & De Villiers, 2014). Collaboration occurs between practitioners and researchers and their participation has an impact on decisions in the different phases of the DBR process. DBR addresses unsolved complex problems in innovative and unique ways and iterative, systematic processes of analysis, design, development and implementation are conducted on a continuous basis throughout the research study. A vital feature of DBR is the fact that there is a dual outcome consisting of a practical contribution and a theoretical contribution, in the form of a set of design guidelines. Since DBR's aim is to resolve actual problems in terms of refining and extending theories it has to be pragmatic, yet theoretical. Finally an authentic artefact is produced as a result of the DBR conducted which is fully functional in real-world environments. Van Wyk and De Villiers (2014) summarised the main features evident in DBR (Table 2-2).

Table 2-2: Features of DBR (Van Wyk & De Villiers, 2014, p. 72)

DBR Features		
1.	Appropriate for complex environments	DBR deals with important issues, sizable effects and significant results in complex environments.
2.	Problem-solving	DBR is fundamentally a problem-solving paradigm. It explores research issues related to real-world practical problems. New solutions must be developed that are relevant to authentic organisational issues.
3.	Collaborative and participative	Practitioners and researchers are engaged in long-term collaborations. Their expertise impacts decisions in the different phases of the research process.
4.	Innovative	DBR addresses complex, unsolved problems in unique or innovative ways. The development of solutions is informed by existing design principles and technological innovations. Methods, technologies and innovative tools are generated, whereby new design principles can be put into practice.
5.	Iterative	Researchers conduct systematic and iterative processes of analysis, design, development and implementation for continuous refinement of design interventions.
6.	Dual outcomes	The outcomes of DBR are: (i) A practical contribution in the form of an innovative product or intervention; and (ii) A set of design principles or guidelines, with the objective of a theoretical contribution.
7.	Pragmatic, yet theoretical	DBR aims to resolve actual challenges, as it extends theories and refines design principles, i.e. it impacts directly on practice, leading to substantial change, while simultaneously advancing transferable theory.
8.	Artefacts	Authentic artefacts are produced as purposeful practical interventions in functioning environments.

It is evident that there is a variety of DBR features reported on and identified in literature, however, it is noted that there are common characteristics. For the purposes

of this research study, the features of DBR as discussed by Van Wyk and De Villiers (2014) will be applied.

2.4.2 Design-Based Research Process Model

The classic ADDIE (Analysis, Design, Development, Implementation, Evaluation) model is used as a notation within DBR (De Villiers & Harpur, 2013). According to Molenda (2003), the ADDIE model is considered to be a colloquial, umbrella term describing a systematic approach to instructional development. ADDIE has five main processes: analyse, design, develop, implement and evaluate. These processes are considered to be sequential as well as iterative in nature.

Since researchers often work closely with participants, unforeseen influences can result from the researcher's dominant presence and can thus unintentionally affect the research outcomes and thus has created a paradigm shift (Wang & Hannafin, 2005). DBR is often seen to be over methodologised since only a small percentage of the data that is collected is used to report on the findings, large amounts of data are often discharged and thus the degree of data utilisation or lack thereof can negatively influence the quality of research output.

The new generic model of DBR proposed by Van Wyk and De Villiers (2014) has a number of differences to that of the DBR model of Amiel and Reeves (2008). One of the differences is that the new generic DBR model allows for the conceptualisation of solutions outside current mature theoretical frameworks, due to the innovative nature of the technologies being applied (Van Wyk & De Villiers, 2014). An updated version of the DBR cycle has been proposed and can be summarised as follows (Amiel & Reeves, 2008; Van Wyk & De Villiers, 2014):

1. Analysis of practical problems by researchers in collaboration with practitioners;
2. Development of solutions informed by existing design principles and technological innovations;
3. Iterative cycles of testing (evaluation) and refinement of solutions in practice; and
4. Reflection to produce new theory related to design principles and to enhance the implementation of the solution.

Each of these steps can result in some refinement of previous steps and processes and this may result in the need for long-term engagement and numerous cycles of

design (Van Wyk & De Villiers, 2014). The DBR process commences with identifying and analysing the problem or need and this is then followed by the development of a prototype solution which is informed by existing theoretical knowledge, design principles and technological solutions (Teräs & Herrington, 2014). Rapid, agile prototyping then occurs which targets redesign through various iterative cycles which assist with forming a deeper understanding of the problem being addressed. Evaluation in DBR, is of the utmost importance since the design is largely based on the information obtained through evaluation. DBR emphasises solutions that can be adopted elsewhere and newly generated theory that can guide similar research and development (Van Wyk & De Villiers, 2014). The new DBR model (Figure 2-3) also adds an additional feature to DSR by encouraging a proposal as an output of the first phase.

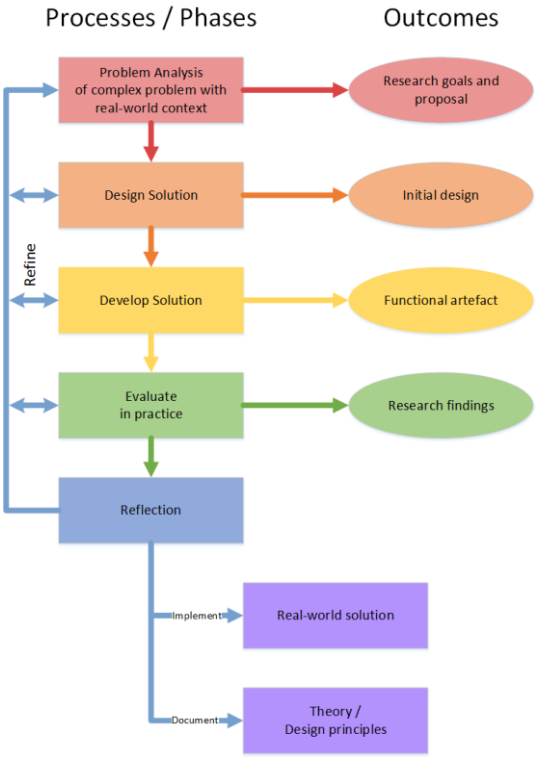

Figure 2-3: A Synthesised Generic Model for Design-Based Research (Van Wyk & De Villiers, 2014, p. 74)

The DBR proposal should include tentative design and performance criteria that will be used to evaluate the prototype and research goals. With the new generic DBR model provision is also made for the extension of new theoretical contributions which should inform future design and evaluation in similar real-world environments. This

new DBR model integrates the phases and processes of various variations of the DBR and explicitly demonstrates the outcomes within each phase.

2.5 Application of the Design-Based Research Methodology

Iterations in the DBR process occur in terms of design, evaluation and redesign (Van Wyk & De Villiers, 2014). In this study, the Van Wyk and De Villiers (2014) new generic model of DBR with its five phases will be used (Figure 2-4). As previously mentioned (Section 1.9) this study as a whole will address the five DBR phases at a high-level, each chapter addressing a specific set of the DBR phases. Each evaluation cycle of this study will also cover all five phases (areas of DBR). These phases are discussed in more detail in this section.

Phase 1: Problem Analysis within Context

Phase 1 includes the identification of a practical and authentic problem in a complex environment and literature is reviewed in order to determine the significance of the problem as well as to detect existing theory on the topic (Van Wyk & De Villiers, 2014). Collaboration occurs between the researcher and practitioners in terms of analysing the given problem and the establishment of research goals. In this study, a literature review will be conducted where problems with ERP education will be identified. Various trends in learning approaches will also be discussed together with success factors for e-learning of ERP systems. Criteria that are used for the evaluation of e-learning will be explored. The problem will be motivated by means of preliminary field studies making use of a case study approach.

As part of the ***problem analysis of the complex problem with real world context*** case studies will be used. A case study is a *"detailed examination of one or more specific situations"* and in this case, can be used to assist the researcher with understanding how users make use of a variety of technologies in order to accomplish various tasks (Lazar, Feng, & Hochheiser, 2010, p. 147). Case studies can be described by the following four aspects: an in-depth investigation of a small number of cases, examination (evaluation) in content, multiple data sources and also emphasis being made on qualitative data and analysis. The goal of a case study is to explore, explain, describe and demonstrate problems, models, systems and tools (Chapters 3 and 4; RO_1, RO_2, RO_3 and RO_4).

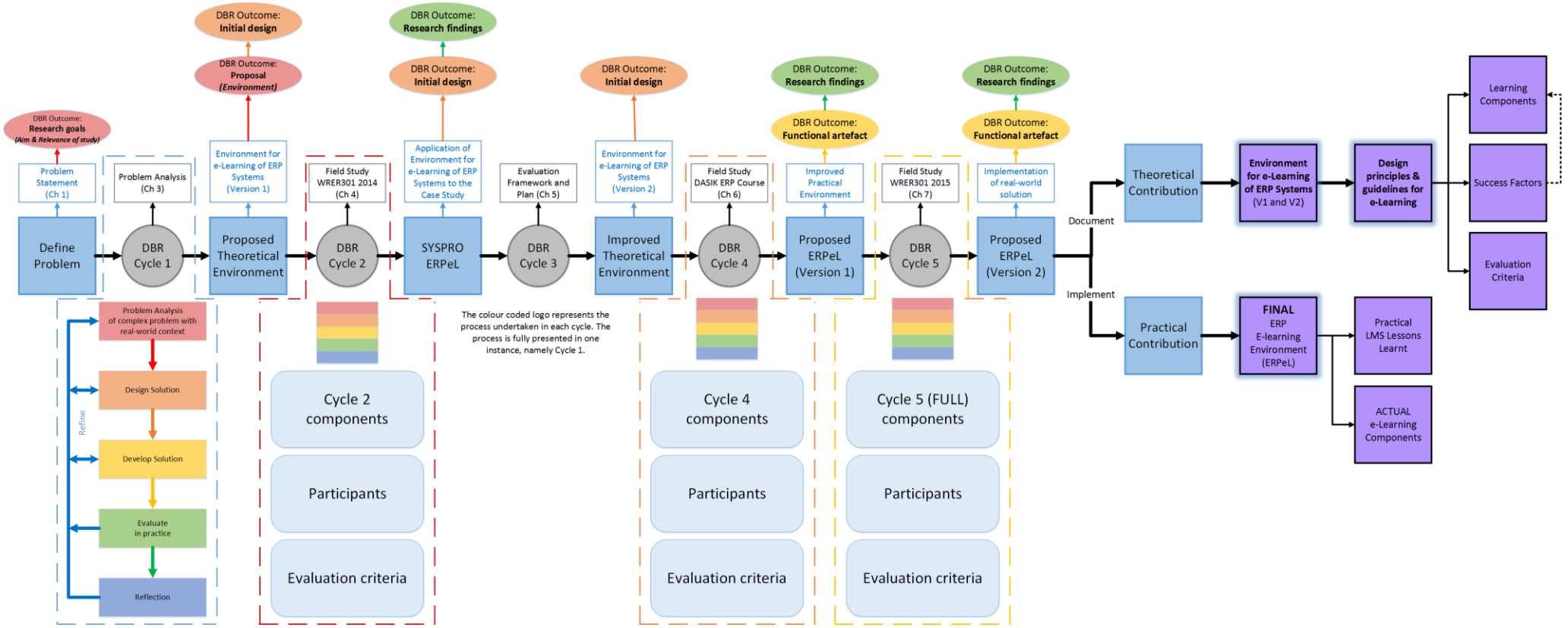

Figure 2-4: High Level Process Flow Diagram of this Research Study (Author's Own Contribution)

Phase 2: Design Solution

Phase 2 includes an initial design being proposed to address the identified problem (Van Wyk & De Villiers, 2014). The appropriateness of this design is influenced by contextual limitations as well as the complexity of real-world interactions.

A literature review will be conducted for the duration of this research study in order to obtain the latest research in ERP education and e-learning. A combination of the literature review together with field studies and interviews will be used to determine a possible design solution as well as explore the existing e-learning tools and components available to ERP systems. High-level objectives will be determined and specified in this phase, along with the proposal for the evaluation plan and design considerations. This phase will also include detailed descriptions of the various DBR cycles which are to be carried out over the duration of this study and the various components which were evaluated during the relevant cycles (Chapters 3, 4 and 5; RO_1, RO_2, RO_3 and RO_4).

Phase 3: Develop Solution

Phase 3 involves the development of a prototype which serves the purpose of the research and which is informed by existing design principles and innovations in technology (Van Wyk & De Villiers, 2014). The resulting outcome is an innovative and functional artefact (an environment, in this case).

From the investigation of existing systems as well as the feedback and input gained from all sets of participants, mainly ERP students in higher education and SYSPRO practitioners, the artefact will be developed and described. Proposed prototype environments will be presented where an entire iterative cycle will be presented in Chapters 6 and 7 respectively, from start to finish, because the cycles follow on and build on one another (Chapters 6 and 7; RO_5 and RO_6).

Phase 4: Evaluate in Practice

Phase 4 involves the artefact being tested in the real-world setting (Van Wyk & De Villiers, 2014). This phase involves data which is collected and analysed in order to address and answer the research questions and also to construct design principles.

The proposed artefact, the ERP e-Learning Environment (ERPeL), will be adopted and evaluated by a set of participants from the selected case studies to determine the

success of the proposed environments. The proposed ERPeLs will be evaluated as a proof of concept of the environments. The data that is collected will be both qualitative and quantitative and will be statistically analysed. Both development/evaluation cycles will be considered to adhere to DBR Phases 3 and 4 at a high level and within each cycle all the Phases (1 to 5) will also be followed (Chapters 6 and 7; RO_5 and RO_6).

Phase 5: Reflection, Leading to Dual Outcomes

The final phase is subdivided into ***practical*** and ***theoretical*** outcomes (Van Wyk & De Villiers, 2014). In terms of practical outcomes, reflection can enhance the implementation of a given solution. For instance, from the reflection on data, new designs can be developed and implemented which lead to an ongoing cycle of design-reflection-design. In terms of theoretical outcomes, the design principles ought to be repetitively and cumulatively documented to be transferable and utilised by others in similar settings of research. Therefore, development of a new theory can occur which may need numerous DBR cycles. The DBR process culminates into dual outputs, namely: 1) an implemented solution which addresses the original, identified problem in real-world settings, as well as 2) a documented design principle and/or theory which can be used to guide similar research and development efforts.

In concluding this research study the findings will be discussed in great detail where the finalised ERPeL will be discussed as well as any recommendations for future work (Chapter 8; RO_7 and RO_M). During the course of this study, papers will be written and submitted to journals and/or conferences.

The eight DBR features (Section 2.4.1) have also been considered and specifically applied to this study (Table 2-3).

Table 2-3: Application of Features of DBR to this Study

Application of DBR Features for this Study		
1.	Appropriate for complex environments	The final artefact of this research study will be the combination of a variety of components in order to present a comprehensive and integrated environment for ERP education.
2.	Problem-solving	The proposed artefact should address the problem statement of this study.
3.	Collaborative and participative	Collaboration amongst researchers and practitioners in the same field of research will occur at NMMU and other South African HEIs. Industry partners will also be involved in this research and possibly international collaborators as well. Participants of this study include NMMU students, academic staff and industry delegates.
4.	Innovative	The final artefact aims to be innovative and will consider various design principles and guidelines. A set of design considerations is to be recommended for future research in this field, including new technology, interactive components and pedagogical issues.
5.	Iterative	More than one evaluation will be conducted in the form of iterative cycles that will occur over the duration of this study and will follow the DBR phases. The Environment for e-Learning of ERP Systems will evolve through more than one version. The study as a whole, the form of the structure (and chapters) will follow the DBR phases and within each cycle the same DBR phases will also be applied in a systematic way focusing on problem analysis, design, development, evaluation and reflection.
6.	Dual outcomes	This study will produce dual outcomes, mainly a practical contribution in the form of the proposed ERP e-Learning Environment (actual, practical e-learning components and practical LMS lessons learnt) and a theoretical contribution consisting of design principles and guidelines for e-learning (success factors, learning components and evaluation criteria).
7.	Pragmatic, yet theoretical	Not only should this study solve the problem identified it should present a significant contribution to the field of ERP education, specifically referring to e-learning.
8.	Artefacts	Since the artefact is to be evaluated in a real-world context i.e. an ERP systems module, it needs to address the requirements of the course and be suitable for novice ERP users.

2.6 Research Materials

The research materials for this research study will include instructional guides such as practical guides that contain exact instructions about the tasks and evaluations which need to be undertaken by the participants. For the heuristic evaluations and field studies, tasks lists and supporting documentation will also be compiled. In the case of interviews and focus groups, possible questions and discussion points will also be drawn up. More importantly, before participants participate in a cycle evaluation they will be required to complete an informed consent form indicating that they agree to participate and that their participation is voluntary. Participants will also be verbally given the background information to the study in order for them to form a better understanding of the aim of the study as a whole, as well as the individual cycle evaluation, interview or focus group at hand.

2.7 Summary

DBR is considered to be a suitable option for TELEs, therefore it can be deemed an appropriate and suitable option for this research study. Not only does DBR increase relevance and practical impact, it also assists in developing empirically grounded

theories and increasing the robustness of design practice. However, a major goal of this research methodology is to ultimately address a complex educational problem.

Therefore, it can be deduced that since this is an IS project which focuses on educational technology and DBR is a research methodology and paradigm which is employed and used in IS and educational technology research projects, it is a fitting choice to be used as a set of guidelines to follow and apply throughout this research study. The next chapter will provide a literature review of problems with ERP systems' education and e-learning approaches.

Chapter 3. A Theoretical Review of ERP Education and e-Learning

3.1 Introduction

In order to address Phase 1 (Problem analysis within context) of the DBR methodology a thorough literature review needs to be conducted. This chapter reports on the literature review. Chapter 3 will also focus on Phase 2 (Design Solution) of the DBR methodology where an ERP e-Learning Environment (ERPeL) will be proposed in the concluding section based on the literature discussed throughout the chapter. The problem analysis concluded in this chapter is considered as the DBR Cycle 1 of this study.

This chapter will answer the following research questions:

RQ1: *What problems are evident in ERP systems education*?

RQ2: *What factors make e-learning of ERP systems successful?*

RQ3: *What criteria can be used to evaluate the success of e-learning environments?*

RQ4: *Which e-learning components can be used to assist with ERP education?*

The layout of Chapter 3 and the research objectives and deliverables addressed in this chapter are illustrated in Figure 3-1. Several types of ERP system users (Section 3.2) and problems related to educating these users in ERP education have been identified in literature (Section 3.3). There are several pedagogical principles relevant to this study (Section 3.4). Trends in learning approaches must also be considered when designing a learning environment (Section 3.5). There are a variety of systems that support e-learning (Section 3.6) and several Critical Success Factors (CSFs) for e-learning of ERP systems have been proposed (Section 3.7). Various components exist for e-learning that can be combined to present an e-learning environment (Section 3.8). For these components to be deemed successful, an evaluation of the e-learning components and environments needs to be conducted (Section 3.9). An e-learning environment for ERP education is proposed based on the literature (Section 3.10). Several conclusions can be made based on the theory presented and discussed (Section 3.11).

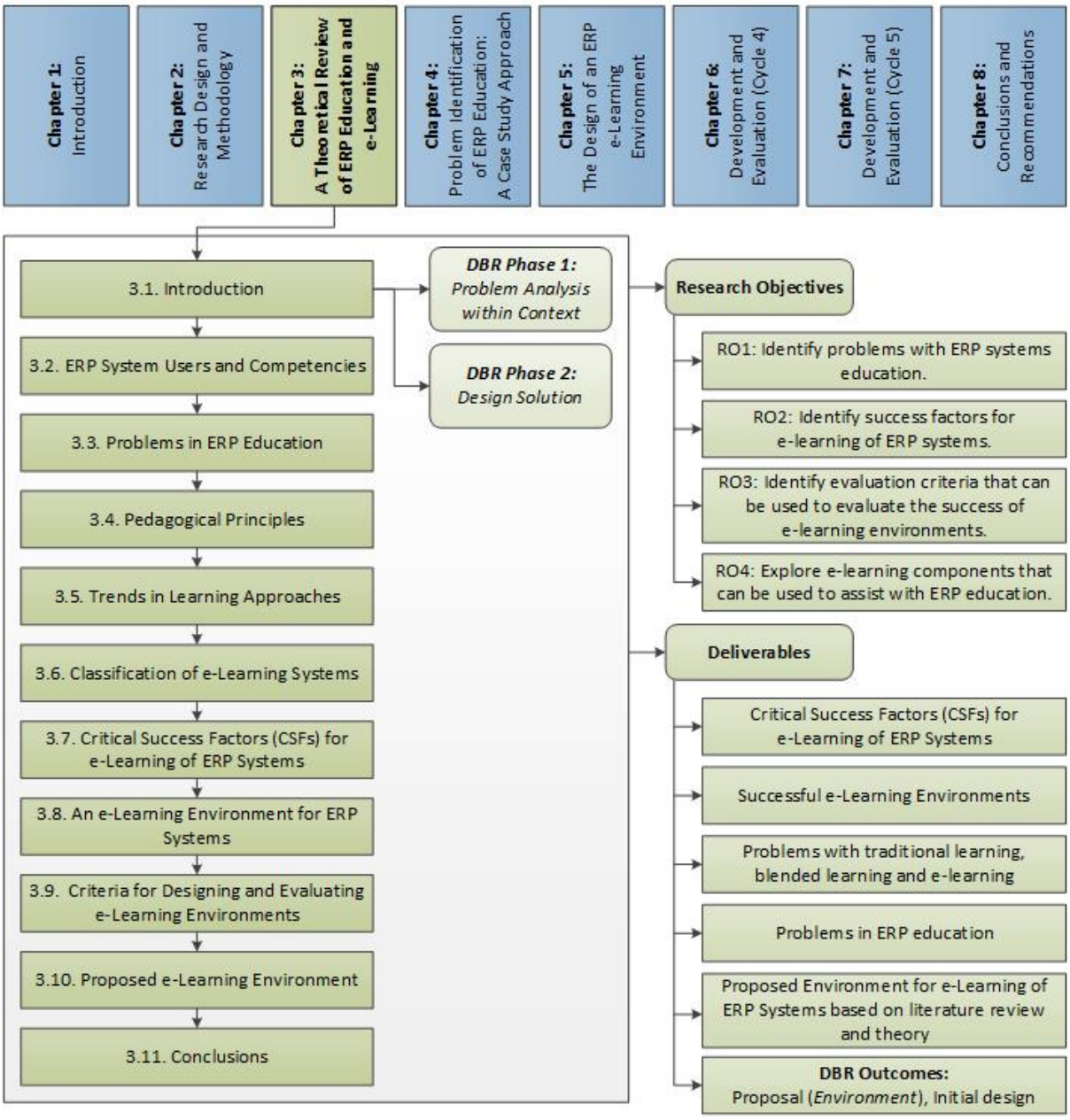

Figure 3-1: Chapter 3 Layout and Deliverables

3.2 ERP System Users and Competencies

Computer users have varying capabilities and this can lead to significant implications for interface design and these differences in capability can have an impact on performance (Streicher, Wesson, & Calitz, 2002). In a university context users of ERP systems can be grouped as university students, faculty, staff, alumni and friends (Helmich, Herzog, & Neumann, 2014). Staff includes lecturers and student assistants who need training in order to have a successful ERP curriculum (Kanthawongs & Kanthawongs, 2010). In terms of ERP system implementations in industry users are classified as key users and end users (Wu & Wang, 2007). A key user is usually

chosen from operating departments and will normally be familiar with business processes and have domain knowledge of these areas (Wu & Wang, 2007). They will have to develop the requirements of the system and will also specialise in specific parts of the ERP system and therefore act as trainers, help-desk personnel, educators, advisors and change agents for end users. End users, on the other hand, will be the ultimate users of the ERP system and will have very specific knowledge depending on the part(s) of the system they will work with.

According to Rusu, Muresan, Arba and Grigore (2008), ERP system users can be classified according to three learner competency levels: novice, practitioner and expert. An ERP user classification model that combines the research of Kanthawongs and Kanthawongs (2010), Rusu et al. (2008) and Wu and Wang (2007) is proposed (Figure 3-2).

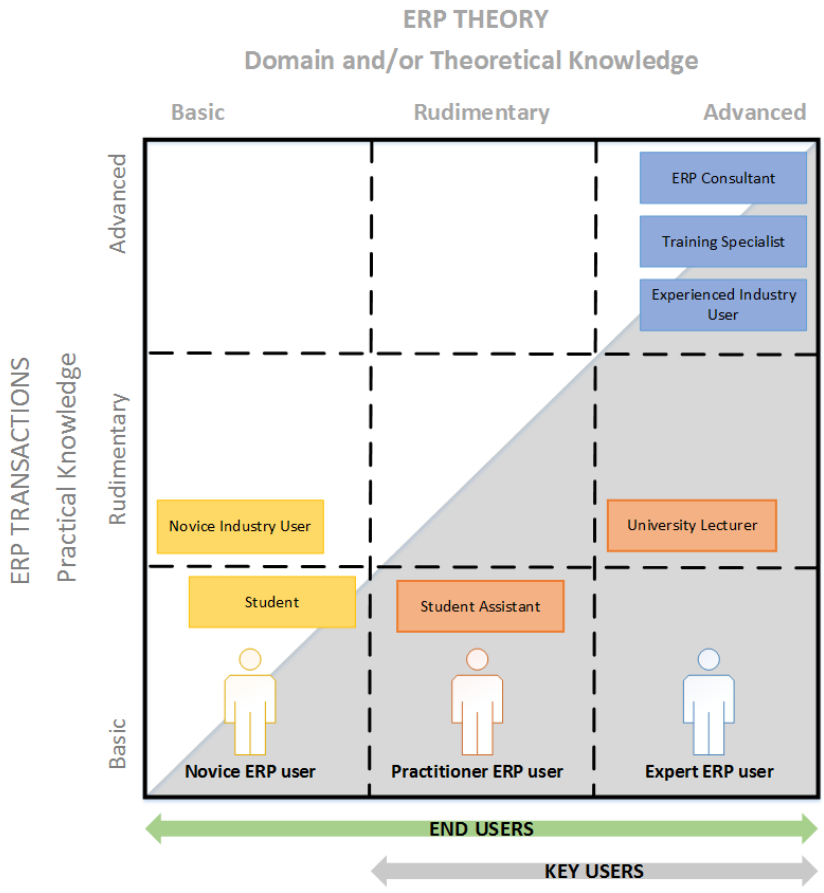

Figure 3-2: ERP User Classification Model (Author's Own Contribution)

A **novice user** is an individual, typically a student or someone completely new to industry, who has a basic theoretical knowledge and no practical knowledge, real world skills, or experience in ERP systems and concepts (Rusu et al., 2008). A

practitioner user is an individual, typically working in industry, who has basic to advanced theoretical knowledge, but rudimentary practical knowledge or experience in ERP systems and concepts. For example, someone who is fairly new to the work place/industry and has roughly five years of experience or a university lecturer or student assistant *(end and/or key user)*. An **expert user** is an individual, usually working in industry, who has advanced knowledge in both theoretical and practical aspects (more than 15 years work experience) of ERP systems and concepts. For example, an ERP consultant or training specialist *(end and/or key user)*. Educators is the collective term that is going to be used when referring to both lecturers as well as trainers.

There are two ERP competency categories which are deemed to be appropriate for this study, namely: ERP Transactions and ERP Theory and Concepts (Scholtz, 2011). Being able to perform and create *ERP Transactions* is an important competency to identify and address, since operational capability with the software is the primary goal required of an ERP specialist. The *ERP Theory and Concepts* competency is also important because having the knowledge to be able to perform practical tasks is necessary for understanding.

3.3 Problems in ERP Education

There are various problems related to the education of ERP systems (Jensen, Fink, Møller, & Rikhardsson, 2005). Learning of ERP systems requires great effort and time from students due to the extensive theoretical learning content as well as the immense range of the functions of ERP systems (Eicker, Kress, & Lars, 2007). Another problem is the availability of instructional content and demonstration data (Ask, Juell-Skielse, Magnusson, Olsen, & Päivärinta, 2008). Usability and user-interface (UI) problems with ERP systems specifically used for instructional purposes are also challenges which ERP educators have to deal with (Scholtz, Cilliers, & Calitz, 2010).

Not only is the ICT skills shortage putting a burden on the South African economy, but it has also shown that there is a significant lack of specialist skills in fields such as ERP systems and often outsourcing to other countries is a result of this (Ansen, 2014; Hustad & Olsen, 2014). A lack of ERP skills for ERP projects in general and specifically in developing countries is a huge challenge (Abdullabhai & Acosta, 2012).

In order to minimise the gap between the competencies of university graduates and those competencies required by industry, academic alliance programmes with ERP vendors have been created. ERP vendors such as SYSPRO, SAP, Microsoft and others have formed strategic academic university alliances with HEIs (Springer, Ross, & Humann, 2007). These strategic academic university alliances allow HEIs access to fully functioning ERP systems which are used specifically for education and research purposes (Seethamraju, 2007).

Hands-on training of ERP systems is recommended for HEIs, however, it is often the case that learners are prone to take on a passive approach of merely following or watching projectors, screens and button clicking and thus understanding of the underlying processes ***(process view)*** is limited or non-existent (Seethamraju, 2007). The problem with hands-on training is emphasised by the lack of suitable learning material. Since existing material is designed for vendor-based training (Zhang, Lee, Huang, Zhang, & Huang, 2005).

Vendor-based ERP training can be referred to as the process of providing employees, along with management, the logic and overall concepts of an ERP system, in order for them to have a greater understanding of how their jobs are related to the specific functional areas of the organisation (Zhang et al., 2005). However, vendor-based training and material is not geared or suitable for use in an academic, HEI curriculum (Surendran, Somarajan, & Colton, 2006). Vendor-based training material is often informal, non-scientific, very practical and is limited theoretically in terms of abstract knowledge and skills required by HEIs which need to align with specified learning outcomes and aims.

Step-by-step practical guides provided by vendors are not always considered an adequate representation to showcase the business processes in ERP systems to students (Rienzo & Han, 2010). Often students find such tasks to be tedious, find no real value from them and lack understanding as to why they are being done at all. After completing such tasks they often cannot remember what they have done or how they did it. Thus, the instructional use (hands-on) of ERP systems is seen to raise various problems and issues for ERP educators especially since students often fail to acquire the required levels of conceptual knowledge and procedural skills. Sometimes a lack of ERP skills and knowledge is also experienced with academic staff at HEIs, which is

also deemed to be a significant challenge (Hustad & Olsen, 2014). Thus, additional material and learning resources are required at HEIs to fill in the gaps in the ERP curriculum.

The integration of ERP systems into HEI curricula is slow or non-existent (Grandzol & Ochs, 2010). Some of the common problems specific to ERP education have been summarised (Table 3-1) and analysed using a cause and effect diagram (Harmon, 2007) (Figure 3-3).

Table 3-1: Problems with ERP Education (HEI and Industry)

Problems with ERP Education	
Description	**References**
Limited access and availability of quality trained academics	Cameron (2008); Hustad and Olsen (2014)
Gap between university and industry competencies	Ansen (2014); Ram, Wu and Tagg (2014); Scholtz et al. (2013)
Slow/no integration of ERP systems into curricula	Boyle (2007); Grandzol and Ochs (2010)
Lack of ERP specialists	Ansen (2014); Boyle (2007); Hustad and Olsen (2014)
Lack of understanding of underlying processes (process view)	Rienzo and Han (2010)
Availability of instructional content and demonstration content	Ansen (2014); Ask et al. (2008); Seethamraju (2007)
Vendor-based content and training	Surendran et al. (2006); Zhang et al. (2005)
Students fail to acquire required knowledge and skills	Abdullabhai and Acosta (2012); Jensen et al. (2005); Rienzo and Han (2010)
Problems with usability of ERP systems (not designed for learning)	Scholtz et al. (2010); Seffah, Donyaee, Kline and Padda (2006); Winkelmann and Leyh (2010)

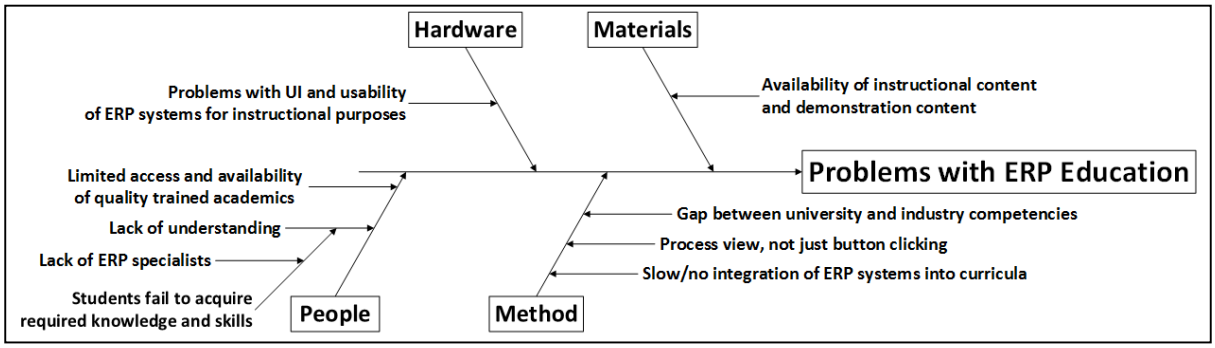

Figure 3-3: Cause and Effect Diagram of Problems in ERP Education

3.4 Pedagogical Principles

In order to tackle the problems faced with ERP education and training, reflection needs to occur on some pedagogical principles. According to Kushnir and Berry (2014), teaching strategies (pedagogy) affect and influence the teaching tools and technologies that are chosen and used, which also impacts the strategies of teaching and learning. This is why it is extremely important for online courses to be built on comprehensive and rigorous pedagogical principles in order to facilitate expressive

and productive learning (Kushnir & Berry, 2014). The understanding of the pedagogy behind the tools and technology will assist in understanding how to best implement educational media and technologies into learning environments so as to enrich the overall experience. According to Siqueira, Braz and Melo (2007), education can be implicit through three diverse dimensions, mainly content, pedagogy and technology (Figure 3-4). Pedagogy influences both content and technology. For the purpose of this study these can be applied to e-learning and will be referred to as the CPT (content, pedagogy and technology) dimensions of e-learning.

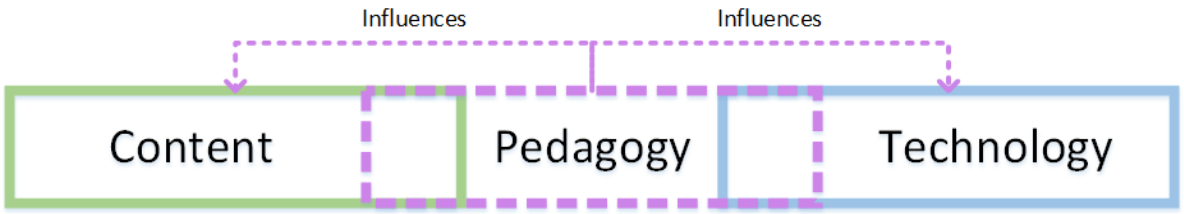

Figure 3-4: CPT Dimensions of e-Learning (Adapted from Siqueira et al., 2007)

The pedagogy of an e-learning environment should also incorporate the learning design methodology (Moore et al., 2011) (Section 1.1). As part of the pedagogical dimension *The Seven Principles of Effective Teaching* should be considered when designing a learning environment. These principles were proposed by Chickering and Gamson (1987) and are well-known pedagogical practices. According to these principles, effective teaching should do the following:

- Encourage student-faculty contact;
- Encourage cooperation among students;
- Encourage active learning;
- Give prompt feedback;
- Emphasise time on task;
- Communicate high expectations; and
- Respect diverse talents and ways of learning.

This set of principles is intended for faculty members, students and administrators to improve the quality and effectiveness of teaching and learning (Chickering & Gamson, 1987). The principles depend on the way teachers teach, how students learn, how students work and play and how students and academics communicate amongst each other. Each principle can stand on its own and when all seven are present their effects multiply.

The Seven Principles framework focuses on constructivist (learner-centred) based teaching practices and are therefore well suited to the design and delivery of e-learning instruction (Bangert, 2004). Constructivists emphasise that students are responsible for taking control and ownership for their own learning. The manipulation of existing technology in a way that effectively operationalises *The Seven Principles* for effective instruction can be a challenging endeavour. The latest versions of course authoring tools can allow academics to easily create instructional activities which are recommended by this framework; however, the pedagogy that is implicitly defined by *The Seven Principles* framework needs to be emphasised since it will in due course determine the effectiveness of online teaching and not the technology that is accompanied by the course authoring tools.

3.5 Trends in Learning Approaches

The analysis of the literature revealed the following trends in learning approaches:

- F2F learning (Section 3.5.1);
- e-Learning (Section 3.5.2); and
- Blended learning (Section 3.5.3).

3.5.1 Face-to-Face Learning

Learning which involves the teacher making all the major decisions (such as who, what, where, why and by whom the instruction is for) is known as traditional, classroom or F2F learning (Lim & Chai, 2013). A typical traditional classroom environment will consist of a presenter who is in control of the entire instructional and learning process (Neo, Neo, Lim, Tan, & Kwok, 2013). In traditional F2F learning, those persons attending will essentially just be there to listen and will thus play little part in the learning process and experience. This type of learning is known as a passive approach. Learning can also occur in a more active approach where interaction is promoted when students participate in question and answer sessions as well as group discussions (Ituma, 2011).

Some reports have indicated that satisfaction is generally higher in F2F learning as opposed to distance education and learning (Huerta-Wong & Schoech, 2010). The advantages of F2F learning environments such as social and personal interactions are often lost in e-learning environments (Akkoyunlu & Soylu, 2008).

This could be because research has shown that students and lecturers who attend F2F classroom presentations are limited in terms of effectiveness in both teaching and learning (Neo et al., 2013). F2F learning is advantageous in its ability to motivate students, however, problems have been identified in terms of time and location constraints and also the fact that F2F delivery is more expensive (Monika, 2013). The benefits and problems associated with traditional F2F learning have been summarised in Table 3-2.

Table 3-2: Benefits and Problems of F2F Learning

F2F Learning Benefits	
Description	**References**
Higher levels of satisfaction	Huerta-Wong and Schoech (2010)
Social and personal interactions	Akkoyunlu and Soylu (2008); Monika (2013)
Motivating students	Monika (2013)
F2F Learning Problems	
Instructor-centred	Lim and Chai (2013); Monika (2013); Neo et al. (2013)
Attendees usually just listen, passive approach	Neo et al. (2013)
Limited in effectiveness of teaching and learning	Neo et al. (2013)
Time and location constraints	Monika (2013)
More expensive to deliver	Monika (2013)

3.5.2 e-Learning

As noted by Moore et al. (2011) there are conflicting definitions of e-learning, distance learning and online learning. Some feel they are one and the same thing, others feel there are differences based on instructional characteristics and technology usage (Moore et al., 2011). e-Learning is considered to be one of the promising applications of IT and network technologies and is a representation of the most recent evolution of distance learning where the instructor and the student are separated by time and space, and sometimes both (Liaw & Huang, 2013). Online learning technologies make use of the Internet to access learning materials, interact with the content, instructor and fellow peers and acquire support for the duration of the learning process (Farahat, 2012). These technologies are also used to obtain knowledge, create personal meaning and allow growth from the learning experience.

e-Learning is defined as learning that is conducted over and across the Internet making use of a network and computer as well as audio, video and possibly interactive activities (Akkoyunlu & Soylu, 2008). e-Learning takes place when the student and

teacher are located in different geographical whereabouts and/or locations and all communication is handled and conveyed over the Internet, for example via instant emails or forums. This method is commonly used in the presentation of courses as it allows for course content to be presented for extended periods of time, therefore, education can occur 24 hours a day, seven days a week. e-Learning intensifies the reach of students and also allows for learning to transcend the bounds of time and place where material can be accessed anywhere.

An **e-learning system** uses the concept of e-learning and combines it with technology (Hassanzadeh, Kanaani, & Elahi, 2012). An e-learning system is learning technology that makes use of web browsers as tools for interaction amongst learners and other systems and serves as a platform for teaching and learning facilitation. An e-learning system can alternatively be considered an IS that is based on the World Wide Web (WWW) and provides flexible training and learning. The e-learning system is responsible for handling the various aspects such as assessment, discussion, content management, peer reviewing, amongst others and is considered successful if it can replicate the classroom experience and at the same time consider student needs (Tarhini, Hone, & Liu, 2013).

Over the last decade, the corporate e-learning market has shown rapid growth and many organisations have adopted e-learning as their favoured method for human resources skills development (Monika, 2013). Similarly, in higher education, e-learning is becoming mainstream. e-Learning allows for the quick creation of learning resources in order to address various business and educational needs as well as to help minimise the time and resource contribution from the student. Ultimately, e-learning focuses on the individual requirements of learners (learner-centred) and the content delivered.

e-Learning or online learning can also be referred to as an Online Learning Environment (OLE) and is considered to be the most extensively used educational tool, however, it is the most expensive (Palmer & Holt, 2009). Occasionally, also known as a LMS, OLEs have also been extensively and regularly accepted by HEIs, often without any evaluation. An LMS is commonly used for information retrieval including guidelines, lecture notes and additional course information (Hrastinski & Aghaee, 2012). An **LMS** is considered to be an e-learning system which distributes

courses over the Internet, promotes online collaboration, facilitates communication between educators and students, tracks progress and shares course content (Islam, 2013). LMSs usually have a wide variety of features which assist and support distance as well as traditional learning. LMS have become indispensable tools used in education and most universities are making use of them to support and improve their learning and teaching processes. Making use of LMSs at university level has the potential to improve quality and encourage learner-centred education. LMSs are also known as Course (Content) Management Systems (CMS), when specially referring to e-learning platforms adopted in higher education (Kim, Trimi, Park, & Rhee, 2012). LMSs are seen to provide a flexible learning environment for students, 24/7 access to learning content and a variety of content including quizzes, to name, one of many (Kaliski, Booker, & Schumann, 2012). With such a wide variety of options, the learning experience is seen only to be limited by technology, connectivity and the instructor's own creativity.

According to Abdous and Yen (2010), **distance education** is seen as an umbrella term which incorporates an assortment of delivery modes and technologies ranging from satellite broadcasts in remote locations to mobile learning via hand-held devices. Distance education specifically is considered as being the effort of providing access to learning for learners who are geographically distant (Moore et al., 2011). Distance learning is considered to encompass e-learning, online learning as well as various other types of learning that have evolved from it.

Interaction, social and interpersonal, through an e-learning system is conducted through computer networks and interfaces as opposed to through F2F communications (Liaw & Huang, 2013). Communications and interactions in the form of questions, answers, discussions, debates, to name but a few occur online between students, lecturers and peers where communication is either asynchronous or synchronous. Asynchronous communication and interaction are mediated with the assistance of technology and are not dependent on the students and lecturers being active in the learning process at the same time. Students are able to work at their own pace and convenience. Alternatively, synchronous communication and interaction occurs in real time and therefore requires that all parties be available simultaneously. Studies have shown that the interactive nature of an e-learning environment can potentially enhance the positive attitudes of students making use of the environment

and thereby increase their perceived satisfaction, usefulness and self-regulation towards e-learning.

One important benefit of e-learning is the use of text, images, audio and videos (Da Silva et al., 2013). Content can be created, communicated with others and managed in a virtual space. Students' learning experiences will be richer where incorporating more visual elements into teaching which can prevent or reduce boredom (Dalveren, 2014). Including visual elements into lectures can promote improvements in terms of student attention span as well as increased retention.

Overall e-learning can decrease the burden on management since they can track progress as well as attendance (Dalveren, 2014). e-Learning allows instructors the capability of being able to transfer far more information and resources than F2F learning thereby increasing efficiency. e-Learning supports *The Seven Principles of Effective Teaching* proposed by Chickering and Gamson (1987) where instructional practices and principles can be followed in order to improve the effectiveness and quality of teaching and learning (Section 3.4). e-Learning has noticeably brought about various advantages to the learning process such as flexibility and efficacy (Akkoyunlu & Soylu, 2008).

In spite of the benefits of e-learning there are also areas which are challenging (Table 3-3). One challenge in asynchronous e-learning is a potential lack of immediate feedback since the students and educator are not in the same place and time (Monika, 2013). e-Learning usually means increased preparation time for the lecturer or presenter and it can potentially create frustration, anxiety and confusion amongst users. Other drawbacks of e-learning are: culture and acceptance (Al-Adwan & Smedley, 2012; Palacios-Marqués, Cortés-Grao, & Lobato Carral, 2013). An individual's culture and traditions are strongly aligned with their acceptance of learning practices (Al-Adwan & Smedley, 2012). e-Learning can be successful in some cultures, but can also be completely rejected by others. Not everyone has access to the Internet or high bandwidth and this can make access to online videos and course material difficult (Borstorff, 2007; Tagoe, 2012). This is especially true in developing countries like South Africa where adoption rates of e-learning are slow due to poor infrastructure, specifically in terms of connectivity (Tagoe, 2012). People are generally resistant to change and therefore e-learning can sometimes be viewed as

inconvenient or threatening especially because it is seen to be cold and impersonal since there is a lack of human contact (Borstorff, 2007; Tagoe, 2012). e-Learning is all about change and requires that individuals change their habits, behaviours, attitudes and perspectives. e-Learning could be seen to take away students' ability to interact in person with and learn from their peers during the learning process. e-Learning allows the student to have control, however, this control is not always exercised wisely.

Table 3-3: Benefits and Problems of e-Learning

e-Learning Benefits	
Description	**References**
Performance and efficiency is higher than that of F2F learning	Dalveren (2014); Huerta-Wong and Schoech (2010)
Expands **scope**	Akkoyunlu and Soylu (2008); Dalveren (2014); Liaw and Huang (2013); Monika (2013)
Increased flexibility and efficacy of the learning process	Akkoyunlu and Soylu (2008); Dalveren (2014)
STUDENT	
Promotes asynchronous interaction - express opinions, ask questions, collaborate and experiment	Liaw and Huang (2013)
Synchronous communication and interaction occurs in real time	Liaw and Huang (2013)
Removes **geographic proximity** restrictions - allows for learning to occur autonomous of time and place (intensifies **reach** of students).	Akkoyunlu and Soylu (2008); Dalveren (2014); Liaw and Huang (2013); Monika (2013)
Richer learning experience, due to **visual** elements: use of text, images, audio, video	Dalveren (2014); Da Silva et al. (2013)
Extended periods of time of presentation	Akkoyunlu and Soylu (2008); Dalveren (2014); Liaw and Huang (2013); Monika (2013)
INSTRUCTOR	
Decrease burden on management, for example track attendance	Dalveren (2014)
Material can be re-used. Content can be created more easily, communicated and managed with others.	Da Silva et al. (2013); Dalveren (2014); Siqueira et al. (2007)
e-Learning Problems	
INSTRUCTOR	
Social and personal interactions are lost	Akkoyunlu and Soylu (2008); Borstorff (2007); Tagoe (2012)
Development of high quality e-learning material is expensive (cost) and time consuming	Siqueira et al. (2007); Borstorff (2007)
Lack of immediate feedback for asynchronous e-learning	Monika (2013)
Increased preparation time for instructor could cause frustration, anxiety and confusion	Monika (2013)
INFRASTRUCTURE	
Bandwidth access and technical difficulties	Tagoe (2012)
INSTRUCTOR and STUDENT	
Culture	Al-Adwan and Smedley (2012); Borstorff (2007)
Acceptance and resistance to change	Al-Adwan and Smedley (2012); Borstorff (2007); Palacios-Marqués et al. (2013)

Students' perceptions, in general, can easily be influenced by various factors (Tagoe, 2012). Specifically, predictive factors influencing perceptions of e-learning are: age, gender, previous experience and exposure to technology, acceptance of technology, along with individual learning styles. An Australian study conducted at Deakin University (Palmer & Holt, 2009), indicated that students felt that an OLE had increased levels of satisfaction when being compared to traditional, classroom teaching and that they felt that an OLE would in fact enhance their learning experience. The study also showed that over a two year period, academic staff rated the importance and satisfaction much higher in year two as opposed to year one.

3.5.3 Blended Learning

Problems related to e-learning led to the combination of F2F learning and e-learning approaches which is known as blended learning (Akkoyunlu & Soylu, 2008). Blended learning can be defined as learning which involves the integration and combination of the strengths of e-learning with those valuable features of traditional, F2F interaction (Akkoyunlu & Soylu, 2008; Daun, Theling, & Loos, 2006). However, according to Wu, Tennyson and Hsia (2010), the blended learning approach is recognised for combining and integrating a variety of delivery methods with different styles of learning.

The idea of blended learning was initiated and started from Computer Based Trainings (CBTs) where users could make use of computer-supported learning programs offline (Daun et al., 2006). CBTs were then enhanced and replaced with Web Based Trainings (WBTs), where users could access up-to-date learning material over the Internet. Blended learning is also described as a concept which is both simple and complex (Gerbic, 2011). Simple in the sense that it involves the integration of classroom F2F learning experiences with online learning experiences. Blended learning has been seen to be very positive in campus-based settings and even in distance education programmes. Usually extensively used at undergraduate level, blended learning has been known to address pragmatic educational issues such as helping non-traditional first year students to settle into university and encourage engagement.

In addition to the benefits of blended learning, there are also various problems and challenges (Table 3-4). A challenge which faces teachers in terms of blended learning is the development of a holistic and integrated learning design (Gerbic, 2011). With

the changes in learning and teaching, academics are faced with new technological, managerial and social roles which often make them question their identity. Teachers themselves will have to adapt and change their beliefs and views about teaching, but this will take time and probably follow an iterative process where over time they will begin to find the best balance for themselves as academics and for their students. Usually, students are drawn to and prefer a mixed-methods approach to teaching, learning and education which is supplemented with aspects of the web and technology (Tagoe, 2012).

Table 3-4: Benefits and Problems of Blended Learning

Blended Learning Benefits	
Description	**References**
Combines the strengths of F2F learning and e-learning	Akkoyunlu and Soylu (2008); Daun et al. (2006); Ellis and Calvo (2007); Wu et al. (2010)
Very positive in campus-based settings and distance education programmes	Gerbic (2011)
Improved student attention and increased retention	Dalveren (2014)
Blended Learning Problems	
Development of holistic and integrated learning design	Gerbic (2011)
Takes time to change instructors views and opinions about teaching and find best balance	Gerbic (2011)

3.6 Classification of e-Learning Systems

Earlier forms of e-learning, include computer-aided instruction (CAI) and tutorials as well as CBT (Section 3.5.3) (Daun et al., 2006). Some of these forms of e-learning are still in use today, however, usually on an offline basis where computer supported learning programs can be used by learners. As with e-learning, CBT promoted the use of graphical animation, however, lacked the possibilities of communication. Thus, WBT complemented CBT where internet technologies were used to promote online communication possibilities as well as to provide access to up to date learning content. Simulations are another e-learning variant which are often used to replicate different software and tools (Plass, Homer, & Hayward, 2009). Simulations are considered to be manipulated visualisations that cannot be altered by the user. Currently simulations are incorporated into e-learning for demonstration purposes.

A classification model of e-learning approaches is proposed (Figure 3-5) and will be discussed in the following sections. Virtual learning, MOOCs (Section 3.6.1) and social media (Section 3.6.2) are only briefly discussed as they are beyond the scope of this study (Section 1.6). The *Top 100 Tools for Learning 2015 Report* revealed that Twitter was ranked in first place (for 2 consecutive years), Moodle was in position 15 and

Blackboard Learn is ranked at 95 (Hart, 2015). e-Learning authoring and video software such as Articulate was at 26th place and Camtasia in 31st place. Mobile learning (Section 3.6.3) and gamification (Section 3.6.4) are two popular categories of e-learning. Systems which are known for their support of e-learning include web-based e-learning platforms (Section 3.6.5) and learning content designer software (Section 3.6.6).

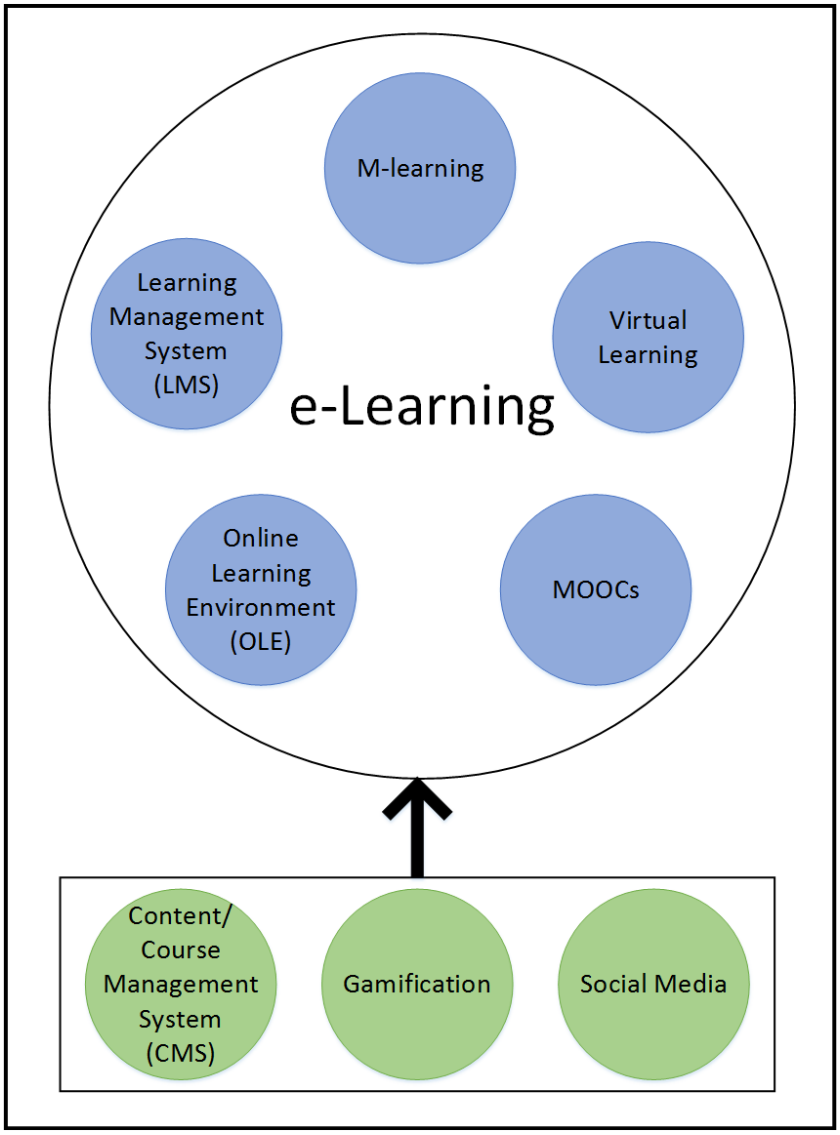

Figure 3-5: Classification of Elements of e-Learning (Author's Own Contribution)

3.6.1 Virtual Learning and MOOCs

According to Huggett (2014, p. 42), virtual training is defined as *"a highly interactive synchronous online instructor-led training class, with defined learning objectives, with participants who are individually connected from geographically dispersed locations, using a web-based classroom platform"*. Virtual Instructor-Led Training (VILT), also

known as Virtual Classroom Training (VCT), has been recognised as being one of the fastest, growing methods of Internet-based learning delivery (TrainingIndustry.com, 2013). VILT is usually conducted in a virtual or replicated environment where the instructor and students are in different locations. Virtual instruction environments expect to imitate the traditional classroom and learning experience. This alternative form of education and learning is considered an efficient and cost-effective alternative and solution to reaching widely dispersed students. VILT can reduce and eliminate travel and accommodation costs.

Sloodle (Simulation Linked Object Oriented Dynamic Learning Environment) combines the characteristics of Moodle LMS with that of Second Life which is an open simulator 3D virtual world in order to support learning (Kyalo & Hopkins, 2013). Sloodle blended these two distinct platforms together into a single blended 3D/web virtual learning environment (Livingstone, 2009). With the increase in popularity of virtual environments in educational communities, so the need has also grown to interconnect these virtual environments with LMSs such as Moodle (Kyalo & Hopkins, 2013). Combining the educational culture of Moodle with the usage advantages of virtual worlds the Sloodle platform allows users to create four educational activities, namely: 1) role playing and simulations; 2) group work and team building; 3) events and presentations and 4) constructive activities.

A **Massive Open Online Course (MOOC)** is usually free and credit less, merely because anyone on the Internet can enrol and the course is made with the student in mind (Pappano, 2012). The course is designed in terms of course material and interaction where peers can communicate in study groups, online forums and work on group projects. The evolution of MOOCs ties education, entertainment (games) and social networking together. MOOCs offer great potential in terms of exploiting the social aspect of learning, but the organisation and management of social learning on such a massive scale can result in losing predicted benefits of collaboration because of scale (Bates, 2014). Examples of MOOCs portals and/platforms include Coursera and edX (Chen, 2013).

3.6.2 Social Media

Social media can be defined as the creation and exchange of user generated content (Hrastinski & Aghaee, 2012). Social media services such as Facebook and LinkedIn

have become extremely popular, especially amongst young people (Silius, Miilumäki, Huhtamäki, Tebest, Meriläinen, & Pohjolainen, 2010a). Social networking sites enable users to participate intensively in activities, share content and opinions, debate and create different groups for different needs (Helmich et al., 2014; Silius, Miilumäki, Huhtamäki, Tebest, Meriläinen, & Pohjolainen, 2010b). The potential benefits of social media used for learning purposes relate to study enhancement especially since the tools provided by social media are attractive to the students of today (Silius et al., 2010b). Quick questions and answers, group work coordination, information retrieval from external sources and the sharing of documents can all be conducted over social media (Hrastinski & Aghaee, 2012). Social media is said to improve communication in and around learning and work campuses (Helmich et al., 2014).

Although opinions are conflicting in terms of bringing social media into educational learning, there are some benefits that do exist, including: time and energy invested in building relationships on shared interest and knowledge, promoting critical thinking, easy and positive networking amongst teachers and students (Hrastinski & Aghaee, 2012). The use of social media in learning can improve student motivation. However, there is a concern that social media will create and contribute towards the intellectual depowering of a “Google generation” of students who are not capable of independent critical thinking.

The use of external social networks has resulted in various problems for HEIs, legally and organisationally (Helmich et al., 2014). Studies have shown that social media is mainly used for entertainment and often does not have any apparent educational benefits (Hrastinski & Aghaee, 2012). Educators play a vital role in the adoption and usage of social media to promote collaborative learning. However, the disadvantage of social media is the conflict between the use of social media for personal and education purposes, especially amongst young learners.

Elgg is a social networking engine which is open source and provides a strong framework where various types of social environments can be created such as a campus-wide social network for a HEI (Elgg, 2015a). Elgg allows for increased variety in terms of communication, such as blogs, groups, messages and for users to have their own E-Portfolio (Helmich et al., 2014). Elgg is widely used by governments, universities and companies, for example NASA, The World Bank, Australian and

British Governments and Harvard and Stanford Universities (Elgg, 2015c). Features of Elgg include a powerful data model, activity streams, plugin application program interface (APIs), user management, access controls and web services API (Elgg, 2015b). According to a Teaching Development Professional (Goldstone, 2015) at NMMU, Elgg is currently not being officially used at other universities in South Africa, although there is no way to know whether or not it has been tested or reviewed at HEIs because it is open source and thus freely available for download and implementation.

3.6.3 Mobile Learning

Initially e-learning environments were created to be used in conjunction with a mouse, keyboard and medium sized display (Da Silva et al., 2013). The increased popularity and accessibility of smartphones and tablets has also increased the need and demand for these e-learning environments to be easily accessible on mobile devices. Thus, mobile learning or m-learning can be considered to be part of e-learning and therefore, when referred to e-learning, m-learning is included. According to Shetty (2014), shipment of tablet PCs (Personal Computers) to South Africa increased to 107.1% (513 000 units) in the final quarter of 2013. Conversely, the country's traditional PC market dropped by 18% over the same period. In 2013, consumer adoption of smartphones rose above 50% and in conjunction with this, 75.5% of companies support some variation of Bring Your Own Device (BYOD) policy (Cheatham, 2013). Trends such as increased use of mobile devices and applications (apps) and BYOD are expected to continue.

m-Learning can be defined as the amalgamation of e-learning and mobile computing and is frequently said to be an extension of e-learning itself (Kumar, 2013). m-Learning is considered particularly influential amongst students engaging on their own terms and making use of PDA's (Personal Digital Assistant), handhelds, palmtops, smart and mobile phones. The idea behind m-learning is that students are able to learn on the move from any place at any time by making use of portable learning devices. With the assistance of mobile phones and devices, learners are capable of learning as if they were in a traditional classroom setting (Vinu, Sherimon, & Krishnan, 2011). The sensors embedded into the devices are able to recognise particular content unique to a specific individual learner. Learners can thus be provided with learning services based on their own unique learning content and situation.

The main benefits of m-learning are mobility and its tendency to improve the broader learning experience. Another benefit of m-learning is its flexibility, since there are no limitations associated with age, gender, geography, time or space and it is for this reason that it is considered a novel educational approach (Kumar, 2013; Vinu et al., 2011). According to Cheatham (2013), companies should take full advantage of the anywhere, anytime access consumers covet with mobile devices.

Frequently, the quality of m-learning is questioned since mobile devices come with their own set of unique limitations and benefits (Kumar, 2013). Studies have also shown that in general, people prefer using the actual, original web sites and web pages opposed to tailor made mobile versions (Da Silva et al., 2013). However, alternatively a study conducted by Schmiedl, Seidl and Temper (2009) shows the select few that do in fact prefer the tailored option. Therefore further studies are required to investigate user preferences with regards to m-learning.

3.6.4 Gamification

Since e-learning courses are often linear, their structures can easily be gamified (Todor & Pitica, 2013). Theoretical information can be presented in a progressive manner which focuses on exercises that are correlated. The exercises are transformed into competitive stages or dynamic games where learners can receive rewards and/or badges. Individuals are always in some state of learning and anything can influence and change their feelings and thoughts (De Oliveira & De Castro, 2014). Games can do this, much in the same way that books and movies can influence a user's mind set. According to Deterding, Khaled, Nacke and Dixon (2011, p. 2), gamification can be defined as *"the use of game design elements in non-game contexts".*

Gamification used in the field of e-learning is extremely useful since it is able to assist with learning as well as information retention (Pasterfield, 2014). Characteristically gamification adds classic elements of game playing such as point scoring, competition with others and rules of play to other areas of activity. Gamification should add fun, foster team spirit, promote new knowledge, increase motivation, global accessibility and increase levels of engagement amongst other things and is also considered to be a cost effective alternative to F2F teaching. However, according to Gartner (2012), it is predicted that 80% of gamified applications will fail to meet their objectives by 2014 due to poor design such as meaningless points and badges.

The interaction time between the student and the course information provided by such an e-learning platform is considerably increased, the speed of browsing is faster and the final results show significant improvement (Todor & Pitica, 2013). Instant feedback is another benefit since students are able to directly observe their current level of knowledge at the end of each learning stage or level and therefore they are persistently being motivated to improve their performance (Labrador & Villegas, 2014; Todor & Pitica, 2013). Rewards are made public and therefore users are able to compare their rewards with those of their peers, which too contributes towards motivation.

Gamification has been especially used in business and marketing in the creation of customer and employee loyalty, brand recognition and marketing efficiency (Todor & Pitica, 2013). However, the application of gamification into education is limited in terms of introducing game elements into the educational process and that is why special attention needs to be given to task and exercise integration in educational gamification design. According to Meder, Plumbaum and Hopfgartner (2013) three gamification elements can be identified (Figure 3-6):

- Points;
- Badges; and
- A leader board.

These elements cover different types of motivation and gamification types, for instance rewards from fulfilling assigned tasks in the form of points and badges and the competition element in the form of a leader board (Meder et al., 2013). Points are usually rewarded for direct interaction, whereas badges are rewarded for continuous good work and longer term goals.

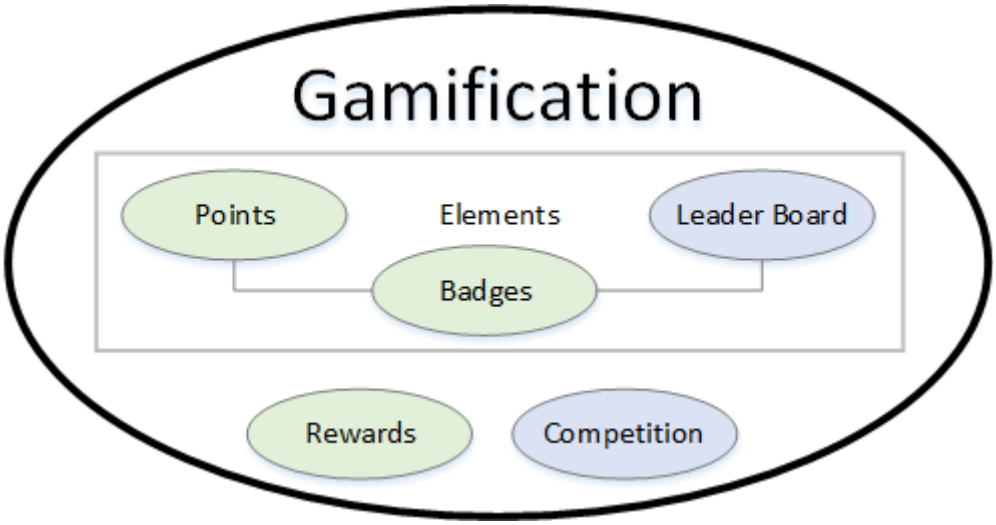

Figure 3-6: Elements of Gamification (Author's Own Contribution)

According to Mekler, Brühlmann, Opwis and Tuch (2013) gamification elements such as points, levels and leader boards can potentially have a negative effect on a user's intrinsic motivation. However, these gamification elements have been reported to drive effective user behaviour in the short-term (Mekler et al., 2013). Mekler et al. (2013) argue that gamification elements do not always increase intrinsic motivation and therefore they cannot be used solely to sustain long-term user engagement. Motivation is linked to engagement and gamification can be applied to learning environments in order to raise levels of engagement for e-learning (Bittner & Shipper, 2014).

3.6.5 Web-based e-Learning Platforms

Obami is a web-based e-learning platform that was developed in Africa for Africa and it makes use of gamification to connect users in VLEs (Obami, 2014a). Obami is also seen as a social learning platform since it promotes collaboration and makes use of gaming elements. The primary goal of Obami is to connect educators with their students by providing an environment where users can access, share and participate in activities and resources. The Obami platform has security controls in place that are created by the users to protect the content that is uploaded. Similar to other e-learning platforms, the Obami platform incorporates a variety of learning styles which are complemented and supplemented by elements such as blogs, online chats, messages, media galleries, resource repositories, newsfeeds, portals, assignments, events and widgets. The Obami e-learning platform also has a Flash Games portal which includes assessments which test logic, memory, mathematics, language and typing skills of the users (Obami, 2014b). Their target market lies explicitly with

teachers and school children. Obami has noticeably advantageous features, however, a disadvantage is the fact that it does not explicitly support ERP capabilities.

Blackboard is renowned for being one of the leading Virtual Learning Environments (VLEs) which is a popular choice as an e-learning platform/system amongst universities (Green, Weaver, Voegeli, Fitzsimmons, Knowles, Harrison & Shephard, 2006). Reasons for its popularity include the fact that it allows students to easily access their university content anytime and anywhere and it is also noted for being a useful tool for lecturers and students alike (Liaw, 2008).

Moodle (Modular Object-Oriented Dynamic Learning Environment) is classified as an LMS, however, it also uses additional e-learning aspects such as gamification, CMS, OLE and blended learning. Moodle can be described as a platform which is used to create online course pages where lecturers and educators can design hybrid courses that create the opportunity to combine F2F teaching with online activities (Islam, 2013). Moodle is an open source CMS/LMS online environment which is often used to support teaching and learning activities and has features such as file uploads, forums, submission, grading, assessment and many more (Deng & Judith, 2013). Moodle was originally developed to allow for the creation of online courses that would promote interaction and collaboration (Amandu, Muliira, & Fronda, 2013). However, more importantly it has transformed the role of the "teacher" who was considered 'the source of knowledge' to a *facilitator* and *role model* whose responsibility has shifted to the process of acquiring and promoting knowledge and skills.

Different roles can be assigned to different types of users, for example lecturer, student or tutor and each type of role has specific accessibility settings and restrictions (Moodle, 2014). Moodle is considered as being a very secure system. Course administrators have the accessibility to be able to configure the instance of Moodle to meet the requirements of their particular course material. There are several plugins that can be obtained for Moodle which can be used to extend Moodle. Moodle has native mobile application offerings such as the Moodle App and Moodbile which are available on most of the popular smartphone platforms (Da Silva et al., 2013). One disadvantage of Moodle is that communication is limited since it is practically impossible to contact peers directly without selecting a particular module first and

thereby users are unable to communicate comfortably and freely with contacts (Helmich et al., 2014).

3.6.6 Learning Content Designer Software

A key benefit of e-learning is the ability to reuse content. In order to do this, learning content designer software is required in order to design and develop learning content for re-use. **Articulate Storyline** is e-learning authoring software that is used in the generation of e-learning elements such as videos and SCORM assessments. **Camtasia** is screen recording software that is used to record on-screen activities, audio and webcam videos. Camtasia can also be used to narrate Microsoft PowerPoint presentations. Camtasia has a variety of uses such as recording, editing, producing and sharing of e-learning course content and materials. For this study, Articulate Storyline will be used to create the content of the videos (visualisations) and Camtasia will be used to edit and produce the videos.

3.7 Critical Success Factors (CSFs) for e-Learning of ERP Systems

There are various factors that can affect the success of an e-learning project (Table 3-5). Scholtz and Kapeso (2014) propose a framework (Figure 3-7) that takes into account the success factors for e-learning of ERP systems. The framework identifies ERP students, ERP users and ERP consultants as the three main stakeholders of ERP learning and looks at the different types of content presentation used in ERP learning, for example videos. Four elements make up the central component of the framework, namely: the ERP system, the LMS, the ERP concepts and processes knowledge base and the learning profile of the learner. In this study various e-learning (Section 3.7.1) and m-learning (Section 3.7.2) success factors are identified and confirmed and additional e-learning success factors are also proposed (Section 3.7.3).

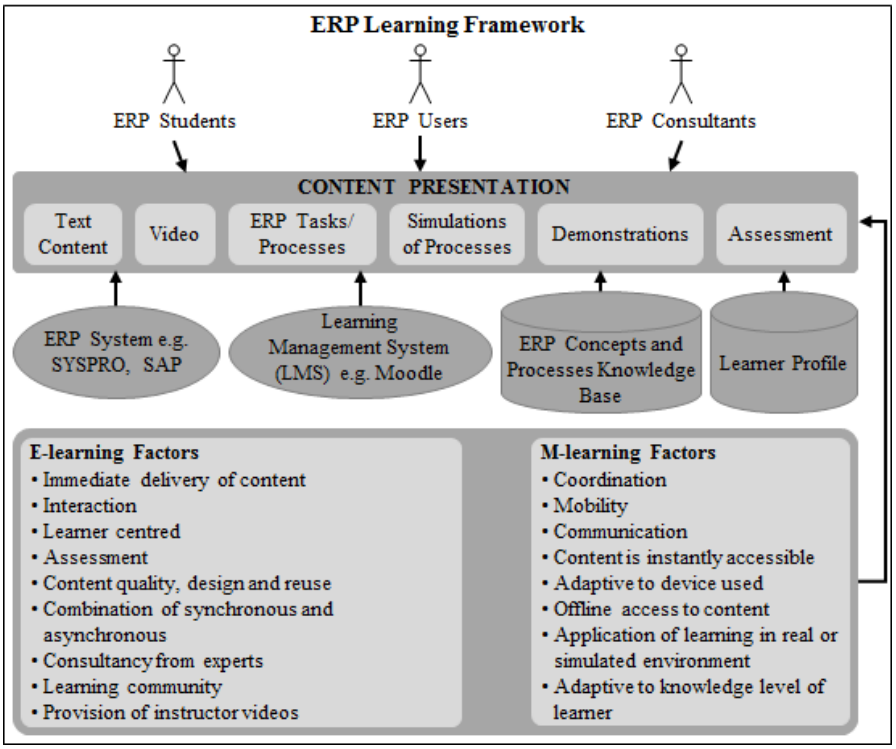

Figure 3-7: Framework for e-Learning of ERP Systems (Scholtz & Kapeso, 2014)

3.7.1 e-Learning Success Factors

e-Learning together with an LMS are mainly used to deliver learning material and information in a timely manner and since such systems are online, access should be readily available, thereby promoting flexible delivery as well as improving accessibility off-campus (McGill, Klobas, & Renzi, 2014) (Table 3-5). Learning needs to be effective in order to be successful (Monika, 2013; Nordin et al., 2010). It needs to be ensured that learning revolves around the learner and that the learner is positioned at the centre of the educational process thus providing learner-centred learning and making learners responsible for their skills. Ssemugabi and De Villiers (2010) also identify the importance of learner-centred instructional design because they propose it as one of the criterion for evaluating web-based learning environments.

Table 3-5: e-Learning Success Factors (Adapted from Scholtz & Kapeso, 2014)

e-Learning Success Factors	
Factors	**References**
Immediate delivery of information/course material	McGill et al. (2014) ***Chickering and Gamson (1987)*** [1]
Learning should be learner-centred	Nordin et al. (2010) ***Chickering and Gamson (1987); Monika (2013); Ssemugabi and De Villiers (2010)***
Interactive learning environment	Bates and Sangra (2011); Maor and Volet (2007) ***Chickering and Gamson (1987)***
Provision of instructor videos	Hawking and McCarthy (2004) ***Plass et al. (2009)***
Combination of synchronous (F2F) and asynchronous e-learning	Hawking and McCarthy (2004) ***Dalveren (2014); Liaw and Huang (2013)***
Assessment-centred	Nordin et al. (2010)
Content quality, design and reuse	Nedungadi and Raman (2012); Siqueira et al. (2007)
Community-centred: learning networks, social media	Hawking and McCarthy (2004); Nordin et al. (2010); Suki and Suki (2007) ***Chickering and Gamson (1987); Helmich et al. (2014); Liaw and Huang (2013)***
Consultancy from experts	Hawking and McCarthy (2004); McGill et al. (2014) ***Chickering and Gamson (1987)***

Successful learning is also promoted by focusing on the evaluation of learner abilities, the diagnosis of problems and proposing guidance, which enables assessment-centred learning (Monika, 2013; Nordin et al., 2010). Alternatively, the sharing of knowledge and peer-to-peer learning and support also contribute to successful learning which is thus community-centred. Consultancy with experts is also associated with the community-centred nature of e-learning (Nordin et al., 2010) and is considered a vital component for e-learning projects (McGill et al., 2014). Consultancy with experts and encouragement of community-centred learning can be enhanced with the use of social media communities (Suki & Suki, 2007). Specifically in terms of ERP systems' education, making use of well-established social learning networks can potentially reduce learning time (Bologa & Lupu, 2014).

The interactive capabilities of these learning environments are seen to be detrimental to the successful outcome of learning, knowledge construction as well as the quality of e-learning (Bates & Sangra, 2011; Maor & Volet, 2007). With increased interaction, learning is more flexible and individualised and this has the potential of having a negative effect on learning outcomes, knowledge construction and the quality of the e-learning initiative. The quality of the content and material produced and used to support learning (Siqueira et al., 2007) and suitable management thereof play an

[1] Additional authors that confirm the e-learning success factors as proposed by Scholtz and Kapeso (2014)

important role in the efficiency of e-learning (Nedungadi & Raman, 2012). Management is involved with the development, maintenance and updates of all information and content. These tasks can be time-consuming as well as expensive. Therefore the learning process needs to be as quick and cost effective as possible in order to address this issue. Content also needs to be designed for reuse.

A combination of synchronous and asynchronous learning approaches that have been integrated are used to assist with offsite delivery of ERP education (Dalveren, 2014; Hawking & McCarthy, 2004; Liaw & Huang, 2013). Such models and approaches have noticeably been adopted by various ERP vendors where they have learning community sites available for students to interact with instructors and experts, who can then also provide assistance in virtual classes, webinars or videos. As shown in Table 3-5 five of the success factors proposed by Scholtz and Kapeso (2014) support the pedagogy of Chickering and Gamson (1987).

3.7.2 m-Learning Success Factors

The following eight m-learning success factors have been identified and can be applied to ERP education (Scholtz & Kapeso, 2014):

- Co-ordination;
- Mobility;
- Communication;
- Content is instantly accessible;
- Adaptive to device used;
- Offline access to content;
- Application of learning in real or simulated environment; and
- Adaptive to knowledge level of learner.

According to Udanor and Nwodoh (2010) mobility as well as portability are considered to be important factors in m-learning projects. The presence of communication between peers and also between the learners and the instructor is also important for m-learning. The idea behind m-learning is the fact that content is easily accessible for users that are “on-the-go” and need access to learning content anytime and anywhere (Nordin et al., 2010; Sharma & Kitchens, 2004). In terms of content, m-learning should promote flexibility and adaptability of the mobile learning environment presented where the content presented can change to best suit the device being used

(Nedungadi & Raman, 2012). Since the screen size of mobile devices are so much smaller than regular computer monitors, this needs to be carefully considered when m-learning projects are designed (Nordin et al., 2010). Initially, the content should also be suitable for a mobile device where the delivery of the content must be conscious of the context of use (Little, 2013). m-Learning also provides interaction amongst peers in terms collaborative and also learning opportunities for persons in other geographical locations (Uzunboylu, Cavus, & Ercag, 2009). Ultimately, m-learning provides various new capabilities for learning in the form of portability, content awareness, social interaction, connectivity and individuality (Minović, Štavljanin, Milovanović, & Starčević, 2008). Even though these eight success factors are proposed as m-learning specific only mobility and adaptive to device used are relevant specific to learning which occurs on mobile devices. Thus, the remaining six factors will be added to be general e-learning success factors.

3.7.3 Additional e-Learning Success Factors

The literature review revealed other success factors of e-learning (Table 3-6). Technology is a factor that effects success, particularly with regard to ease of access, internet speed and screen design (Bhuasiri, Xaymoungkhoun, Zo, Jeung, & Ciganek, 2012). Examples of IT infrastructure needs for the success of e-learning are: bandwidth, security, accessibility, audio and video plug-ins, Internet access, multimedia and authoring services and tools, videoconferencing, LMS and UI (Selim, 2007). The assessment-centred factor can be further expanded to incorporate online certification with ERP vendors where users gain knowledge of ERP systems by completing online assessments and exams in order to be certified and specialised in a certain topic field (SYSPRO, 2012). These three factors (CSFs 16, 17 and 18) are added to the success factors proposed by Scholtz and Kapeso (2014). Taking all of the above into consideration an extended list of 20 e-learning success factors is proposed, with two (CSFs 19 and 20) of these factors specific to m-learning (Table 3-7).

Table 3-6: Additional e-Learning Success Factors

Additional e-Learning Success Factors	
Factors	**References**
Technology: Ease of access and screen design	Bhuasiri et al. (2012)
IT infrastructure: Bandwidth; security; audio and video plug-ins; Internet access; multimedia and authoring services and tools.	Kim et al. (2012); Selim (2007); Tagoe (2012)
Gamification elements	Labrador and Villegas (2014); Pasterfield (2014)

Thus taking the e-learning (Table 3-5) and m-learning success factors (Section 3.7.2), together with the three additional e-learning success factors (Table 3-6), the following set of 20 CSFs (CSF1 - CSF20) for e-learning is proposed:

Table 3-7: CSFs for e-Learning of ERP Systems

CSFs for e-Learning
CSF1: Immediate delivery of information/course material
CSF2: Learning should be learner-centred
CSF3: Interactive learning environment
CSF4: Provision of instructor videos
CSF5: Combination of synchronous (F2F) and asynchronous e-learning
CSF6: Assessment-centred
CSF7: Content quality, design and reuse
CSF8: Community-centred: learning networks, social media
CSF9: Consultancy from experts
CSF10: Co-ordination
CSF11: Communication
CSF12: Content is instantly accessible
CSF13: Offline access to content
CSF14: Application of learning in real or simulated environment
CSF15: Adaptive to knowledge level of learner
CSF16: Technology: Ease of access and screen design
CSF17: IT infrastructure: Bandwidth; security; audio and video plug-ins; Internet access; multimedia and authoring services and tools.
CSF18: Gamification elements
M-LEARNING
CSF19: Mobility
CSF20: Adaptive to device used

3.8 An e-Learning Environment for ERP Systems

Development of high quality e-learning content is still expensive as well as time-consuming (Siqueira et al., 2007). The large capital outlay usually required for high quality e-learning has increased the interest in and promotion of reusing e-learning material and resources (Dalveren, 2014). In order to assist with the reuse of these materials the development and usage of Learning Objects (LOs) have become widely accepted. An LO can be defined as *"any entity, digital or non-digital, which can be used, reused or referenced during technology supported learning"* (Siqueira et al., 2007, p. 141). There are various elements and components which can form part of an e-learning environment. Popularly used e-learning components include visual presentation such as videos (Section 3.8.1), SCORM packages (Section 3.8.2), user generated content (Section 3.8.3) and online certification (Section 3.8.4).

3.8.1 Visual Presentation (Visualisations)

Visualisations noticeably bring about great potential for the enhancement of learning and education, however, users are required to invest extensive mental effort in order

to process them, with their educational effectiveness depending on a multitude of design considerations and objectives (Plass et al., 2009). Important aspects to take into consideration when designing interactive content and/or videos for e-learning systems include the length of the videos, quality and optimal interactivity (Scholtz & Kapeso, 2014). Visual presentation maps with CSF4, where the provision of instructor videos are considered a factor of e-learning success (Table 3-7).

A **simulation** can be defined as *"something that is made to look, feel or behave like something else especially so that it can be studied or used to train people"* and/or *"the imitative representation of the functioning of one system or process by means of the functioning of another"* (Merriam-Webster, 2014b). Alternatively, a **demonstration** is *"an act of showing someone how something is used or done" and/or "an act of showing or proving something"* (Merriam-Webster, 2014a). Dictionary.com (2014a) also defines a demonstration as *"the act of exhibiting the operation or use of a device…"* and *"a description or explanation… illustrated by examples, specimens".*

When designing a simulation, the following considerations need to be taken into account: educational objectives, content, learner characteristics, educational settings and plans for curriculum integration (Plass et al., 2009). These considerations will determine if the information should be:

- Static visualisation (image);
- Dynamic visualisation (animation); or
- Interactive dynamic visualisation (simulation).

The following decisions must also be made pertaining to:

- Information design and how the content and controls are going to be represented in the visual interface;
- Interaction design and how the tools and features are going to be implemented so that they enable learning strategies;
- The kinds of controls and navigation tools that are going to be made available to users; and
- The kinds of scaffolds that are going to be provided in order to guide the learning process.

It is these design decisions that will essentially impact the capability of the visualisations to facilitate learning.

3.8.2 Standards for Learning Content and Objects

In order for e-learning content, lessons and courses to be appropriately uploaded and made accessible from an LMS such as Moodle, they need to conform to a specific set of technical and instructional standards (Ghirardini, 2011). Shareable Content Object Reference Model (SCORM) is one such model which encompasses packaging standards which allow courses to run under different LMSs, runtime specifications in terms of how LMSs can launch courses and report results back to the system, as well as metadata standards used to create and publish metadata records about courses, lessons and topics. Most LMSs require that delivery output (courseware) complies with SCORM technical standards. SCORM came about as a result of the United States Department of Defense's Advanced Distributed Learning (ADL) initiative and when applied to course content can yield small, reusable learning objects which can be effortlessly fused with other compliant elements to produce a highly modular repository of training materials. For example, SCORM packages can be used to create interactive assessments and videos.

3.8.3 User Generated Content

User Generated Content (UGC) refers to the users being involved with the creation of their own content, sometimes to facilitate learning, however, they are not considered to be professionals in the field (Quoquab, Zeinali, Mahadi, & Mohammad, 2014). Plainly said, UGC is content that originates from ordinary people who have voluntarily contributed content, information and/or media that can be used by others and is usually available on the Web (Krumm, Davies, & Narayanaswami, 2008). The use and generation of UGC shows creativity and is universally present on social media networks and platforms (Quoquab et al., 2014).

The popularity of UGC has increased in line with improvements to and advancements in technologies, including a variety of content and media such as audio, video and graphics (Quoquab et al., 2014). With the advancements in Web 2.0 and the fact that free content is readily available, this has also affected sharing and collaboration that can occur online. The use of UGC has grown rapidly, mainly due to its inexpensive nature, it is easy to obtain and contributors are recognised for their content (Krumm et al., 2008). YouTube, a common, free video sharing website shows potential in terms

of a learning channel and to assist with learning (Young & Lehto, 2013). Sometimes also referred to as User-Created Content (UCC), UGC such as videos found on YouTube have been known to be innovative and efficient mediums of learning.

3.8.4 Online Certifications

Online ERP certifications were created to solve the problem of the shortage of ERP knowledge and skills as well as training costs. Certification can occur at a variety of levels depending on various functions, for example the certification of a salesperson, demonstrator, implementer, support person and developer will not be the same (SYSPRO, 2012). Certification involves end users writing online exams in their own time from a location of their choice. The benefits of obtaining ERP certification are: comprehensive, detailed knowledge of the ERP system and a dependable authentication of knowledge obtained. Creditability and acknowledgement within the ERP community specific to the ERP system and if certification is acquired in each category it is seen to be a unique, valued and internationally commended recognition.

3.9 Criteria for Designing and Evaluating e-Learning Environments

According to Tarhini et al. (2013), **success**, with specific reference to e-learning, is influenced by factors such as student acceptance and the usage of these e-learning systems. Success of e-learning environments is said to include useful characteristics, enhanced satisfaction, effective learning activities and positive learner characteristics (Liaw & Huang, 2013). Noticeably, success incorporates various aspects such as technology acceptance, effectiveness, usability and user satisfaction.

One of the factors for success of a new IS, such as online learning, is user acceptance (Farahat, 2012). Studies have shown that the Technology Acceptance Model (TAM) has been used to investigate the factors affecting students and their attitudes towards e-learning and e-learning environments (Liaw & Huang, 2013). *Technology acceptance* refers to the attitudes of individuals towards the interest, approval and use of diverse technologies (Davis, Bagozzi, & Warshaw, 1989). Even though acceptance and success are not equivalent, acceptance of an IS is an essential precondition of success (Petter, DeLone, & McLean, 2008). The TAM (Figure 3-8) is a theory of technology acceptance and is used in the identification and determination of value in terms of user perceptions (Davis et al., 1989). TAM is based on the theory of reasons action (TRA) which, as stated by Fishbein and Ajzen (1975), proposes that beliefs can

impact attitudes which then leads to intention, use and inevitably authentic usage behaviour. The TAM applies the TRA and suggests that an individual's behavioural intention to make use of a system is determined by their Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) of approach, tool and environment (Davis et al., 1989). Subsequently, the TAM is also used in presenting explanations as to the reasons behind why individuals may or may not accept and/or use a particular technology.

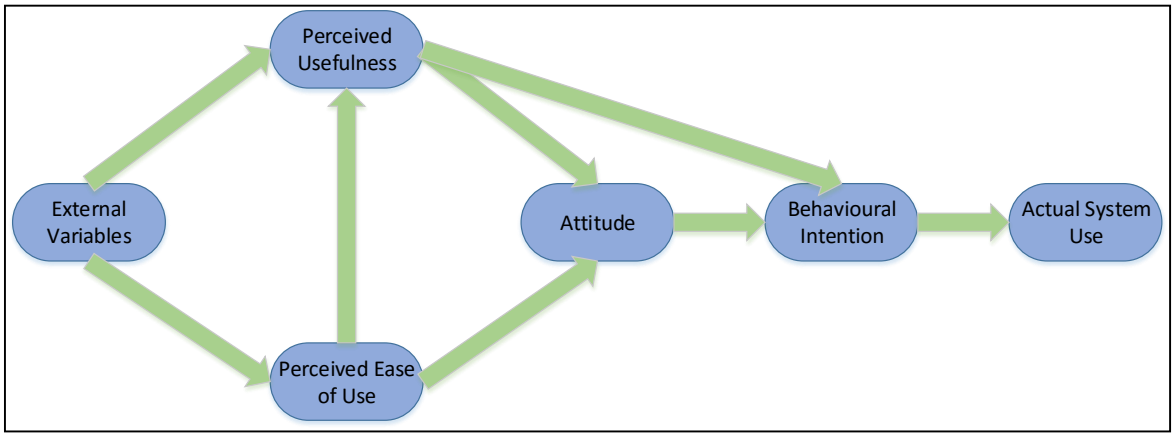

Figure 3-8: Technology Acceptance Model (TAM) (Davis, 1993)

PU is defined as *"the degree to which a person believes that using a particular system would enhance his or her job performance"* (Davis et al., 1989, p. 985). Within an organisational environment if individuals presume that technology can possibly improve the performance of their job, then their intentions to make use of that technology will be superior as opposed to their intentions to use, and attitudes towards that same technology alone (Amoako-Gyampah, 2007). Therefore the higher the PU of a new technology, the more likely it will be adopted (Kyalo & Hopkins, 2013). Both PU and PEOU lead to behavioural intention (Amoako-Gyampah, 2007). In the context of online universities, online learning programs and platforms PU is associated with the quality of the content presented (Ju, Yon, & Kyung, 2011). PU along with PEOU are said to be significant methods in which to measure user satisfaction within IS and that user satisfaction is intensely connected to PU (Calisir & Calisir, 2004). Liaw and Huang (2013) also identified PU and perceived satisfaction as factors for developing effective e-learning.

PEOU can be defined as *"the degree to which a person believes that using a particular system would be free of effort"* (Davis et al., 1989, p. 985). The easier it is to use a

technology, the greater the anticipated paybacks from that particular technology with regard to performance enhancement will be (Amoako-Gyampah, 2007). PEOU is said to influence the PU of a technology (Amoako-Gyampah, 2007) and essentially it is used to indicate the effort needed to use the technology (Kyalo & Hopkins, 2013). In terms of online learning programs and platforms PEOU is more concerned with interface and content delivery (Ju et al., 2011).

TRA and TAM both have strong behavioural elements and are based on the assumption that when an individual forms an intention to act that they will be free to act without limitation (Oye, Iahad, & Rahim, 2014). However, in the real world there are various limitations affecting the freedom to act such as limited ability, time constraints, environmental and/or organisational limitations or unconscious habits. As with all new technologies there is an element of uncertainty in terms of successful adoption and users form attitudes, opinions and intentions about these technologies before attempting to use them.

Authors such as Islam (2013), Ong, Lai and Wang (2004) and Tagoe (2012) have all acknowledged PU and PEOU as criteria for evaluating the technology acceptance of e-learning systems. The TAM has progressively become the accepted model for research in IS adoption and acceptance of IS technology (Oye et al., 2014). A limitation of the TAM is the fact that it does not take into account any barriers that would prevent someone from adopting a specified IS technology. Examples of barriers could be design and decision making characteristics, training and support.

The Unified Theory of Acceptance and Use of Technology (UTAUT) is a more recent take on the TAM (Venkatesh, Morris, Davis, & Davis, 2003). UTAUT recognises key factors in acceptance of ICT as measured by behavioural intention to the technology and actual usage (Oye et al., 2014). ICT acceptance consists of four determinants: performance expectancy, effort expectancy, social influence and facilitating conditions. UTAUT is seen as an improvement to the TAM, however, in contrast, the UTAUT takes into consideration the fact that some systems are mandatory while others are voluntary (Seymour, Makanya, & Berrangé, 2007).

Updates have been made to the TAM which succeeds the Davis et al. (1989) version, such as TAM2 and TAM3 (Venkatesh et al. 2003). Moreover, there is also a version of UTAUT geared for educational applications (Peng-Chun, Hsin-Ke, & Shang-Chia,

2013). However, for the purposes of this study the original TAM (Davis et al., 1989) was considered since it is simpler and the criteria were more appropriate for the selected context.

PEOU and PU together with trust affect and influence **Attitude Towards Usability (ATU)** (Guritno & Siringoringo, 2013). There is a direct influence on ease of use and a great positive influence by PU on ATU. Thus, there is an evident link between attitude towards using a system and the PEOU and PU of that system (Choi, Kim, & Kim, 2007). Online learning and its technologies rely heavily on whether or not the students want and accept the implementation of online learning (Farahat, 2012). User acceptance is therefore one criterion that can measure the success of an e-learning environment.

There are various elements which have been identified which need to be considered for the successful development and evaluation of an effective e-learning environment (Liaw & Huang, 2013). Usage and user **satisfaction** are reported as criteria for evaluating the success of learning environments in general. User satisfaction can be classified as user acceptance of IS and the degree of comfort required in making use of the system, of the contentment and pleasure felt when performing a specific task, activity or action.

There are shortcomings with TAM for evaluating interactive media since it does not consider specific learning components such as videos (Dunne, Lawlor, & Rowley, 2010). Evidently, since e-learning consists of a great deal of interactive features and multimedia the **media richness theory (MRT)** could be considered in conjunction to the TAM due to the increased use of rich media used in e-learning. The level of media richness is known as the **MRT** that can potentially enhance user concentration and is defined as the ability to process rich information (Liu, Liao, & Pratt, 2009). The MRT proposes that the types of media available differ in their competence to facilitate changes in understanding amongst communicators (Sun & Cheng, 2007). Media is classified as ranging from rich, for example, when referring to F2F, to lean, for example text-based documents (Liu et al., 2009). F2F communication is richer than written content since it can enhance the facilitation of changes in understanding and enables immediate feedback and can convey cues such as facial expressions (Sun & Cheng, 2007). Research has indicated that text-based presentations are best suited to the

communication of factual information, whereas multimedia-based presentations are better suited to convey factual and equivocal information (Liu et al., 2009). Lean (text) based media has been found to be as effective as and sometimes even more efficient than rich (video) media.

The primary goal of the MRT is in fact in business settings and in determining which technologies can best decrease uncertainty and equivocality (Liu et al., 2009). With regular advancements being made with technology and an increase in user sophistication, it is necessary for new media to be continuously assessed in terms of MRT. MRT business studies have shown incorporation of video, audio and web technologies. However, media selection in education has also had an abundance of research, with the famous “media versus message” debate which still continues today. Aligning learning content and technology with MRT, the suitability for learning of different kinds of media can be determined. Evidently, MRT research is mostly focused on learning effectiveness and is known to include user satisfaction and intent to use.

3.10 Proposed e-Learning Environment

The framework for e-learning of ERP systems (Figure 3-7) as proposed by Scholtz and Kapeso (2014) has been extended (Figure 3-9). The aspects identified and defined in the preceding sections were categorised and the three main elements of the ***Environment for e-Learning of ERP Systems*** are:

- The success factors (Section 3.7);
- The learning components (Sections 3.5, 3.6 and 3.8); and
- The evaluation criteria (Section 3.9).

These three elements are all interconnected, where the success factors drive the design of the learning components. The evaluation criteria are then used for evaluating the success of the learning components and ultimately e-learning. Different types of users (Section 3.2) are evidently stakeholders in the environment and since this is an environment specific for the use in ERP systems’ education, an important element of the environment is the ERP system itself.

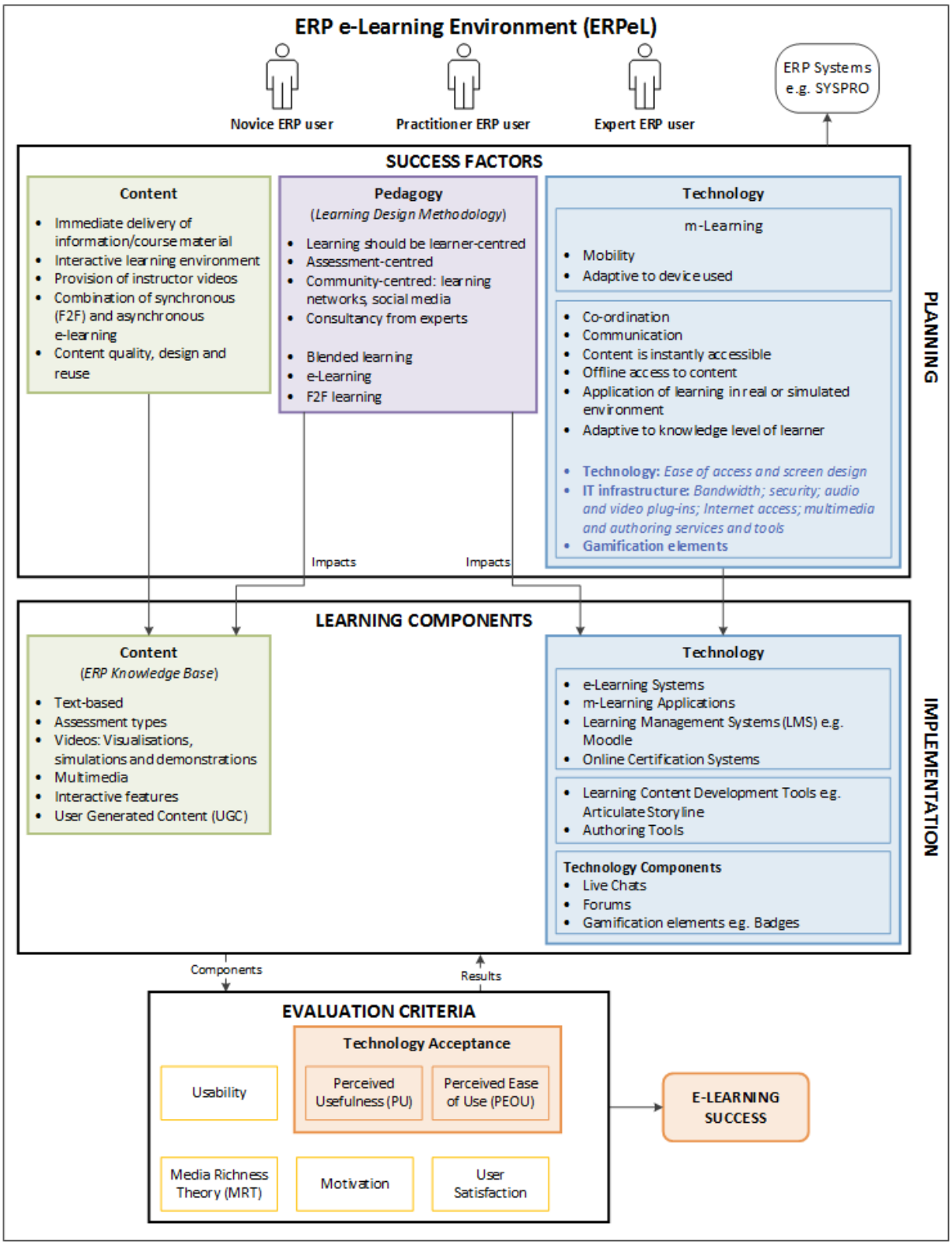

Figure 3-9: Environment for e-Learning of ERP Systems (Version 1) [Author's Own Contribution]

3.11 Conclusions

There are various problems affecting ERP education (Table 3-1) which need to be addressed in order to close the gap between IS and ERP industries and university graduates. The main problems identified are the availability of content, vendor-based training, the process view and a lack of skilled ERP specialists. Overall, it can be seen that e-learning and blended learning affords learners with many benefits, however, with both approaches there are various problems (Figure 3-10).

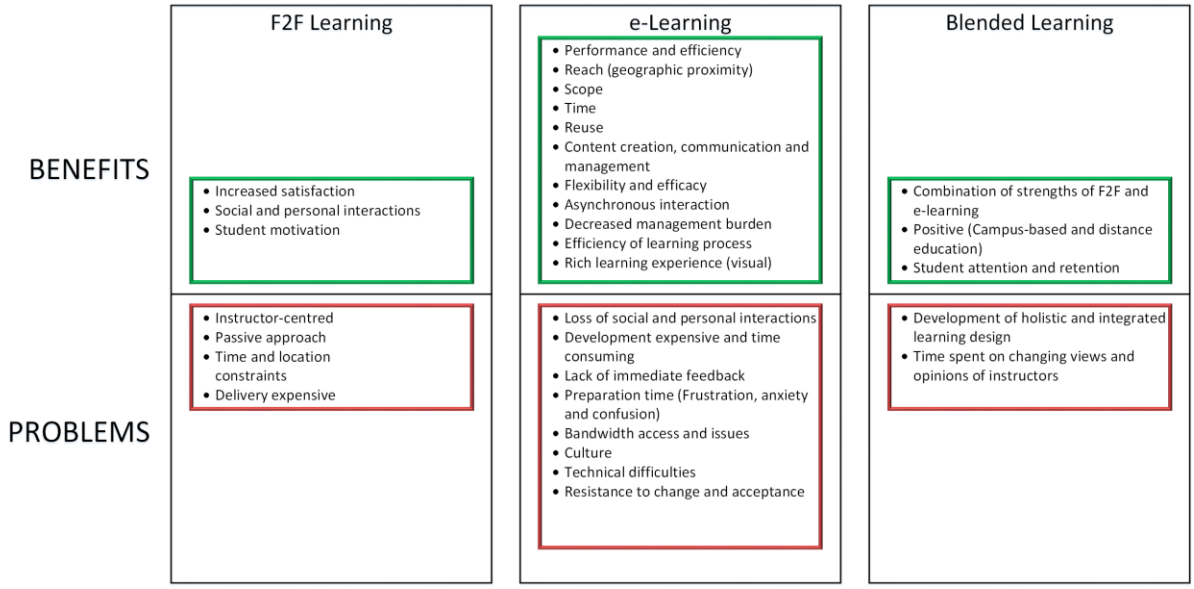

Figure 3-10: Benefits and Problems of Learning Approaches (Author's Own Contribution)

This chapter partially answers ***RQ1:*** *What problems are evident in ERP systems education?* This research question will also be addressed and answered in a real-world context in Chapter 4.

In order for education to be successful and achieve what it is supposed to, effective teaching and pedagogical principles need to be considered and adhered to (Section 3.4). e-Learning has been deemed the solution to the various problems faced with ERP education due to the variety of benefits this learning approach has to offer (Table 3-3). Several CSFs should be considered when designing an e-learning environment in order to ensure that an e-learning project is successful (Section 3.6). Various tools, technologies and systems are also known for supporting e-learning (Section 3.7). Thus, it is evident that there are numerous components of e-learning consisting of a variety of components which can be used to present and develop e-learning solutions (Section 3.8). The following research questions are therefore answered in this chapter:

RQ2: *What factors make e-learning of ERP systems successful?*

RQ4: *Which e-learning components can be used to assist with ERP education?*

From all the literature gathered and discussed in this chapter a theoretical contribution in the form of an ***Environment for e-Learning of ERP Systems (Version 1)*** is proposed, which is considered as the deliverable of DBR Cycle 1 of this study (Figure 3-9). This environment can then be used and applied to a real-world context in order to design, develop and evaluate a practical contribution. In order for an e-learning project to be deemed successful it needs to be properly evaluated and thus the evaluation criteria are a vital component in the success of e-learning. The TAM and UTAUT are possible models for evaluating IS artefacts. UTAUT was not considered, since there were a number of aspects which were not deemed appropriate for this study. Thus, the following research question has also been answered and addressed:

RQ3: *What criteria can be used to evaluate the success of e-learning environments?*

The next chapter will address the first research question, primarily focusing on the identification of the problem of ERP education in a real-world context. It will also include reports of the case studies, field studies and industry interviews that will be conducted.

Chapter 4. Problem Identification of ERP Education: A Case Study Approach

4.1 Introduction

Chapter 3 reported on the various problems with ERP education and the factors that influence the success of e-learning with specific focus on ERP systems' education. This chapter focuses on Phase 1 (Problem analysis within context) of the DBR methodology and uses a case study research strategy in conjunction with DBR. It also addresses DBR Phase 2 (Design Solution) because findings of this chapter will contribute to the design of the final artefact. The TAM (Section 3.9) is used to investigate the acceptance of users of e-learning. More specifically, as recommended by DSR Principle 3, the research is conducted in representative real-world settings. The main field study in this chapter, conducted as part of the student perspective problem investigation, is considered to be the DBR Cycle 2 for this study.

This chapter will discuss and answer the following research question:

RQ1: *What problems are evident in ERP systems education?*

The layout of Chapter 4 and the research objectives and deliverables addressed in this chapter are shown in Figure 4-1. An overview of the case studies for this research study is defined and stipulated (Sections 4.2 and 4.3) in order to address Phase 1 of the DBR methodology. e-Learning and its use at NMMU are explored and feedback from the lecturer perspective is obtained (Section 4.2). The ERP case study, which is situated in the introductory ERP systems courses presented by NMMU, is discussed. The identification and discussion of industry problems with ERP education and training are discussed, that will address the industry perspective (Section 4.3). Since the e-learning environment in this study is SYSPRO specific, the various education options provided by SYSPRO are investigated (Section 4.4). Field studies of ERP education problems that will address the student perspective were conducted (Section 4.5). The proposed version of the environment which is based on the theory (Chapter 3) is confirmed by real-world data and results and various conclusions are made (Section 4.6).

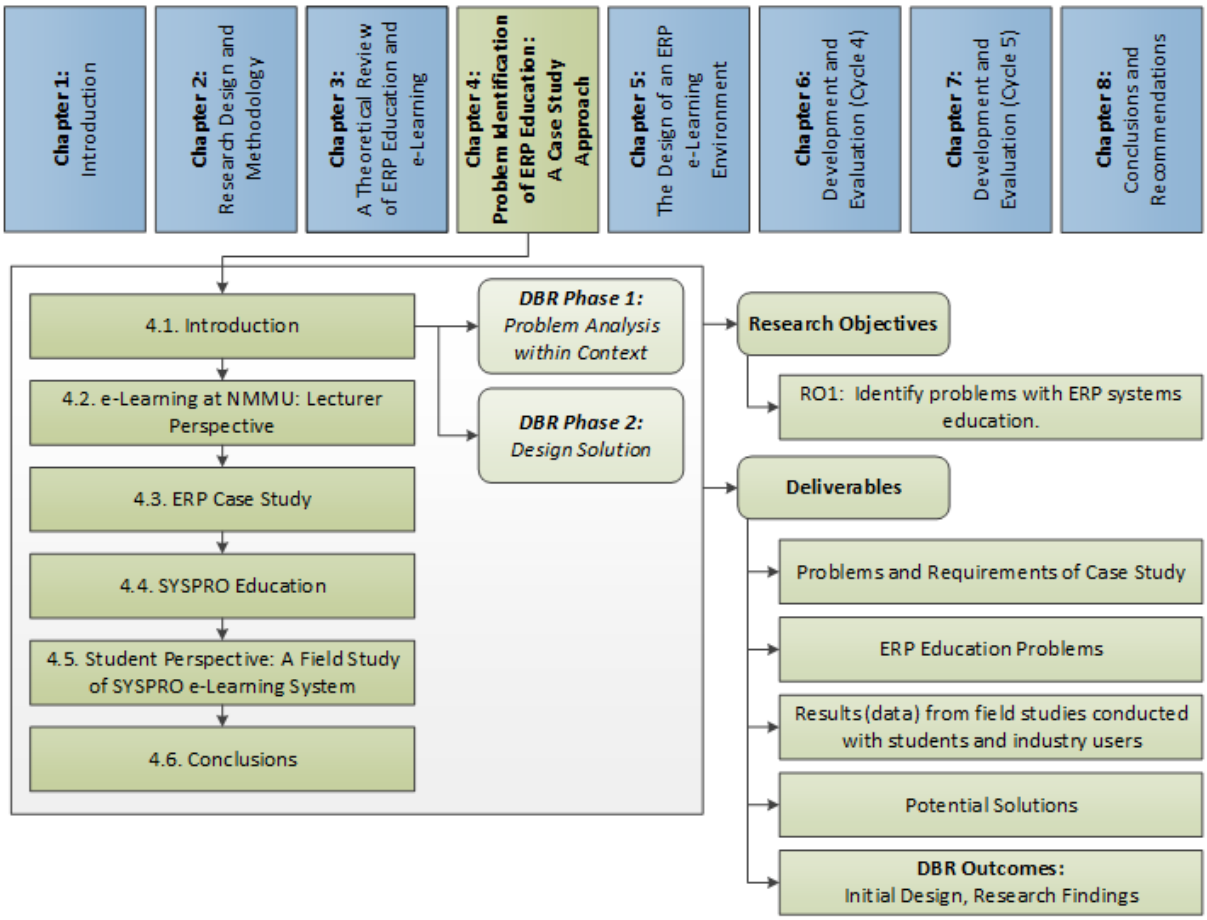

Figure 4-1: Chapter 4 Layout and Deliverables

4.2 e-Learning at NMMU: Lecturer Perspective

This study makes use of a case study approach where NMMU is the main case study used. Since NMMU has included blended learning as part of its Vision 2020 the university has developed a Blended Learning Team (Nelson Mandela Metropolitan University, 2011). The participants in the case study are students, specifically third year ERP systems students, and lecturers from one department and consist of academic staff members who present modules within the Department of Computing Sciences (CS) at NMMU. The students are regarded as novice users and the lecturers as practitioner users (Figure 3-2). The lecturers have varying levels of knowledge and skills with regards to ERP systems and concepts. The lecturer participation will reflect the educator perspective of e-learning and not specifically e-learning for ERP systems.

As part of problem identification, statistics pertaining to the Moodle footprint of NMMU and the CS department were obtained and reported on in order to determine the extent of use of Moodle (Section 4.2.1). Secondly, a focus group was conducted with several

CS Department lecturers (August 2014) in order to gain some insight into the practitioner/educator perspective of e-learning and Moodle (Sections 4.2.2 and 4.2.3).

4.2.1 NMMU and Computing Sciences' Moodle Footprint

The tools used at NMMU are Moodle, Respondus and Camtasia (Figure 4-2). Students are able to create "the perfect" blend of online and offline resources which can be considered a unique toolbox filled of the tools and technologies of their choice. NMMU lecturers can select from a variety of options and thereby customise the ideal blend for their course(s) and this combination can be across any of the categories (Futcher & Gerner, 2014).

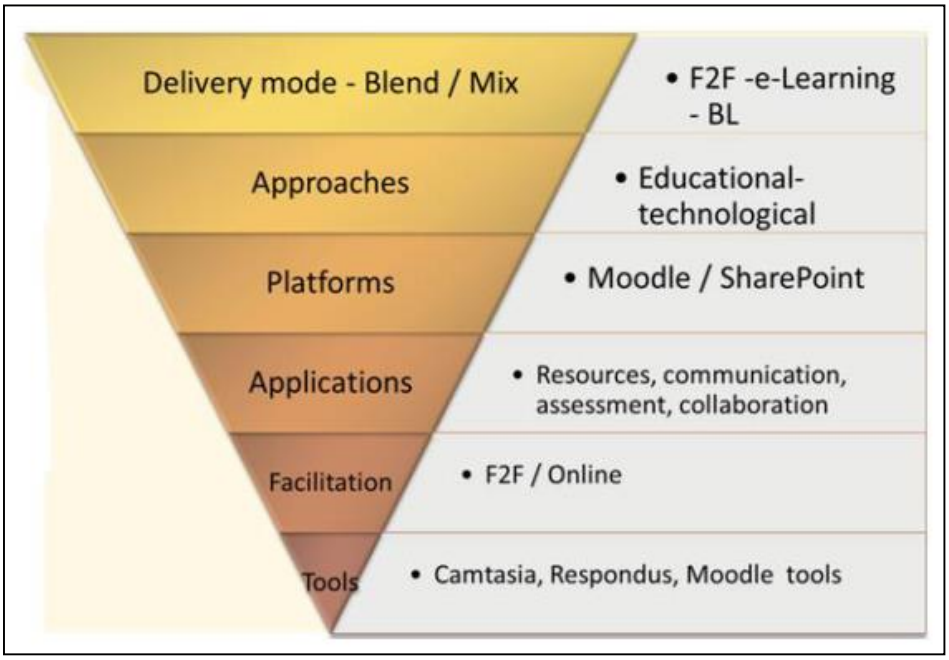

Figure 4-2: Blended Learning at NMMU (Futcher & Gerner, 2014, p. 94)

Moodle is a common open source learning platform used (Ghirardini, 2011). Moodle promotes collaboration and was originally designed for education, training and development environments, however, it has also been extended to business settings. Moodle has more than one million users and almost 50 000 registered sites across the globe. This tool offers a vast selection of functionality including chat, exam, wikis, checking course information and news (noticeboard), discussion forms, assignment submission and lecture material downloads (Table 4-1) (Islam, 2013).

Table 4-1: Moodle (Version 2.9) Activities and Resources

Moodle Activities	Moodle Resources
Assignment	Book
Attendance	File
Chat	Folder
Choice	IMS content package
Database	Label
Engagement analytics	Lightbox Gallery
External tool	Page
Feedback	URL
Forum	
Glossary	
HotPot	
Lesson	
Questionnaire	
Quiz	
SCORM package	
Survey	
Turnitin Assignment	
Wiki	
Workshop	

In August 2014 there were 36 232 NMMU Moodle users, 14 672 of which had been active users in the last 180 days (Terblanche, 2015). In the Department of CS there were 38 Moodle lecturers, 32 (84%) of them having been active users in the last six months. Comparatively, in terms of CS students there were 2 687 Moodle users of which 2 448 (91%) were active in the last six months. It is therefore evident that the Department of CS has high levels of Moodle enrolment and activity in terms of their academic staff as well as their students on Moodle. Another statistic which confirms the Department of CS' high levels of Moodle enrolment and usage is indicated by the fact that the Computing Fundamentals (WRFC101) Moodle module page is ranked second on the *Top 50 sites* at NMMU in terms of the number of hits. It can therefore be deduced that the CS Department is promoting the use of e-learning tools such as Moodle from as early as first year.

In September 2015 there were 43 789 NMMU Moodle users, 21 926 of which had been active users in the last 180 days (Terblanche, 2015). There has been a significant increase of up to 7 557 users (49% increase) and also a significant increase in the number of active users (7 254) in the last 180 days. From this is can be deduced that NMMU is truly enforcing its blended learning strategy and that the university as a whole, together with the different faculties, schools and departments are also contributing towards this positive increase in Moodle users and utilisation.

Specifically in the Department of CS the number of lecturers has increased to 43 (an additional 5) in 2015, with only 31 (72%) of them being active in the last 180 days (Terblanche, 2015). Even though the number of CS lecturers has increased, the number of active users has decreased significantly even though additional lecturers have been assigned. The number of CS students enrolled on Moodle has increased to 2 763 in 2015 of which 2 433 (88%) have been active in the last 180 days, which too shows a decline from last year. Even though there are more students registered for CS modules, they have noticeably not been as active and a reason could potentially be the decrease in activity of the CS lecturers. The first year CS module, Computing Fundamentals (WRFC101) is ranked in first place with 952 049 hits for the *Top 50 sites* at NMMU 2015. NMMU's Moodle Footprint has been noted for its steady increase over the years in terms of sites, views, logins, activities and posts (Table 4-2).

Table 4-2: Moodle Statistics at NMMU

Moodle Statistics	Then	Now	Percentage Increase
Logins (Hits)	April 2009: **8 641**	April 2015: **218 172**	2 424.8%
Posts	April 2009: **4 375**	April 2015: **206 040**	4 609.5%
Activities	April 2009: **72 464**	April 2015: **2 648 016**	3 554.3%
Views	April 2009: **68 089**	April 2015: **2 441 976**	3 486.4%
Number of courses (module sites)	March 2012: **508**	Sept 2015: **2 190**	331.1%

4.2.2 Summary of Focus Group Feedback

The focus group consisted of seven lecturers in the CS department. According to one lecturer, using Moodle as a medium of online submission allows cut off dates and times to be enforced more strictly and has resulted in increased submission rates. Students are no longer able to "sweet talk" their way into an extension. Thus, efficiency has improved which confirms the studies of Dalveren (2014) and Huerta-Wong and Schoech (2010) (Table 3-3). Extensions can be granted in Moodle, but the participants have tried to avoid this feature. Moodle has promoted the move from hand-written paper tests and exams to online, electronic tests and exams. Moodle activities can also be used as attendance for lectures and activities can also be activated beforehand and are made available when they need to be, which decreases the administration and management burdens, which confirms research conducted by Dalveren (2014) (Table 3-3). The Moodle Feedback activity has been used by some lecturers to identify problems students might be experiencing. Feedback activities can also be used for self-assessment and reflection.

One participant stated that there is an interest in using Moodle badges, an element of gamification, from the students since they like to win things especially if they can win exemption from certain tasks, for example practical attendance. This confirms the studies of Labrador and Villegas (2014) and Pasterfield (2014) (Table 3-6). Implementing the badges per activity/task and also looking into having the badges expire and/or taken away was highlighted in the discussion. Even trading existing badges for something else and having different levels of badges, for example bronze, silver and gold. There is also some interest in the use of Moodle Workshops for peer reviewing.

The participants felt that the use of Moodle results in increased preparation from the lecturer side, especially in the first year. However, a great deal of the material can be recycled and reused in year two, confirming the research of Da Silva et al. (2013), Dalveren (2014), Nedungadi and Raman (2012) and Siqueira et al. (2007) (Tables 3-3 and 3-5). The participants feel that the settings that must be set up on Moodle are time consuming, overly complex as well as confusing and there are too many options available.

The participants reported that there are problems with Wi-Fi in lecture venues that affect the adoption of Moodle. Problems with bandwidth access and technical difficulties have also been identified by Tagoe (2012) to be problematic for e-learning adoption (Table 3-3). The participants feel that the Moodle interface that is used in setting up questions for quizzes is poor and most of them do not like it. The use of forums on Moodle has not been very successful because the students just do not seem to use them at all. The students prefer to use WhatsApp groups because it is quick, they have easy access and it is mobile.

The participants indicated that they feel that the process of getting to a particular module's Moodle page is a tedious exercise. For example ***Login > choose module > choose week/topic > choose activity*****.** The students of this generation want tasks such as logging in to be quick and instant. The fact that Moodle does not make use of the NMMU student numbers, specifically in terms of the Gradebook, does create some additional work for the lecturers in terms of extracting names. Even though Moodle does have a mobile platform, there have been various problems with it that have been noted in some modules. The participants stated that they felt that there should be

various versions of Moodle, for instance a simple, limited version differentiated according to beginner, intermediate and expert.

Moodle definitely has its benefits, for example, the time saved on physically marking assignments, quizzes or tests goes into the setting up of them in Moodle. This confirms the study of Dalveren (2014) who noticed the decreased burden on management (instructors) with the use of e-learning initiatives. Participants who have been making use of Moodle, had the following recommendations and suggestions to make:

- Make use of the Moodle question bank, when setting up of quizzes and tests;
- Test your Moodle page with a "student test" user account which will enable the person with the "Lecturer" role to see what the students will see; and
- Make use of Respondus (***Respondus*** *is an authoring tool which bridges the gap between hard copy and online exams and is used in creating and managing exams which can either be printed to paper or published to an LMS such as Moodle*) when setting up tests, quizzes, exams because questions can be imported and exported to and from Moodle.

4.2.3 Questionnaire Feedback

The participants were asked to fill in a short questionnaire pertaining to their knowledge and usage of e-learning applications and which resources they make use of, along with their frequency of use. In order to determine the participants' ***knowledge*** of e-learning applications and/or tools they were asked to rank themselves from 1 to 5, with 1 meaning *Very Poor* and 5 meaning *Very Good*. The majority (n = 3) indicated *Fair* (43%), followed by two participants indicating *Poor* (29%) and two indicating *Good* (29%). The participants were also asked to rank their ***usage*** of e-learning applications on a scale from 1 to 5, with 1 being *Very Seldom (less than once a month)* and 5 being *Always (numerous times a day)*. Most of the participants indicated either *Occasional (once a week or more)* (n = 3) or *Frequent (every day)* (n =3), with one (14%) participant indicating *Always (numerous times a day)*.

Participants were asked to indicate which resources they make use of for their lectures or practicals and the frequency of their use (Table 4-3). Frequency was indicated as *Seldom (once or twice a month)*; *Occasional (once a week or more)* or *Frequent (every day)*.

Table 4-3: e-Learning Usage at NMMU Computing Sciences

Element	Usage	Frequency (n)		
		Seldom	Occasional	Frequent
1. Lecture notes/slides	100% (n = 7)	0	3	4
2. Online assessment (quizzes, assignments)	100% (n = 7)	3	4	0
3. Additional resources (Journal articles, links)	86% (n = 6)	2	3	1
4. Moodle (e-learning)	86% (n = 6)	0	5	1
5. Practical notes/slides	86% (n = 6)	0	3	3
6. Videos	86% (n = 6)	5	0	1
7. Learning Management System (LMS)	71% (n = 5)	1	3	1
8. Forums	57% (n = 4)	4	0	0
9. Badges	29% (n = 2)	1	1	0
10. Other	14% (n = 1)	0	1	0

The results showed that **lecture notes and/or slides** are used during lectures and practicals by all (100%) participants, three use them on an *Occasional* basis and four use them on a *Frequent* basis. **Online assessment (quizzes, assignments)** are also used by 100% of the participants, three (43%) participants using them *Seldom* and four (57%) making use of them *Occasional.* **Additional resources** such as journal articles and links are used by 86% (n = 6) of the participants, where half of them (50%, n = 3) use them *Occasional,* two use them *Seldom* and only one uses them *Frequent.* **Moodle (e-learning)** is used by six (86%) participants, with the majority (83%, n = 5) using it *Occasional* and one participant using it *Frequent.* The main usage of Moodle is for lecture notes and/or slides and online assessment.

Practical notes/slides are used by 86% (n = 6) of the participants, with 50% (n = 3) using them *Occasional* and the other 50% (n = 3) using them *Frequent*. **Videos** are used by six (86%) of the participants, five use them *Seldom* and one uses them *Frequent*. An **LMS**, other than Moodle, are used by five (71%) participants, with one participant indicating using them *Seldom*, three (60%) *Occasional* and one *Frequent.* **Forums** are used by four (57%) of the participants and with all four (100%) of them making use of them *Seldom*. **Badges** are used by only two (29%) participants, with one using them *Seldom* and specified that they are *"wanting to"* use them more. The other participant stated that they make use of them *Occasional* and indicated that they had *"just started"* using badges. One participant stated that *"Moodle is a very powerful [tool], but there is a very steep learning curve".*

4.3 ERP Case Study

The ERP case study at NMMU consists of the introductory ERP systems course. This course is part of the degree curriculum, but is sometimes presented as a one week short course (Section 4.3.1). For the purposes of this study a short course was presented where student and industry delegates could attend. Input with regards to the problem being analysed and investigated in this study was also obtained from industry members (Section 4.3.2).

4.3.1 Introductory ERP Systems (WRER301 2014 and 2015)

The student participants in this case study will consist of undergraduate CS students who have registered for the ERP systems (WRER301) module. ERP Systems 3.1 is a third year module which is offered in the Department of CS at NMMU. The aim of this module is to develop a comprehensive theoretical basis of state-of-the-art theories in the field of ERP systems and its various modules and applications. The general learning outcomes for this module which are relevant to the processes in the ERP systems are as follows:

- Describe the functions provided by ERP modules;
- Describe the components provided by ERP modules;
- Explain the typical procurement, fulfilment, financial and manufacturing processes as implemented by an ERP system; and
- Perform hands-on exercises with an ERP system to create master and transactional data in the financial, procurement, sales and marketing and inventory modules.

Prior to 2014, the ERP systems module always used a 100% F2F learning approach, with limited use of Microsoft SharePoint for content sharing (as a CMS). The decision was made to adopt a blended learning approach into this module, due to the increased interest and usage of e-learning in higher education (Sections 1.1 and 3.5.2). The ERP systems courses only started using SYSPRO (ERP vendor material) in the last three years and Moodle has been used (as a CMS) since 2012. SYSPRO subsequently launched an e-learning system which was used for the first time in 2014.

4.3.2 Industry Perspective

It is evident that there is a problem with ERP system education, not only at university level, but also in industry (Section 3.3). In order to gain perspective of the problem in

context, three informal interviews were conducted with practitioners in the ERP industry in Cape Town, Johannesburg and Port Elizabeth. The following stakeholders were interviewed:

- P1: An ERP consultant from SYSPRO Cape Town;
- P2: A senior business consultant from one of SYSPRO's Value Added Resellers (VARs) (Company E); and
- P3: An Education Executive from SYSPRO Johannesburg.

According to P1 there are various multi-level training methods offered at SYSPRO, consisting of:

1. Self-learning in the form of certification and e-learning;
2. On/at site or off-site classroom training (which is considered the light version);
3. Train-the-trainer which are senior users who are trained extensively and will become a trainer and then will have to train other users;
4. Support Zone;
5. Videos and snippets; and
6. One-on-one training.

P2 stated that that Company E has a Support Desk specifically for e-learning and for customers and that they supplement training with online learning assessments which are based on frequently asked questions (FAQs). These assessments are used for induction purposes, on-the-job training and are used to increase knowledge and create confidence amongst employees. P2 said that Company E makes use of formal training at SYSPRO and has not made use of e-learning, except for the SYSPRO Support Zone.

P3 stated that the reason why only certain modules are included in the SYSPRO e-Learning System and why sometimes not the whole module is included; is because the SYSPRO e-Learning System is aimed at someone who is new to SYSPRO (a novice user) and to give them an introduction to ERP and SYSPRO. Another reason stated by P3, is that usually people (consultants) specialise in a particular discipline such as Finance or Manufacturing and therefore will usually not need to know everything about every module. Expert users have additional resources available to them on the Support Zone.

According to P3, in terms of architecture, flexibility, ease and difficulty to add another module, it is very easy to achieve and update when versions change, specific to content management. SYSPRO makes use of DreamWeaver for content development which has a pleasant UI, is user friendly and is a wikiwig. Typically there are two separate screens, one for coding in the back-end and the other for the front-end. The video tutorials and simulations are produced using Adobe Captivate. Camtasia is used for feature demos. Development of content and simulations is time consuming and can be troublesome when version changes occur. It is P3's opinion, in general, that maintenance of the SYSPRO e-Learning System is not feasible. The content had to be re-entered into DreamWeaver from the manual, paper-based guides which can be considered as a disadvantage of the SYSPRO e-Learning System. The SYSPRO e-Learning System comes free with a SYSPRO licence and changes cannot be made to it by customers, however, there have been requests from customers to customise. According to P3, SYSPRO also make use of webinars which they send out and are downloadable.

A disadvantage of the SYSPRO e-Learning System, as stated by P3, is that there is no search function and SYSPRO has to be installed on the user's device in order for it to work properly. The SYSPRO e-Learning System is also roughly 198 megabytes (MBs) in size which can make shipment a problem and therefore it is more customised for the web. SYSPRO decided not to make the e-learning system a live, web-based system that could be accessible with a username and password because it needed to be available offline as well.

At this stage there is no mobile offering for learning, apart from SYSPRO Espresso. P3 feels that videos are too big and not ideal for mobile phones and that it will not be comfortable to learn ERP theory off a mobile phone as there is too much content, so a tablet computer is preferred. According to P3, feature demonstrations are suitable on mobile phones and are roughly three to five minutes long and videos on mobile phones enable users to self-help at home. Support articles and online certifications are also available. However, everything is in a different place and there is a need to bring everything together, into one place.

In summary SYSPRO's education footprint consists of: webinars, the e-learning system and feature demos. The findings of these interviews regarding the benefits and

disadvantages of the SYSPRO e-Learning System based on these interviews, are summarised (Table 4-4).

Table 4-4: SYSPRO e-Learning System Benefits and Disadvantages

SYSPRO e-Learning System	
Benefits	**Disadvantages**
Overview of SYSPRO ERP System	Only certain modules are included
Simple	Sometimes only partial modules are included
Targeted at novice users	Learning content and guides have to be manually re-entered from the paper-based guides
Specific to content management	Not customisable
Easy to update when versions change and another module is added	No search function
Flexible	SYSPRO has to be installed on your computer
Feature demonstrations: • are accessible from mobile phones • roughly three to five minutes long • self-help at home	Large size (198 MB)
Free with a SYSPRO license	Integration difficult
Webinars	Not web-based
Online Certifications	No mobile feature for learning

4.4 SYSPRO Education

After the industry interviews a detailed functional analysis of the SYSPRO education and e-learning elements was undertaken by the researcher. The first solution is the SYSPRO e-Learning System (Section 4.4.1), followed by the Support Zone, Info Zone and certification (Section 4.4.2). Lastly, this research proposed a new m-learning application for SYSPRO (Section 4.4.3).

4.4.1 SYSPRO e-Learning System

The SYSPRO e-Learning System for End Users contains eight units (Figure 4-3). The SYSPRO e-Learning Systems include interactive self-assessments that provide immediate feedback to the user which reflects their understanding and progress. However, there are only a limited number of simulations available, only in Unit 1: SYSPRO Orientation. Each unit of the SYSPRO e-Learning System was investigated in detail (Appendix B) and one or more of the following types of content presentation are included in each unit:

- Simulations (Demonstration, training, assessment);
- Tasks;
- Theory; and
- Assessment (self-check quizzes).

Unit 1 (SYSPRO Orientation) of the SYSPRO e-Learning System, is the only unit that includes all four forms of e-learning (Table 4-5). There are some units in the SYSPRO

e-Learning System that are purely theoretical units, namely: Unit 2 (Supply Chain, ERP and SYSPRO Business Processes), Unit 3 (Introducing Inventory) as well as the Summary and Conclusion unit. The other units consist of a combination of theory, tasks and assessment (self-check quizzes).

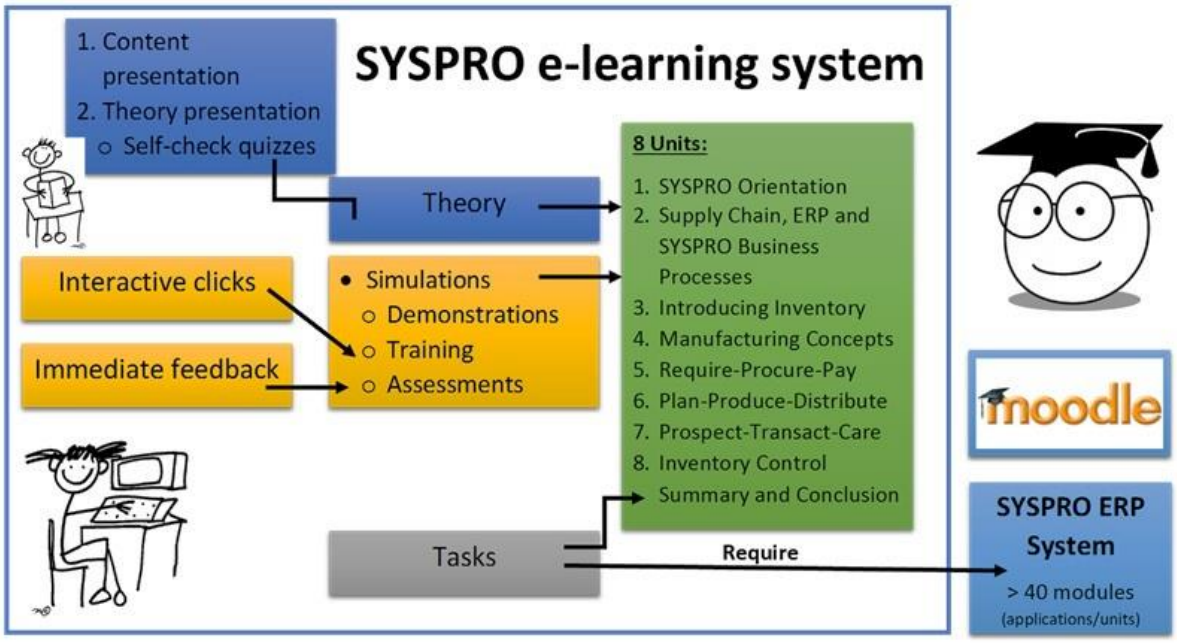

Figure 4-3: Learning Process of the SYSPRO e-Learning System (Author's Own Contribution)

Due to the instant feedback of the SYSPRO e-Learning System users are able to skip ahead of topics that they are comfortable with and are therefore able to spend more time on topics and sections that they find more difficult and/or challenging (SYSPRO, 2013a). It is these learning methods such as adaptive teaching that can considerably increase the learning experience (Section 3.5.2). Learners can go through the content at a faster pace as well as adapt the method of learning in order to meet their specific preferences. Feedback is immediate, regardless if questions and/or assessments are correct or not. Immediate feedback allows users to work through content and topics numerous times until they feel comfortable and satisfied with their level of understanding and retention. Simulations are available on the SYSPRO e-Learning System where users are able to watch video tutorials of demonstrations, training and assessments of specific tasks performed in the actual ERP system (Figure 4-4).

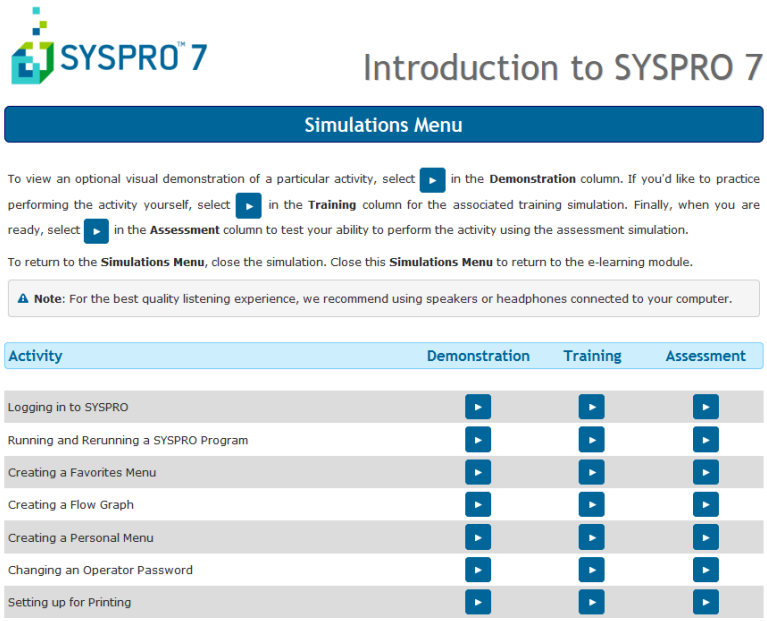

Figure 4-4: SYSPRO e-Learning System Simulations Page

SYSPRO uses some commonly used e-learning terms (Table 4-5). SYSPRO **demonstration** simulations are videos where there is a person speaking (audio) and demonstrating a specific task on the screen, in the SYSPRO ERP system, for example *Adding a Sales Order*. Therefore, it can be deduced that a SYSPRO demonstration conforms to the definition of a demonstration as defined in Section 3.8.1.

Table 4-5: e-Learning System Terminology (SYSPRO e-Learning System)

Term		Definition
Simulation	*The simulations menu provides three options which are then further classified into a demonstration simulation, a training simulation and an assessment simulation. The SYSPRO ERP system is not required in order to run these.*	
	Demonstration	*A demonstration is seen as an optional visual demonstration of a particular activity.*
	Training	*If users would like to practise performing the activity themselves, associated training simulations are provided.*
	Assessment	*When users are ready, they are able to test their ability to perform the activity using the assessment simulation.*
Tasks		*An online user manual which gives a step-by-step electronic guide to how to perform the actual tasks in the SYSPRO ERP system. In order to perform the tasks, the SYSPRO ERP system is required.*
Assessment	**Self-Check Quizzes**	*An alternative form of assessment, in the form of multiple choice questions, True/False questions and questions which merely give users the answers. Considered to be self-assessment.*

A SYSPRO **training** simulation does not have audio, instead it has green information boxes explaining what needs to be done on that particular screen, for instance “You are going to access the contents of the Sales Orders module”. There are also blue hint boxes with the steps that are required, for example, “Select the Expand icon for the Sales orders module” and a red box is shown where the user needs to click. If the user

clicks in the wrong place an error message, “Incorrect. Please try again”, will appear and the user is able to re-attempt the step. The SYSPRO training simulation also adheres to the definition provided in literature since it involves teaching a user how to perform a specific activity and allows them to practise it until perfected (Section 1.1).

The SYSPRO **assessment** simulation also does not have any audio and also has green information boxes, however, there are no blue hint boxes. If the user clicks in the wrong place, a hint is made available. After completion of the assessment the results will indicate the accuracy in percentage format as well as the number of attempts. If a user gets below a certain percentage they will be advised to review the training simulation again before re-attempting the assessment. The SYSPRO assessment simulation also adheres to the theory definition since it evaluates the progress and achievement in performing a specific task.

For the purposes of this study, only the SYSPRO e-Learning System for end users will be used and evaluated. However, there are numerous e-learning systems, roughly nine in total, which SYSPRO has available (Appendix C). These e-learning systems are aimed at different types of users for instance, ERP consultants and resellers (Figure 3-2). For the duration of this study whenever referring to the SYSPRO e-Learning System, it is referring to the e-learning system for end users since the scope of this study is limited to novice users.

However, it is argued that industry training and learning content (such as provided by SYSPRO) is not well suited for HEIs and therefore is better suited for industry, because it was designed for industry use (Surendran et al., 2006). HEIs curricula needs to incorporate more formal and abstract knowledge and skills that align with their aims and outcomes (Section 3.3).

4.4.2 Support Zone, Info Zone and Certification

The SYSPRO Support Zone offers various online learning options to suit all levels of engagement as well as different formats of educational material to suit the needs of individuals (SYSPRO, 2013b). The “zones” consist of libraries (folders) that store, for example, fact sheets and brochures regarding each SYSPRO module. The Info Zone is a central repository and the main focus here is providing content for online certifications. The site is grouped according to topic and type. Electronic documentation in the form of *Global Talk* and SYSPRO brochures are available online.

Usually the colour tabs ‘carousel’ is used to search for documents based on colour instead of from a list. Users are able to download or watch feature demo videos, training guides and webinars.

4.4.3 SYSPRO m-Learning Application (SYSPRO Latte)

The **SYSPRO Espresso** app is seen as a platform or hub for SYSPRO apps (Hurry, 2014). The main benefit is that it is a one app install. SYSPRO Espresso is usually used in conjunction with the actual SYSPRO ERP system and is for “on-the-go”. At the time of interview, SYSPRO Espresso did not have any learning aspect, however, according to the Software Engineer/Developer it should. SYSPRO has no m-learning platform, therefore as part of this research **SYSPRO Latte** was developed which is a mobile application that can be used to assist with the training and education of SYSPRO users (Kapeso, 2014). SYSPRO Latte was developed on an Android platform and consists of numerous components such as theoretical content, video tutorials, assessment and more importantly a hands-on simulation of performing a specific task in the actual SYSPRO ERP system.

The hands-on simulation of SYSPRO Latte (Kapeso, 2014) is the most popular feature of the m-learning application and consists of a replicated simulated environment of the SYSPRO ERP system, specifically the Require-Procure-Pay business process (Figure 4-5). The simulation involves the creation of a purchase order and can either be done in the beginner mode or advanced mode. The beginner mode includes hints in red blocks which advise and assist the user in completing the task. The steps required in completing the task are shown in the left pane and a green tick indicates that the specific step has been completed. Once the task has been successfully completed a message is shown on the screen.

Users who have more advanced knowledge, skills and experience in terms of ERP systems, SYSPRO and the Require-Procure-Pay business process can do the hands-on simulation in the advanced mode. The advanced mode is conducted without hints and the steps are not shown in the left pane either.

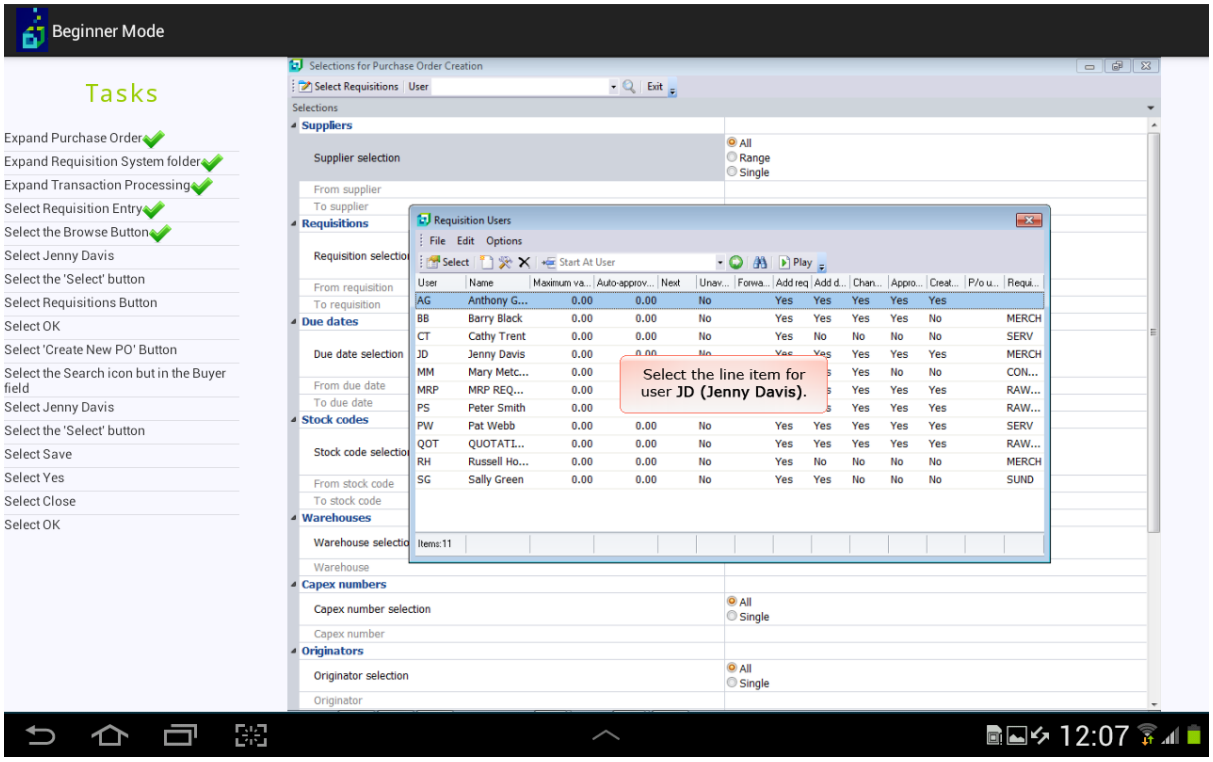

Figure 4-5: Screenshot of SYSPRO Latte Simulation (Beginner Mode)

4.5 Student Perspective: A Field Study of SYSPRO e-Learning System[2]

As part of the problem analysis phase of DBR in Cycle 1, students who were registered for a semester long course in ERP systems (WRER301 2014) took part in a field study of SYSPRO's e-Learning System (Section 4.5.1). The data analysis process to be used for this study is also determined and discussed (Section 4.5.2). This field study as a whole is considered to be the DBR Cycle 2 of this study. As part of the SYSPRO University Alliance, NMMU was the first university to use the SYSPRO e-Learning System (Fryer, 2014). The TAM (Section 3.9) was used to evaluate the acceptance of the SYSPRO e-Learning System (Section 4.5.3). Both quantitative and qualitative data was collected and analysed (Section 4.5.4). An additional *Elements Questionnaire* (Appendix D) was also used for data collection in terms of the SYSPRO e-Learning System (Sections 4.5.3 and 4.5.4).

[2] The results reported on in this section were published as a full paper in a double-blind peer reviewed conference at Southern African Computer Lecturers Association (SACLA) in June 2014. Scholtz, B., Calitz, A. & Whale, A. Students' Perceptions of ERP e-Learning Material in a Blended Learning Environment. SACLA Conference. Port Elizabeth, South Africa. **(Appendix E)**

4.5.1 Procedure and Participant Profile

The study was conducted in three, three-hour long laboratory practical sessions that were conducted on a weekly basis. The aim of these practical sessions is to support the theory based, weekly F2F lectures and to teach ERP systems by making use of a hands-on approach. Units 1, 5 and 7 of the SYSPRO e-Learning System were covered in the three practical sessions.

- **Unit 1: SYSPRO Orientation** familiarises users with the SYSPRO menu and UI. It contains simulations that can be used to assist with learning since there are demonstrations, training and assessments which include tasks that need to be conducted in the actual SYSPRO ERP system.
- **Unit 5: Require-Procure-Pay** deals with the top level of the business process flow focusing on the three phases within this process as well as the stages and tasks within each phase. This unit also includes the concepts, roles, considerations and risks of every stage in this process flow, along with the SYSPRO programs which support this specific business process.
- **Unit 7: Prospect-Transact-Care** is concerned with the top level of the business process flow as well as the three phases within this process and the tasks within each phase. The concepts, roles, considerations and risks for each stage in this flow are also covered in this unit as well as the SYSPRO solutions and programs that support this business process.

Studies by Islam (2013), Ong et al. (2004) and Tagoe (2012) indicate that PEOU and PU are often used as criteria in evaluating the technology acceptance and usability of e-learning systems and the *TAM Questionnaire* (Appendix F) was compiled based on the research of these authors (Section 4.5.3). In order to evaluate the quality of a research instrument it needs to be evaluated in terms of face validity and content validity (Saunders et al., 2009). Since the questionnaires have been used in previous studies face validity is established. To ensure the content validity and reliability of the questionnaires they were checked by a statistics expert at NMMU.

The paper-based TAM questionnaires were administered after each practical session in order to determine the PEOU and PU of the SYSPRO e-Learning System. *The TAM Questionnaire* consisted of open- and closed-ended questions. The closed-ended questions used a 7-point Likert scale, where 1 indicated *Strongly disagree* and 7

indicated *Strongly agree*. The following statistical ranges were applied: negative [1 to 2.71), neutral [2.71 to 5.29] and positive (5.29 to 7]. Open-ended questions were added to the TAM questionnaires and related to the students' opinions of the SYSPRO e-Learning System.

The ERP systems 2014 course had 25 registered students with the majority (64%) being male (n = 16) and 36% were female (n = 9). Most of the students (72%) were between 21 and 23 years old and none of them had any previous experience with ERP systems. Since the questionnaires were administered at the end of each practical session and the sessions occurred in different weeks, the sample size of each practical session did fluctuate. However, it can be noted that attendance increased from 60% class attendance to 88% as the semester progressed.

4.5.2 Data Analysis Process

The qualitative data was thematically analysed by using categories and themes (Braun & Clarke, 2006). ***Thematic analysis*** involves the method used to identify, analyse and report on patterns called *themes*, within data that is collected. It is used to organise and describe large sets of qualitative data and is often used to interpret several aspects of a particular research topic. Even though thematic analysis is inadequately defined and acknowledged, it is still a widely used qualitative analysis method.

Qualitative analysis approaches are known for being extremely diverse and complex, thus thematic analysis makes for the perfect foundational method for qualitative analysis (Braun & Clarke, 2006). Thematic analysis should be the first qualitative method learnt by researchers because of the core skills and great usefulness it allows. Braun and Clarke (2006) propose a six phase guide for conducting thematic analysis. The phases are as follows:

1. Phase 1: Familiarising yourself with your data;
2. Phase 2: Generating initial codes;
3. Phase 3: Searching for themes;
4. Phase 4: Reviewing themes;
5. Phase 5: Defining and naming themes; and
6. Phase 6: Producing the report.

The process of thematic analysis commences with the researcher(s) *familiarising themselves with the data* and this may include transcribing of data, but mostly reading

and re-reading of the data as well as taking note of initial ideas and possible codes or themes (Braun & Clarke, 2006). The next phase involves the *generation of initial codes* which could be interesting features of the data, identifying common occurrences and giving them a unique code and brief description, at a high-level. This is conducted in a systematic way over the whole data set where data is collated relevant to each code. Thereafter, the codes are collated into *potential themes* and data is gathered relevant to each potential theme. The themes are then *reviewed* and checked in relation to the coded extracts which are seen as Level 1 and the entire data set as Level 2. This is used to generate a thematic map of the analysis. The next phase, involves the *refinement of the specifications* of each theme, the overall analysis story is told and clear definitions and names (codes) are allocated to each theme. Finally, actual analysis and *reporting* takes place where compelling extracts and vivid examples and quotes are analysed, compared and reported on. The results and discussions are then related back to literature and the research questions. This is the process that is followed in this research study whenever conducting thematic analysis.

4.5.3 Technology Acceptance: PEOU and PU Results

Three items were used to measure and determine ***PEOU*** and are referred to collectively as PEOU (Figure 4-6). It can be noted from the results that the mean score for PEOU showed a minor increase from Session 1 to 2, however, it decreased from Session 2 to 3. The overall mean for PEOU (μ = 5.3) for the three sessions is in the positive range.

Technology Acceptance Questionnaire - PEOU Results

e-Learning Session	Unit topic	Mean	Max	Min	Standard deviation
1	SYSPRO Orientation	5.6	7	3	1.09
2	Require-Procure-Pay	5.7	7	3	1.17
3	Prospect-Transact-Care	4.6	7	2	1.45
PEOU TOTAL (Overall)		**5.3**			**1.24**

Technology Acceptance Questionnaire - PU Results

e-Learning Session	Unit topic	Mean	Max	Min	Standard deviation
1	SYSPRO Orientation	5.7	7	4	1.11
2	Require-Procure-Pay	5.4	7	3	1.13
3	Prospect-Transact-Care	5.0	7	1	1.19
PU TOTAL (Overall)		**5.5**			**1.14**

Figure 4-6: PEOU and PU for the TAM Questionnaire

PEOU was rated in the positive range by the students for Session 1 and 2, however, for the third session the mean rating was neutral (μ = 4.6) and decreased from Session 1 to 2 and again from Session 2 to 3. The increase in the standard deviation shows

that the data and scores of the students became less concentrated around the mean over the duration of the study, which indicates that the range of opinion amongst the students began to increase (Figure 4-7).

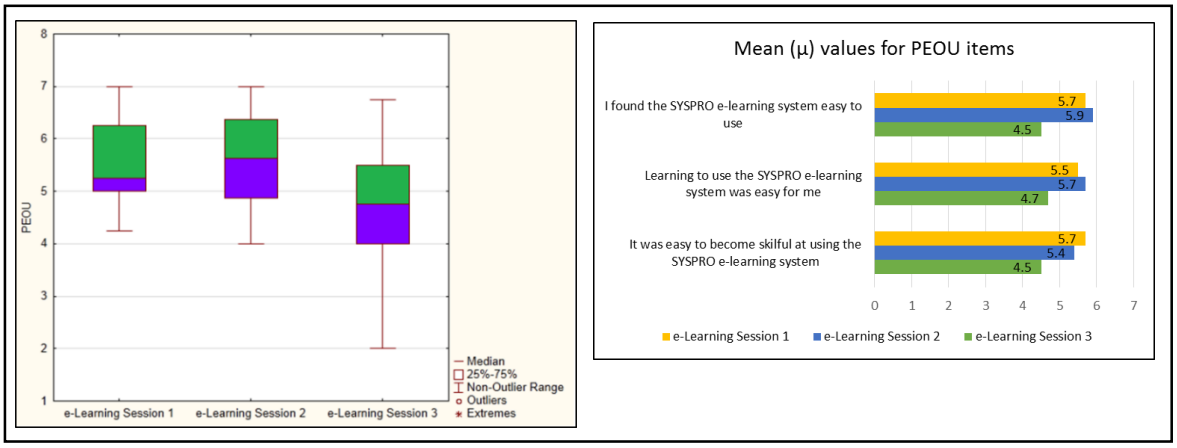

Figure 4-7: PEOU Graphs - Box and Whisker Chart of PEOU items

From the results, it is obvious that for the items "*I found the SYSPRO e-Learning System easy to use"* (Session 1 μ = 5.7; Session 2 μ = 5.9) and *"Learning to use the SYSPRO e-Learning System was easy for me"* (Session 1 μ = 5.5; Session 2 μ = 5.7) that there was an improvement in the mean from Session 1 to 2. The mean for the item *"It was easy to become skilful at using the SYSPRO e-Learning System"* (Session 1 μ = 5.7; Session μ = 5.4) decreased from Session 1 to 2. From Session 2 to 3 all items showed a decrease in mean value and it can thus be deduced that the students PEOU of the SYSPRO e-Learning System also began to decrease.

This result indicates that the PEOU of the students towards the SYSPRO e-Learning System began to decline over time. A possible reason for this could be the complexity of the tasks in Practical 3 (Prospect-Transact-Care) or due to the fact that students started to take the benefits of e-learning for granted. Further research into this topic could potentially reveal more clarity in terms of the reasons for this decline.

Five items were used to measure and determine ***PU*** (Figure 4-8). From Session 1 to 3, there was a decrease in the mean rating for PU and an increase in the standard deviation for each session (Figure 4-6). From these results it can be inferred that the students' perception of the PU of the SYSPRO e-Learning System started to decrease the more time they spent working on it. Overall, both the PEOU and PU criteria were in the positive range with PU (μ = 5.5) being only slightly higher than that of the overall mean of PEOU (μ = 5.3).

The results for Sessions 1 and 2, on average, indicated that the students were positive in terms of the usefulness and ease of use of the SYSPRO e-Learning System. In contrast, for Session 3 the mean rating for PU is in the neutral range (μ = 5.0) and the students' opinions vary between *Somewhat agree* and *Agree.* Once again, the range of student opinions has increased which is indicated by the steady increase in the standard deviation (Figure 4-8).

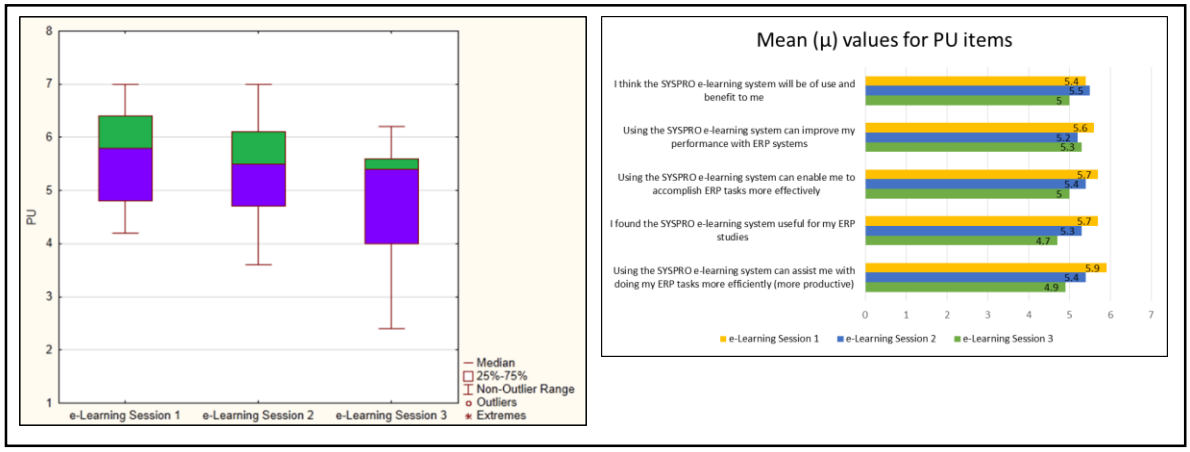

Figure 4-8: PU Graphs - Box and Whisker Chart of PU items

For PU the highest ranking item was "*Using the SYSPRO e-Learning System can assist me with doing my tasks more efficiently"* (μ = 5.0). The majority of the items (3 out of 5) showed decreasing mean values from Session 1 to 3, except for *"I think the SYSPRO e-Learning System will be of use and benefit to me"* which improved from Session 1 to 2 and then declined from Session 2 to 3. "*Using the SYSPRO e-Learning System can improve my performance with ERP systems"* also decreased from Session 1 to 2, but increased from Session 2 to 3.

The SYSPRO Latte m-learning application (Section 4.4.3) was used in one of the practical sessions in order to evaluate the technology acceptance of the application (Kapeso, 2014). The PEOU of the SYSPRO Latte m-learning application was neutral (μ = 4.4) as well as the PU (μ = 4.1). These results indicate that the participants agreed that SYSPRO Latte is useful and easy to use.

4.5.4 Qualitative Results: Positive and Negative Features

The frequency (*f*) of responses in each theme for both positive and negative features of the SYSPRO e-Learning System were identified (Figure 4-9). Only the top three themes for both the positive and negative features are listed. After completion of Session 1, the theme with the highest frequency of ***positive*** responses was the

simulations and demo videos (*f* = 8) theme, followed by the specified tasks (*f* = 6) and the step-by-step nature of the system (*f* = 6). Session 2's highest frequency positive theme was the step-by-step nature and layout (*f* = 7) of the e-learning system. The simulations and videos (*f* = 3) and general layout and format (*f* = 3) of the e-learning system were ranked second highest in terms of the frequency of responses of these themes. After Session 3, when the students had been working in the SYSPRO e-Learning System for a period of time, the explanation and presentation of theory (*f* = 7) was the theme with the highest frequency. The step-by-step nature (*f* = 5) and general layout and format (*f* = 5) of the e-learning system were also recognised as positive features. Additional comments made by students with regard to the positive features of the e-learning system and which were not included in the top three themes related to the self-check quizzes, simplicity and ease of use of the e-learning system as well as the fact that they were able to test their knowledge on an on-going basis.

Top three positive features

Themes (e-Learning Session 1) (n = 15)	*f*	Sample comments from students
Simulations and demo videos	8	*The videos they have that show you exactly what to do*
Tasks	6	*The tasks you do (gives you practical experience)*
Step-by-step nature of the training guide	6	*The system provided a step by step guide on how to use the system*
Themes (e-Learning Session 2) (n = 16)	***f***	**Sample comments from students**
Step-by-step nature of the training guide	7	*It goes step by step*
Simulations and demo videos	3	*Videos can be helpful*
Layout	3	*It is nice that all module content is stored in one system*
Themes (e-Learning Session 3) (n = 22)	***f***	**Sample comments from students**
Explanation and presentation of theory	7	*Having additional information to explain the specific jargon/concepts when click on*
Step-by-step nature of the training guide	5	*Easy to follow process*
Layout	5	*Content is provided in an easy to understand summary*

Top three negative features

Themes (e- Learning Session 1) (n = 15)	*f*	Sample comment from students
Time consuming and complexity	5	*There is a lot of information and work to do. A lot of links.*
Too helpful	3	*Sometimes a little too helpful in telling you what you want to do*
Themes (e- Learning Session 2) (n = 16)	***f***	**Sample comments from students**
Navigation and display	4	*Having to switch between windows the entire time*
Tasks	4	*Tasks – do not find that these are really "teaching" me anything*
Time consuming	4	*I get bored and tired from all the reading*
Themes (e- Learning Session 3) (n = 22)	***f***	**Sample comments from students**
Instructions	13	*Too many instructions and some of the instructions are not clear and make no sense*
Tasks	7	*Some of the tasks are not clear*
Difficult to learn and understand	4	*Not an easy structure to learn from*

Figure 4-9: Qualitative Feedback - Positive and Negative Features

After Session 1 the theme with the highest frequency of ***negative*** features was the time-consuming nature and complexity of the e-learning system (*f* = 5). The second highest frequency for negative themes was the fact that the system was too helpful (*f* = 3) since everything was prescribed and the user could perform tasks in a "button pushing" fashion with minimal understanding. Session 2, had issues and problems

with navigation and display (*f* = 4) as the most frequently mentioned negative feature. Tasks (*f* = 4) and the time consuming nature and length of units (*f* = 4) were again recognised as negative features. After Session 3, instructions (*f* = 13) were seen to be the most frequently mentioned undesirable feature, whereas tasks (*f* = 7) was recognised as the second highest reported negative feature. Difficulty with learning and understanding (*f* = 4) was the third most frequently reported negative feature. Due to the fact that many students had difficulty and problems with completion in Session 3, this could be an underlying reason for the high frequency of negative responses relating to tasks for this session due to the frustration caused.

The best/liked features of the SYSPRO Latte that were identified was the simulation, ease of use and content presentation. Comparatively, some worst/disliked features identified were the problems with the icon size of the simulation and content layout. Overall, SYSPRO Latte was positively received by the participants.

4.6 Conclusions

The focus group that was conducted with CS lecturers indicated that Moodle is actively used within the CS department at NMMU, with various benefits being identified associated with making use of Moodle (Section 4.2.1). Evidently, the CS department has noticed the advantages of making use of a LMS such as Moodle in order to improve the learning process (Sections 3.6.5 and 4.2). From the results it is apparent that Moodle is commonly used for the uploading and sharing of lecture notes and/or slides as well as for online assessments such as quizzes and assignments (Table 4-3) which confirms the benefits identified in theory (Section 3.6.5).

From the industry field study and set of interviews it can be noticed that there is a variety of training methods and options available, especially at SYSPRO. SYSPRO noted the benefits of e-learning in the development of their own e-learning system which was designed to be used in conjunction with the SYSPRO ERP system (Table 3-3). It can also be considered that SYSPRO has noticed problems with ERP education and has therefore implemented a solution specifically for novice users (Section 3.3 and Table 3-1). This is also evident with SYSPRO's strategic academic alliances with HEIs, such as NMMU (Section 3.3). The SYSPRO e-Learning System has encompassed various components of e-learning such as videos, demonstrations and simulations (Section 3.8) which have been reported to have advantageous effects

on learning (Tables 3-3 and 4.4). The SYSPRO e-Learning System can also be seen as a cost effective means of education since it comes free with a SYSPRO licence. Evidently, a gap was identified in terms of SYSPRO's m-learning offerings and thus with the research conducted by Kapeso (2014) this gap was been addressed and filled by SYSPRO Latte (Section 4.4.3). However, SYSPRO Latte still can and needs to be expanded to cover and address all aspects of the SYSPRO ERP system.

The SYSPRO e-Learning System was rated positively overall by the participants, with PU rated slightly higher than PEOU. Positive features of the SYSPRO e-Learning System which were identified include videos (visual presentation), tasks, theory and steps. This confirms the visual appeal of e-learning initiatives that have been reported on in literature (Section 3.8.1). Negative features of the SYSPRO e-Learning System were that the system was too helpful, which can be seen to elaborate on the process view problem (Section 3.3). Problems with the complex nature of the tasks reiterate the fact that ERP systems are indeed complex systems (Section 1.1). Of the positive and negative features that were identified, many correspond with the benefits and disadvantages of e-learning in general which were previously mentioned in Chapter 3 (Table 3-3).

From the case study that was investigated in this chapter, an updated list of the current situation ERP education problems is proposed which compares what was revealed by the literature review conducted in Chapter 3 (Table 4-6). Important problems identified are highlighted as well as additional problems as identified in the case study, with specific reference to the industry perspective. The benefits and problems with e-learning as identified in the literature review have also been confirmed in the case study of this chapter where field studies, interviews and questionnaires were used to collect data (Tables 4-7 and 4-8).

Table 4-6: Problems with ERP Education (Lecturer, Industry and Student Perspectives)

Problems with ERP Education	
Literature	**Case Study Application**
Limited access and availability of quality trained academics	
Gap between university and industry competencies	
Slow/no integration of ERP systems into curricula	
Lack of ERP specialists	• Specialists in one discipline
Lack of understanding of underlying processes (process view)	• Teach hands-on ERP systems to students • SYSPRO e-Learning System too helpful and tasks time consuming
Availability of instructional content and demonstration content	• Limited number of SYSPRO simulations
Vendor-based content and training	• SYSPRO e-Learning System aimed at novice industry users
Students fail to acquire required knowledge and skills	• No theoretical basis of state-of-the-art theories in the field of ERP systems, modules and applications provided
Problems with usability of ERP (not designed for learning)	• Problems identified by students include navigation and display

Table 4-7: Problems with e-Learning (Lecturer and Industry Perspectives)

Problems with e-Learning	
Literature	**Case Study Application**
Social and personal interactions are lost	
Development of high quality e-learning material is expensive (cost) and time consuming	• Moodle Quiz Interface is poor
Lack of immediate feedback for asynchronous e-learning	
Increased preparation time for instructor could cause frustration, anxiety and confusion	• Increase lecturer preparation, especially in the first year • Numerous, complex Moodle settings to set up • Gradebook issues (does not make use of NMMU student numbers) • Testing of activities required
Bandwidth access and technical difficulties	• Problems with Wi-Fi in lecture venues, hindering adoption of Moodle • Tedious navigation to a module's Moodle page • Mobile Moodle platform not well supported due to technical problems • SYSPRO e-Learning System is large in size which makes accessibility difficult (not easily copied or distributed)
Culture	
Acceptance and resistance to change	• Moodle statistics: active users (students and lecturers), posts, activities, views and number of courses - the high levels of adoption over the years as well as the steady increase of use have thus increased levels of acceptance and minimised resistance to change. • Use of Moodle forums has been unsuccessful, students still prefer alternative methods of communication • e-Learning (in general) not previously used for educational purposes in the ERP systems module at NMMU

Table 4-8: Benefits of e-Learning (Lecturer, Industry and Student Perspectives)

Benefits of e-Learning	
Literature	**Case Study Application**
Performance and efficiency is higher than that of F2F learning	• Increased submission rates • Enforce stricter deadlines • PEOU of the SYSPRO e-Learning System was rated positively by students
Expands **scope**	
Increased flexibility and efficacy of the learning process	• PU rated positively by students
Promotes asynchronous interaction - express opinions, ask questions, collaborate and experiment	• Moodle Workshop Activity for peer reviewing • SYSPRO interactive self-assessment give immediate feedback •
Synchronous communication and interaction occurs in real time	• Online feedback to identify problem areas • Self-assessment • Reflection
Removes **geographic proximity** restrictions - allows for learning to occur autonomous of time and place. Intensifies **reach** of students.	*Moodle allows this*
Richer learning experience, due to **visual** elements: use of text, images, audio, video	• The use of gamification elements e.g. badges • SYSPRO: video tutorials, simulations, demonstrations, webinars • Camtasia used for the creation of features demos at SYSPRO • Simulations and demo videos positively viewed by students
Extended periods of time of presentation	
Decrease burden on management, for example track attendance	• Online, electronic tests and marking • Online test setup and question banks • Attendance tracking
Material can be re-used. Content can be created more easily, communicated and managed with others.	• Lecturers agreed that benefits of Moodle were experienced where content can be re-used.
Portability	• Development of SYSPRO Latte m-learning application

From the field study results the theoretical Environment for e-Learning of ERP Systems (Figure 3-9) can be applied to the case study. Basically, the environment (Figure 3-9) is drilled-down (by application) to focus on specific components of e-learning and not a general theoretical environment as previously proposed. In this case the main focus is on the ERP vendor, SYSPRO, and its offerings. It is therefore important to highlight the specific SYSPRO components that were applied in this field study. The case study specifically made use of the SYSPRO ERP and e-Learning Systems and SYSPRO Latte m-learning application.

The first research question (***RQ1***) *"What problems are evident in ERP systems education?"* has now been answered. The chapter to follow will identify the high-level objectives of an ERP e-Learning Environment (ERPeL) and propose an evaluation plan to be followed in this research study.

Chapter 5. The Design of an ERP e-Learning Environment

5.1 Introduction

Chapter 4 addressed the problem identification of ERP education in a real-world context and reported on a field study that was conducted in order to identify ERP education problems (Cycle 2 of the DBR for this study). Obtaining such a diverse set of perspectives from a variety of ERP users allows for further definition of the detailed objectives and requirements as well as the analysis of existing systems, which are needed in order to successfully design an appropriate ERP e-Learning Environment. The design of such a learning environment is of extreme importance to this research study and is the main focus of this chapter.

This chapter focuses on Phase 2 (Design Solution) of the DBR methodology and presents the evaluation plan which is recognised as the initial design outcome of DBR. The high-level objectives will be determined in this chapter along with the design considerations. The development of an evaluation framework and plan which is included in this chapter is considered as the DBR Cycle 3 of this study, together with the improved theoretical framework which is seen as the output of Chapter 5 and DBR Cycle 3.

This chapter will discuss and answer the following research question:

RQ3: *What criteria can be used to evaluate the success of e-learning environments?*

RQ4: *Which e-learning components can be used to assist with ERP education?*

The high-level objectives of tools in the ERP educational environment are identified (Section 5.2) and will be used as input to the DBR Phase 2 (Design Solution) to influence the design considerations (Section 5.3). Since evaluation is a vital component of any e-learning environment, appropriate evaluation criteria are needed in order to ensure a successful outcome (Section 5.4). A detailed evaluation plan will be developed taking into account the above mentioned considerations (Section 5.5). Several conclusions are made (Section 5.6). The layout of Chapter 5 and the research objectives and deliverables addressed in this chapter are shown in Figure 5-1.

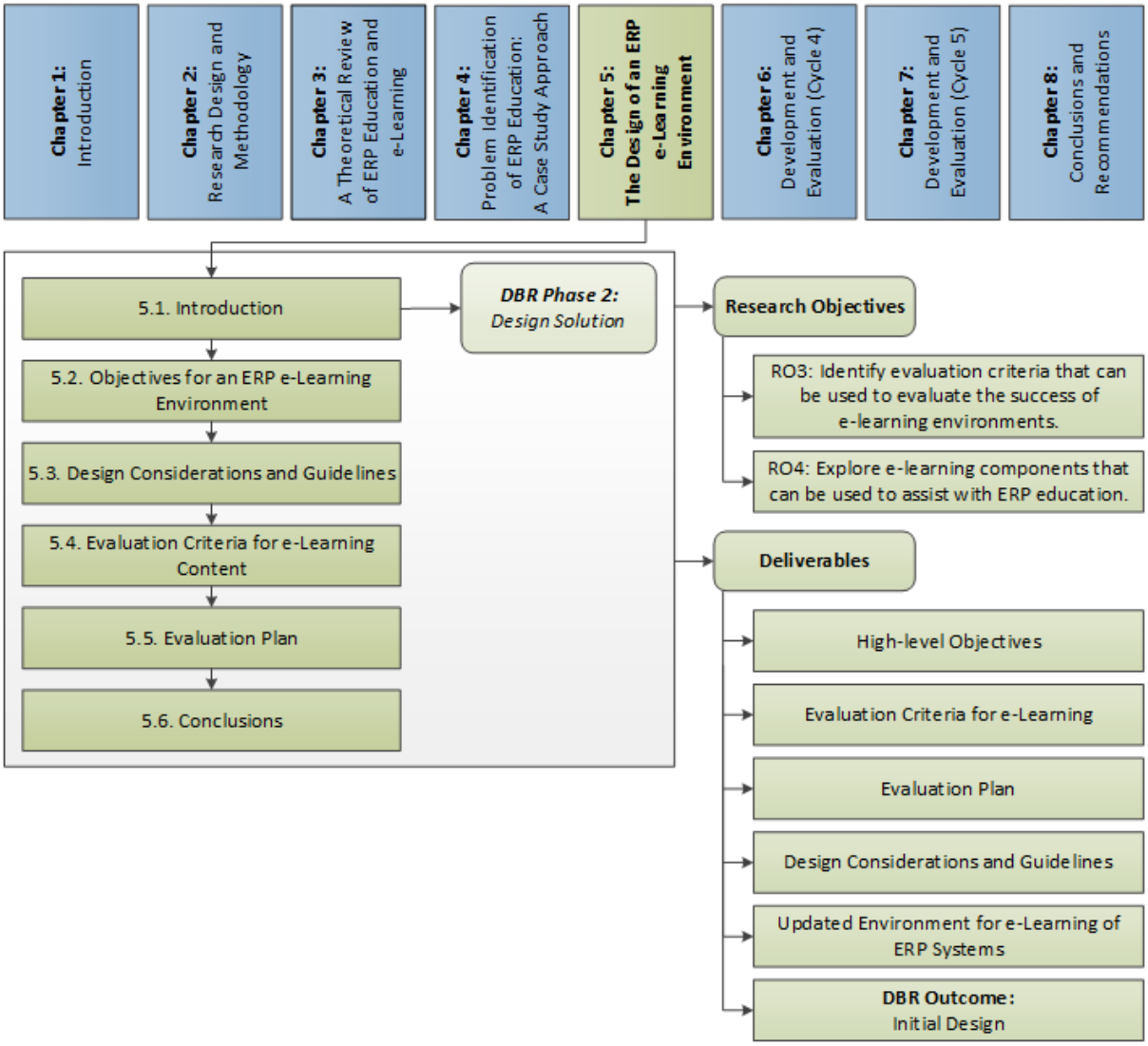

Figure 5-1: Chapter 5 Layout and Deliverables

5.2 Objectives of an ERP e-Learning Environment

From the literature review and the field studies conducted various objectives and requirements can be determined for the ERP e-Learning Environment (ERPeL). The high-level objective for the ERPeL is as follows: ***The environment must allow users easy, secure access to online ERP learning content.*** Based on informal interviews with the WRER301 lecturer and co-ordinator as well as literature consulted, several more detailed objectives are identified:

- Acquisition of the environment should be cost-effective and preferably open-source;
- The environment needs to be password (and login) protected and require enrolment in order for access (security);

- The environment must be compatible with SCORM packages;
- The environment needs to be some form of LMS, OLE or CMS;
- The environment should be able to easily integrate, connect or link to SYSPRO ERP system and SYSPRO e-Learning System (SYSPRO specific);
- Access to a computer (or mobile device);
- Internet connectivity is required;
- Audio equipment (e.g. headphones, earphones or speakers); and
- Require cloud storage (for videos).

It is very important that the theory is considered, especially the 20 CSFs for e-learning that are identified in this study (Table 3-7). The theoretical environment proposed (Figure 3-9) will be used to guide the design of an e-learning environment specific to ERP education which will be implemented in a real-world context consisting of a set list of learning components, success factors and evaluation criteria.

5.3 Design Considerations and Guidelines

Specific design principles need to be taken into consideration when designing content and other components for an e-learning environment (Section 5.3.1). Four cognitive processes also need to be adhered to when it comes to design (Section 5.3.2).

5.3.1 Design Principles

The split-attention principle as well as the contiguity principle relate to the visual design of dynamic representations (Plass et al., 2009). The *split-attention principle* states that the understanding of multimedia materials are hindered when users have to split their attention and are required to mentally integrate a variety of disparate information in order to understand the material being presented. For instance, sub-titles and animations including explanatory text. Split-attention can be avoided if both sources of information are integrated, in physical arrangement and timing, for example, placing labels, instructions and explanations next to the objects to which they refer.

In terms of the *contiguity principle*, it involves how the presentation of related sources of information close to each other, as opposed to separated can enhance learning, by decreasing unnecessary visual search tasks (Plass et al., 2009). This principle was recognised for the spatial arrangement of information (spatial contiguity principle) and the timing of the presentation of the information (temporal contiguity principle), for example, narrations that are offered after the corresponding visual information. The

contiguity principle can be avoided by placing related objects next to each other (spatial) and presenting related information at the same time (temporal) instead of in succession.

There are also various additional principles for information design of simulations and animations (Plass et al., 2009). The *cueing principle*, refers to additional design elements which direct a user's attention to important aspects of the learning material and is also known as signalling. Another important consideration is the type of representation chosen for key information (*representation type principle*), for example icons, images, written or spoken language. Learning is said to be enhanced when key information is represented in iconic or pictorial format instead of symbolic or textual format. The *colour coding principle* highlights the instructional materials making use of colour to highlight important features and/or attributes can result in enhanced learning. Colour is used to emphasise and draw connections between various sources of information. The *integration of multiple dynamic visual representations principle* recommends that learning is facilitated best when numerous representations in interactive visualisations are linked and integrated dynamically with each other.

These design principles were all taken into consideration when creating content such as the ERP videos for the e-learning environment and will also be taken into account when creating the final, complete ERPeL. The specific design principles were applied as follows.

Split-attention principle

- Information was integrated and the use of animations was carefully considered; and
- Labels were placed next to the relevant objects, diagrams and figures.

Contiguity principle

- Text which visually represented the content was shown first and then the supporting audio followed whilst the text was shown on the screen; and
- Related information was presented at the same time, for instance each video covered a different topic.

Cueing principle

- Definitions were usually in boxes to draw the user's attention to them;
- Important text was also made bold or highlighted by making the text size larger; and
- Buttons were representative of life-like buttons in appearance to signal to the user to advance to the next slide.

Representation type principle

- Text was kept to a minimum on the slides and was often replaced by diagrams.

Colour coding principle

- Colour was used to highlight and emphasise important content and aspects.

Integration of multiple dynamic visual representations principle

- One of the videos was interactive in nature.

5.3.2 Cognitive Processes

It is imperative that cognitive processes such as those described by Rogers, Sharp and Preece (2011), are taken into consideration when designing learning content. These cognitive processes are attention, perception, memory and learning. **Attention** involves the process of making a choice to concentrate on a particular thing from a variety of options. It is imperative that users pay attention to learning content and design implications, specifically related to attention include information that must be noticeable, the use of graphics and colour, sequencing and spacing items, avoiding clutter and avoiding the presentation of an overload of media. **Perception** addresses how information is acquired from the environment through different senses and is conveyed into experiences of things. This cognitive process includes additional cognitive processes of memory, attention and language. Design implications for perception include the following: icons and other graphical representations that must be easily interpreted, the effective use of borders and groupings to organise information, audible and distinguishable sound and all text must be easily seen on the background.

Memory covers the recalling of previously learnt knowledge which allows individuals to act appropriately (Rogers et al., 2011). Memory is of extreme importance, especially in e-learning systems where users might be asked to remember specific learning

content. Memory design implications should include avoiding information overloading, but instead present information in smaller snip-bits. UIs need to encourage recognition, as opposed to recall by making use of navigational menus, icons and consistently placed elements. **Learning** can be inferred as how to make use of a computer-based application or using a computer-based application to learn and understand a specific topic. The design implications that are explicit to learning include designing UIs that promote user exploration, but still allow users to correct mistakes and provide guides for exploration.

The specific cognitive processes were applied to ERPeL as follows:

Attention

Information was noticeable (easy to see and take notice of), since text on each slide was kept to a minimum and the font size was relatively large. This too contributed to an appropriate and suitable amount of white space. Items on each slide were carefully spaced and aligned. Graphics were used where appropriate and sometimes replaced the text completely, thus avoiding and limiting clutter. Graphics were used in the form of graphs and/or diagrams as well as the graphics of the avatars (characters). Colour was also used throughout, with each video having its own and similar colour schemes.

Perception

The learning content was designed to cater to the different senses:

- Sight - text, graphics, visual impact;
- Hearing - audio and voices; and
- Touch - specific to the interactive video.

Borders were used to group information, especially headings and definitions. Icons and graphics could be easily interpreted and were supported by audio explanations. Audio was audible and with the appropriate use of colours all text was easily visible.

Memory

Items were consistently placed in all the videos, with similar themes being used as well. Information was kept to a minimum where and when possible and the videos were broken up into shorter topics.

Learning

Exploration by users was evident and encouraged specifically in the interactive video, with learning being left in the hands of the users themselves. All the videos were supported by quizzes.

5.4 Evaluation Criteria for e-Learning Content

Leacock and Nesbit (2007) propose the Learning Object Review Instrument (LORI) which allows learning object users to create reviews which consist of ratings and comments on the following nine dimensions of quality: 1) content quality; 2) learning goal alignment; 3) feedback and adaption; 4) motivation; 5) presentation design; 6) interaction usability; 7) accessibility; 8) reusability and 9) standards compliance. A study by Plantak Vukovac, Kirinic and Klicek (2010) compiled a set of nine criteria that can be used for e-learning evaluations, namely: 1) method instrument/s; 2) formal method background; 3) heuristic or guidelines for evaluation; 4) pedagogical criteria integration; 5) evaluation target; 6) evaluation of stakeholders' roles; 7) empirical evidence of the method; 8) empirical comparison to other methods and 9) future developments of the method.

e-Learning can only be considered successful when it effectively aligns the approaches to learning with the use of technology and therefore technology is the medium, not the message (Ssemugabi & De Villiers, 2010). e-Learning material and environments must be effectively evaluated in terms of learning content, usability and pedagogical issues. The technology acceptance and the media richness (Section 3.9) of e-learning components also form a vital role in the design and evaluation of such learning components.

Ssemugabi and De Villiers (2010) propose a set of criteria and sub-criteria for the evaluation of web-based e-learning applications which is the amalgamation of various learning theories and usability concepts. The set of criteria or framework consists of twenty criteria or heuristics which have associated sub-criteria (Figure 5-2). The twenty criteria are characterised into three categories namely:

- Category 1: General interface usability criteria;
- Category 2: Website-specific criteria; and
- Category 3: Educational criteria (Learner-centred instructional design, grounded in learning theory).

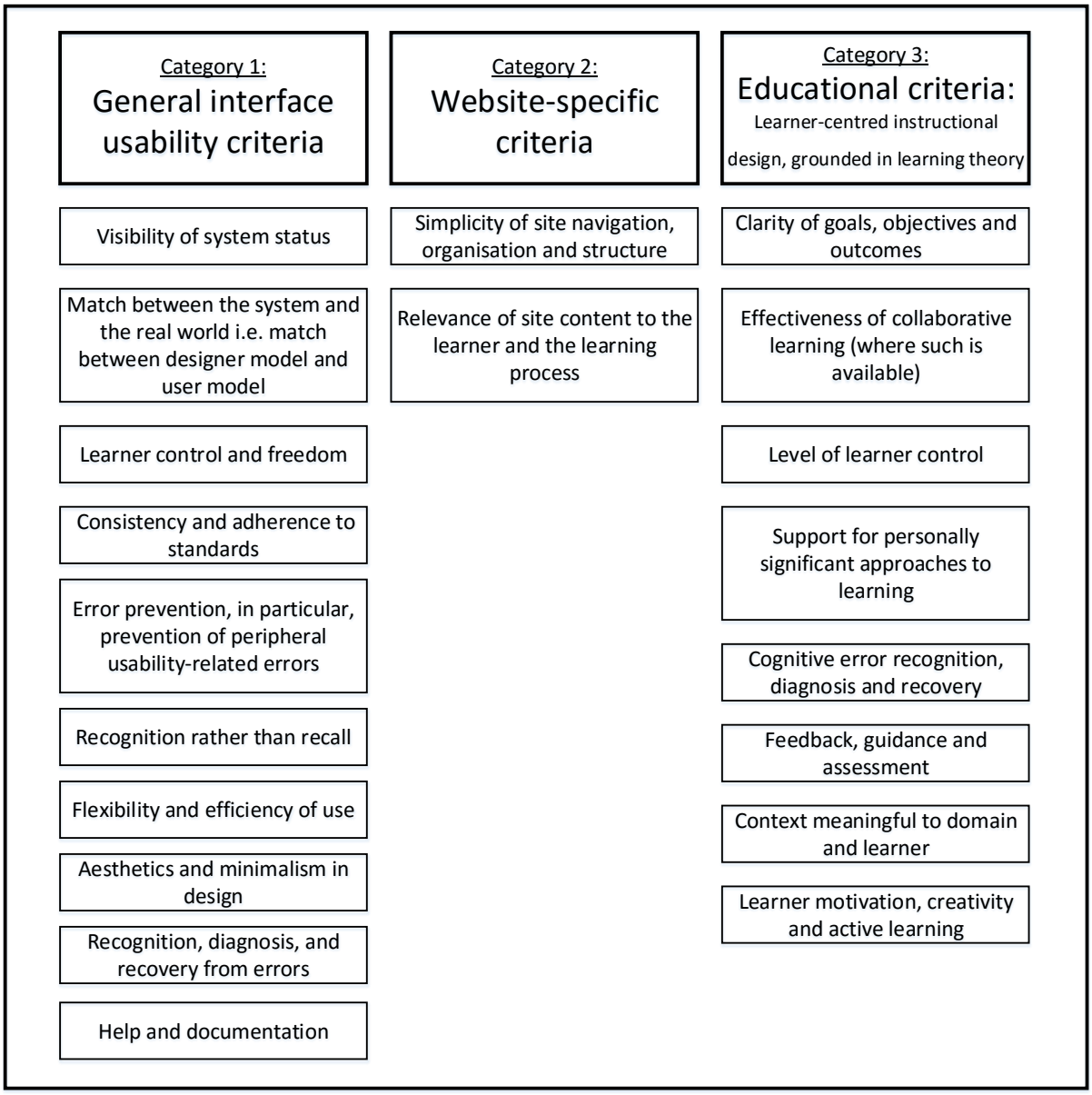

Figure 5-2: Ssemugabi and De Villiers (2010) Evaluation Criteria for e-Learning

Category 1 comprises of general interface usability criteria, based on Nielsen's (1994) heuristic and also influenced by the learning with software heuristic of Squires and Preece (1999). ***Category 2*** focuses specifically on websites. The *"simplicity of site navigation, organisation and structure"* as well as the *"relevance of site content to the learning and the learning process"* are the two website-specific criteria. ***Category 3*** identifies additional educational guidelines that are relevant in evaluating e-learning (Ssemugabi & De Villiers, 2007). The guidelines of ***Category 3*** are grounded in recent learning theories and models and their objective is to promote effective learning within educational software applications. This set of criteria along with its sub-criteria and categories aims to integrate usability with that of learning and are seen to be

appropriate in the field of web-based e-learning. The authors also stipulate that the full set of criteria does not need to be rigidly adhered to because their use will depend and be affected by the content and context of each application. In order to determine whether the criteria are appropriate, specific evaluations known as heuristic evaluations are conducted with expert users in order to identify any problems and to rank the severity of these problems.

5.5 Evaluation Plan

In this study the DBR methodology is adopted with five cycles or iterations (Sections 2.4.2 and 2.5). New components and improvements will be made throughout the study until a final environment is proposed. Within each separate cycle the DBR phases will also be evident, one of which is evaluation. The five cycles are (Figure 5-3):

1. Cycle 1: Problem Analysis of Complex Problem with Real-World Context (Section 5.5.1);
2. Cycle 2: Field Study - WRER301 2014;
3. Cycle 3: Develop Evaluation Framework and Plan;
4. Cycle 4: Develop and Evaluate [DASIK ERP course] (Section 5.5.2); and
5. Cycle 5: Develop and Evaluate [WRER301 2015] (Section 5.5.3).

Each cycle is briefly summarised in the sections to follow and a summary of all the components and criteria that are to be used has also been included (Section 5.5.4).

5.5.1 Cycles 1, 2 and 3

The cycles of this research study will not be complete versions or prototypes of the ERPeL in its entirety, but rather at different stages in its development. In **Cycle 1** the initial problem investigation was conducted and a theoretical framework was proposed (Chapter 3). In **Cycle 2** a field study was conducted to clarify the context and problems, especially focusing on the student perspective and the SYSPRO e-Learning System which was evaluated making use of PEOU and PU (Chapter 4). The development of an evaluation framework and plan is considered to be **Cycle 3** of this study (Section 5.5). Taking a rough estimate **Cycle 4** should comprise of about 70% of the environment and includes only selected components. **Cycle 5** will showcase improvements made based on feedback and present a complete, comprehensive (100%) final product.

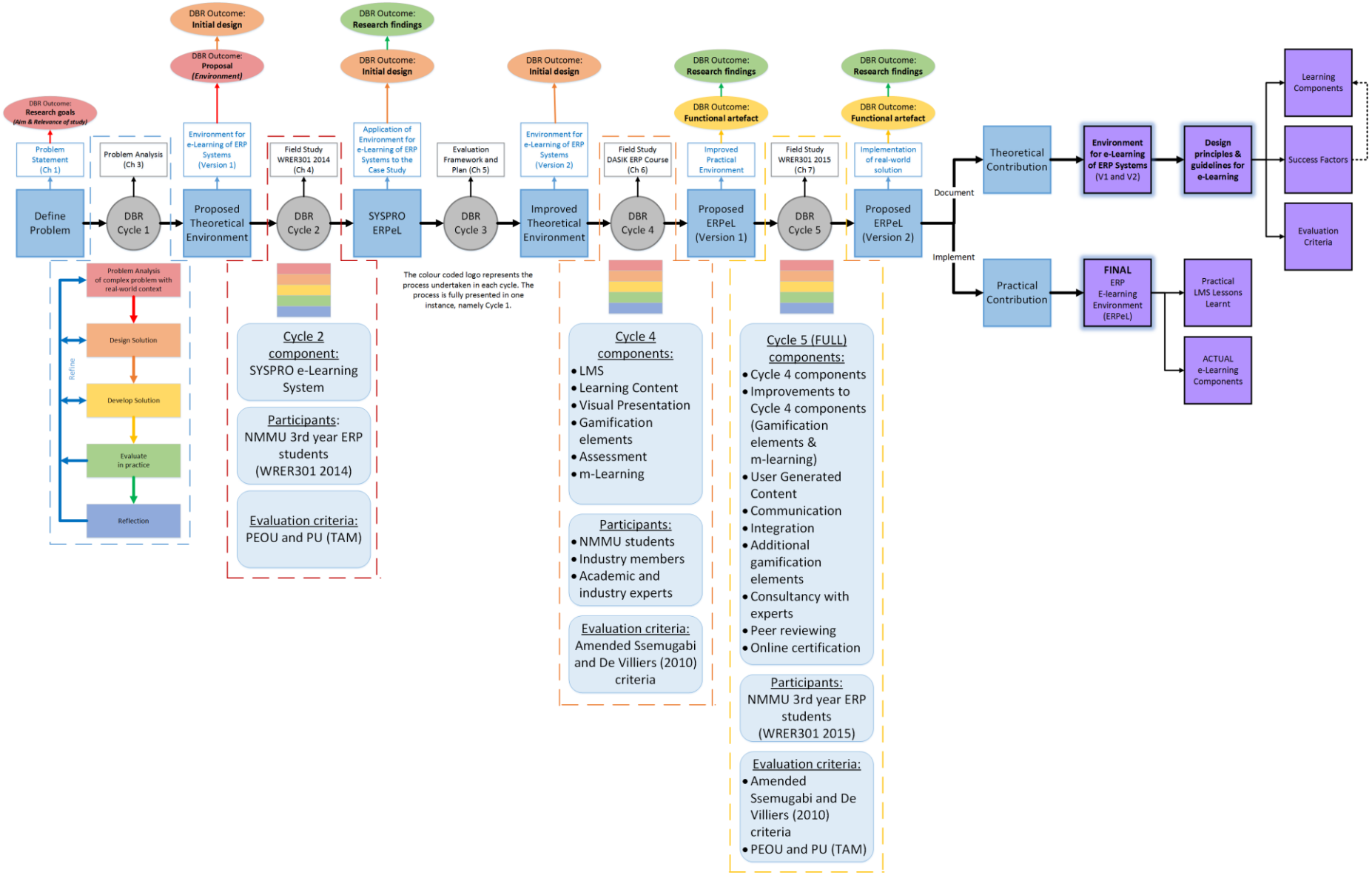

Figure 5-3: DBR Cycle 3 - Development of Evaluation Framework and Plan (Author's Own Contribution)

5.5.2 Cycle 4: Develop and Evaluate DASIK ERP course

The NMMU ERP course is also sometimes offered to industry delegates as a short course, for instance to delegates of the *Developing and Strengthening Industry-driven Knowledge-transfer between developing Countries* (DASIK) ERP course. Cycle 4 will use the participants of the DASIK Introduction to ERP systems course as the sample population. Participants will be NMMU students, NMMU academic staff and delegates from industry. In this cycle only specific components of the ERPeL will be designed, developed, evaluated and reflected on (Figure 5-4).

Cycle 4 will include the use of Moodle as the LMS, the SYSPRO e-Learning System as well as the SYSPRO Latte m-learning application (Section 4.4.3). This cycle will also look at the design, development and evaluation of visualisations in the form of videos. Other components to be implemented and evaluated are badges and assessments in the form of a standard Moodle quiz as well as a SCORM assessment. The e-learning components will be designed based on various design guidelines and considerations (Section 5.3). Data will be collected by means of questionnaires and interviews and the components will be evaluated according to the adapted set of criteria (Section 5.5.2.1). A heuristic evaluation will be conducted with experts in the field of academia and industry in order to determine if there are any problems with the proposed environments (Section 5.5.2.2).

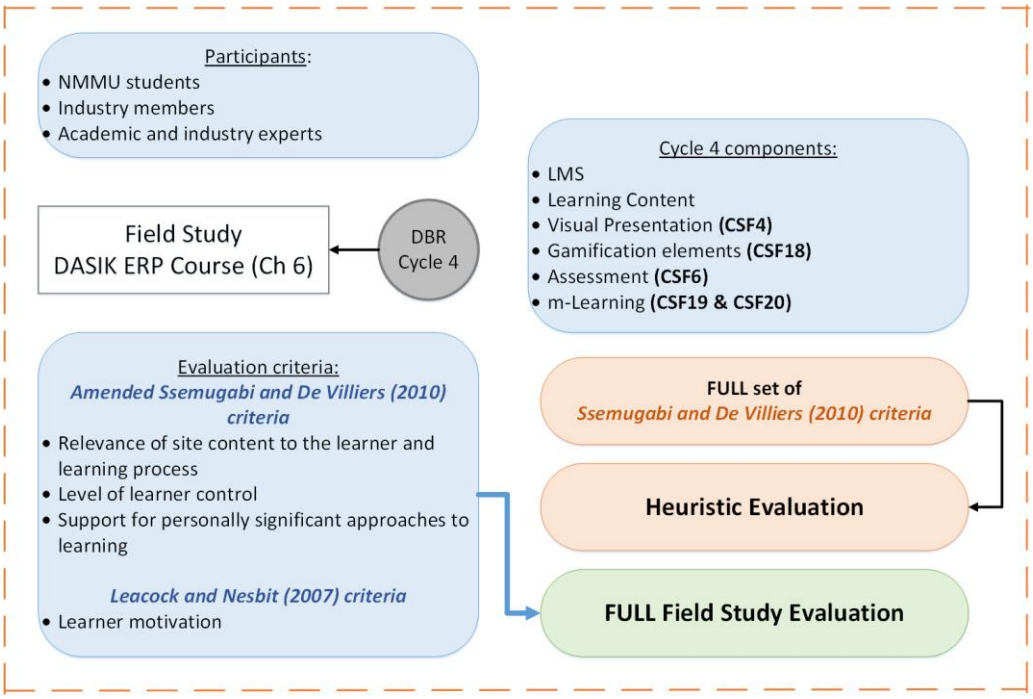

Figure 5-4: DBR Cycle 4 - DASIK ERP Course (Author's Own Contribution)

5.5.2.1 Criteria Used for Cycle 4 Evaluation

PEOU and PU was used as part of problem investigation and analysis to determine technology acceptance (Cycle 2). The TAM will not be used for evaluation purposes in this cycle, due to the fact that TAM usually only looks at technology acceptance at a high-level. Technology acceptance is not adequate on its own for evaluating interactive media and learner preferences for different types of media and learning components (Dunne et al., 2010). TAM has been shown to be inadequate for evaluating interactive media. It is extremely important that the individual components are evaluated and commented on individually in order to determine their success, thus the criteria proposed by Ssemugabi and De Villiers (2010) is seen to be more appropriate for evaluating the success of e-learning and the components. The criteria will also be supported by various open-ended questions which relate to the different components to be implemented in this cycle evaluation.

The Ssemugabi and De Villiers (2010) Category 1 criteria will not be used since they are more appropriate for evaluating general usability. Category 2 which consists of website-specific criteria can be classified as technology related and only one criterion will be used. Category 3 focuses on pedagogy and content, and two criterion will be used from this category. For the purposes of this cycle, only a subset of these criteria will be used which are found to be the most suitable in terms of what needs to be evaluated. Based on the literature review of criteria for e-learning four criteria were selected for evaluation of e-learning components in this cycle:

1. Relevance of site content to the learner and the learning process (Ssemugabi & De Villiers, 2010);
2. Level of learner control (Ssemugabi & De Villiers, 2010);
3. Support for personally significant approaches to learning (Ssemugabi & De Villiers, 2010); and
4. Learner motivation (Leacock & Nesbit, 2007).

Although the Ssemugabi and De Villiers (2010) criteria do consider learner motivation, the criterion stipulated attempts to measure learner motivation, creativity and creative learning all with one criterion (Figure 5-2). It is advised that this criterion be split into three separate criterion. Thus, for the purposes of this study it was decided to solely make use of learner motivation for evaluation purposes.

5.5.2.2 Heuristic Evaluation for Cycle 4

A heuristic evaluation will be conducted on the SYSPRO e-Learning System as well as the proposed ERPeL (Version 1). A heuristic evaluation (HE) can be defined as an "*informal method of usability analysis where a number of evaluators are presented with an interface design and asked to comment on it"* (Nielsen & Molich, 1990, p. 249). HE uses expert users as evaluators and is the most extensively used usability evaluation method (UEM) mainly because it is inexpensive and easy to apply (Ssemugabi & De Villiers, 2010). UEMs are of extreme importance when it comes to e-learning because if the application, system or environment are not easily usable, learning is obstructed and users will spend more time learning to use the system than actually learning the content.

Experts should consider the set of evaluation criteria (Figure 5-2) as suggested by Ssemugabi and De Villiers (2007) for the evaluation of web-based learning (WBL) environments when identifying problems with the specified systems and environments being evaluated. Before completing the tasks set out in the relevant task lists, participants will need to read and understand the specified heuristic. Whilst completing the tasks associated with the relevant systems and/or environments the participants will be required to list any problems they encounter in the tasks as well as rate the severity of the problems using the severity of problems scale (Appendix G).

5.5.3 Cycle 5: Develop and Evaluate WRER301 2015

Cycle 5 involves improvements being made to the Cycle 4 components from the feedback that was obtained during Cycle 4 (Section 5.5.3.1). It will also include some additional components and the extent of integration will also be increased in this cycle (Figure 5-5). The participants of this evaluation will be the NMMU third year students registered for the ERP systems module. This cycle will be conducted over a seven week period consisting of seven practical sessions. The criteria that will be used for evaluation purposes for this cycle have also been identified (Section 5.5.3.2).

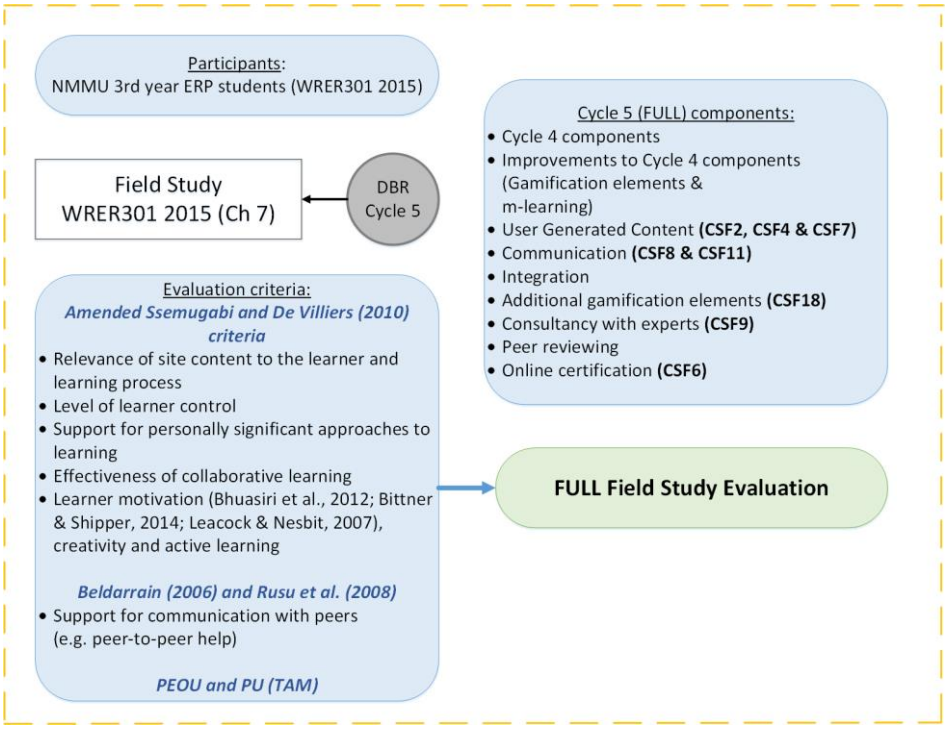

Figure 5-5: DBR Cycle 5 - WRER301 2015 (Author's Own Contribution)

5.5.3.1 Components for Cycle 5 Evaluation

Certain components used in Cycle 4 were kept as-is for Cycle 5 whilst others will be improved on based on the feedback from Cycle 4. Improvements will be made to the badges and the SYSPRO Latte m-learning application. Integration between the SYSPRO ERP system, Moodle and SYSPRO e-Learning System will be explored by creating customisable executive panes in the SYSPRO ERP system. The communication factor (CSF11) will be considered and communication methods will be investigated resulting in the adoption of live chats and forums. Competition and motivation success factors will be added with related features consisting of a leader board with the Top 5 achievers of the week. Other components that will also be included in this cycle are the peer reviewing workshop, consultancy with experts and students creating and developing their own learning content, which are all components and success factors of e-learning (Section 3.6). Data will be collected by means of online questionnaires in a variety of formats and the components will be evaluated.

5.5.3.2 Criteria Used for Cycle 5 Evaluation

For the purposes of this cycle similar criteria used in Cycle 4 (Section 5.5.2.1) will be used in this cycle as well. Two criterion mainly the encouragement of metacognition and scaffolded learning activities which fall under *'support for personally significant*

approaches to learning' were deemed inappropriate and thus will be removed from the list of criteria used to evaluate. The PEOU and PU (TAM) will also be used to evaluate specific components in this cycle (Section 3.9). The closed-ended questions will be supplemented by open-ended questions relating to the specific components. The set of evaluation criteria identified as relevant will be built on over the cycles (Table 5-1). Cycle 3 used PU and PEOU (TAM). Cycle 4 will only make use of four criteria, mostly from the criteria proposed by Ssemugabi and De Villiers (2010). Cycle 5 will then make use of a combination of the criteria used in Cycle 3 and 4 respectively. Various studies and authors (Bhuasiri et al., 2012; Bittner & Shipper, 2014; Leacock & Nesbit, 2007) have identified "learner motivation" as a criterion for evaluating e-learning. Ssemugabi and De Villiers (2010) have also identified "learner motivation" as a criterion for evaluation purposes; however, they have also included creativity and active learning in the same criterion.

Table 5-1: Evaluation Cycles Criteria Breakdown

Evaluation Cycles Criteria	Criteria
Cycle 3	1. Perceived Usefulness (PU).
	2. Perceived Ease of Use (PEOU).
Cycle 4	3. Relevance of site content to the learner and the learning process (Ssemugabi & De Villiers, 2010).
	4. Level of learner control (Ssemugabi & De Villiers, 2010).
	5. Support for personally significant approaches to learning (Ssemugabi & De Villiers, 2010).
	6. Learner motivation (Bhuasiri et al., 2012; Bittner & Shipper, 2014; Leacock & Nesbit, 2007), creativity and active learning (Ssemugabi & De Villiers, 2010).
Cycle 5	7. Support for communication with peers (e.g. peer-to-peer help) (Beldarrain, 2006; Rusu et al., 2008).
	8. Effectiveness of collaborative learning (Ssemugabi & De Villiers, 2010).
ALL	***Qualitative data***

The process of using these e-learning components and dimensions needs to be classified and presented. Learning outcomes which are effective and successful are seen to be the input of the process, which are then presented using a variety of pedagogical principles and approaches that are impacted by technology and content (components and material). Learning should occur by making use of a unique combination of pedagogical, content and technological approaches in order to achieve effective education of the target system (ERP system).

5.5.4 ERP e-Learning Environment

There are numerous components which will be designed, developed and evaluated for this study during a number of iterative cycles. A summary and overview of the e-

learning components to be used for each cycle is depicted (Figure 5-6). Along with all the e-learning components which make up and form part of the ERPeL, these components also need to be evaluated in order to determine their value and success in assisting with the learning process of ERP education. The criteria to be used in each of the cycles has also been summarised (Table 5-5).

From all the planned evaluations it can be deducted and highlighted that some of the learning components are limited in terms of available criteria that can be used to specifically evaluate these components. Most of the heuristic and evaluation criteria are at a high level and are often vague. Thus qualitative feedback can be used to collect data from the participants for several of these components. There is a need for a comprehensive and informative set of evaluation criteria for the following e-learning components:

- Assessment (e.g. standard Moodle quizzes and SCORM packages);
- Videos, visual presentation and interactive features;
- Gamification elements (e.g. badges and leader boards); and
- Mediums of communication (e.g. live chats and forums).

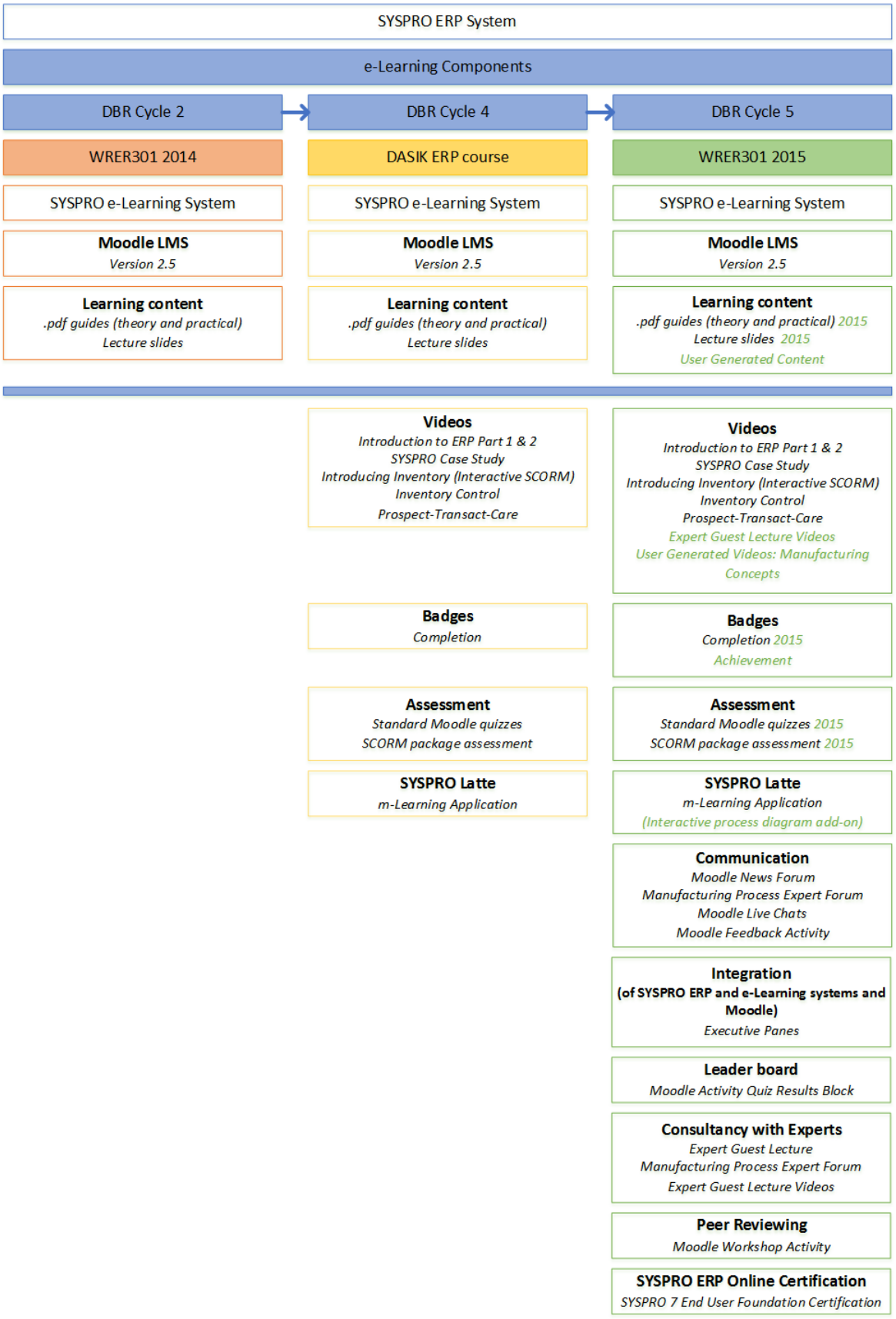

Figure 5-6: e-Learning Components Designed, Developed and Evaluated Throughout this Study (Author's Own Contribution)

Table 5-2: Evaluation Criteria and e-Learning Components: In This Study[3]

Criteria and sub-criteria	Learning Component
Technology Acceptance Model (TAM)	
1. Perceived Usefulness (PU) *e.g. I think the SYSPRO Latte m-learning app will be of use and benefit to me.*	○ SYSPRO e-Learning System ○ Videos ○ SYSPRO Latte (Cycle 5) ○ Live Chat
2. Perceived Ease of Use (PEOU) *e.g. I found the SYSPRO Latte m-learning app easy to use.*	○ SYSPRO Latte (Cycle 5) ○ Live Chat
Ssemugabi and De Villiers' (2010) Heuristic for the Evaluation of WBL Environments	
3. Relevance of site content to the learner and the learning process	
3.1. Content is engaging, relevant, appropriate and clear to learners using the Web-Based Learning (WBL) site.	○ ERPeL (Cycles 4 & 5) ○ SYSPRO Latte (Cycles 4 & 5)
3.2. The material has no biases such as racial and gender biases, which may be deemed offensive.	○ ERPeL (Cycles 4 & 5) ○ SYSPRO Latte (Cycle 4)
4. Level of learner control	
4.1. Apart from controlling the interactions with the site, learners have some freedom to direct their learning, either individually or collaboratively, and to have a sense of ownership of it.	○ ERPeL (Cycles 4 & 5) ○ SYSPRO Latte (Cycle 4) ○ User Generated Content (Cycle 5)
4.2. Learners are given some control of the content they learn, how it is learner, and the sequence of units.	
4.3. Individual learners can customise the site to suit their personal learning strategies.	
4.4. Where appropriate, learners can take the initiative regarding the methods, time, place, content and sequence of learning.	
5. Support for personally significant approaches to learning	
5.1. There are multiple representations and varying views of learning artefacts and tasks.	○ ERPeL (Cycles 4 & 5) ○ SYSPRO Latte (Cycles 4 & 5) ○ Consultancy with experts
5.2. The site supports different strategies for learning and indicated clearly which styles it supports.	○ ERPeL (Cycles 4 & 5) ○ SYSPRO Latte (Cycle 4) ○ Consultancy with experts
5.3. The site is used in combination with other mediums of instruction to support learning.	
5.4. Metacognition (the ability of a learner to plan, monitor and evaluate his/her own cognitive skills) is encouraged.	○ ERPeL (Cycle 4) ○ SYSPRO Latte (Cycle 4)
5.5. Learning activities are scaffolded by learner support and by optional additional information.	
6. Learner motivation, creativity and active learning	
6.1. The site has content and interactive features that attract, motivate and retain learners, and that promote creativity.	○ Leader board (Cycle 5) ○ User Generated Content (Cycle 4)
7. Effectiveness of collaborative learning	
7.1. Facilities and activities are available that encourage learner-learner and learner-teacher interactions.	○ User Generated Content (Cycle 4)
Learner motivation (Leacock & Nesbit, 2007)	
8. I felt that the achievement/completion badge was motivating	○ Badges (Cycles 4 & 5)
Support for communication with peers (e.g. peer-to-peer help) (Beldarrain, 2006; Rusu et al., 2008).	
9. The Live Chat sessions on Moodle allowed me to make use of peer-to-peer help	○ Live Chats

5.6 Conclusions

The evaluation plan consists of five cycles, with the third cycle being that of the development of an evaluation framework and plan, which is a key deliverable of this chapter (Section 5.5). Each cycle has its own set of unique components and criteria

[3] From Practical 4 onwards, the criteria used to evaluate the relevant components were customised to the component being evaluated.

which are to be used in evaluating the components. Ssemugabi and De Villiers' (2010) set of criteria has been used to evaluate web-based learning environments. This set of criteria is to be expanded and specifically applied to this study, since the authors have acknowledged that their criteria do not have to be rigidly adhered to.

Another key deliverable of this chapter is a set of e-learning components that can be designed and developed in order to assist with ERP education. A proposed set of evaluation criteria and learning components that are to be used in this study, but can also be applied and/or adapted to other e-learning solutions is presented. In order for the e-learning components to be properly designed and developed to assist with learning various design considerations are proposed in order to promote a successful e-learning solution.

The fifth and final cycle in the DBR process of this study will consider the improvement of the theoretical framework (Figure 3-9) as well as discuss the final and updated ERPeL. Taking the previous version of the ERPeL into consideration and the improved evaluation criteria identified, an updated ***Environment for e-Learning of ERP systems (Version 2)*** is proposed (Figure 5-7). Hence, it can be noted that throughout this study the ERPeL had gone through various stages of review and design and with each cycle it becomes more detailed and specialised to the specific problem at hand, in this case ERP education. This chapter has thus answered the following research questions:

RQ3: *What criteria can be used to evaluate the success of e-learning environments?*

RQ4: *Which e-learning components can be used to assist with ERP education?*

The next chapter will investigate the development, evaluation and discussion of a proposed ERP e-Learning Environment.

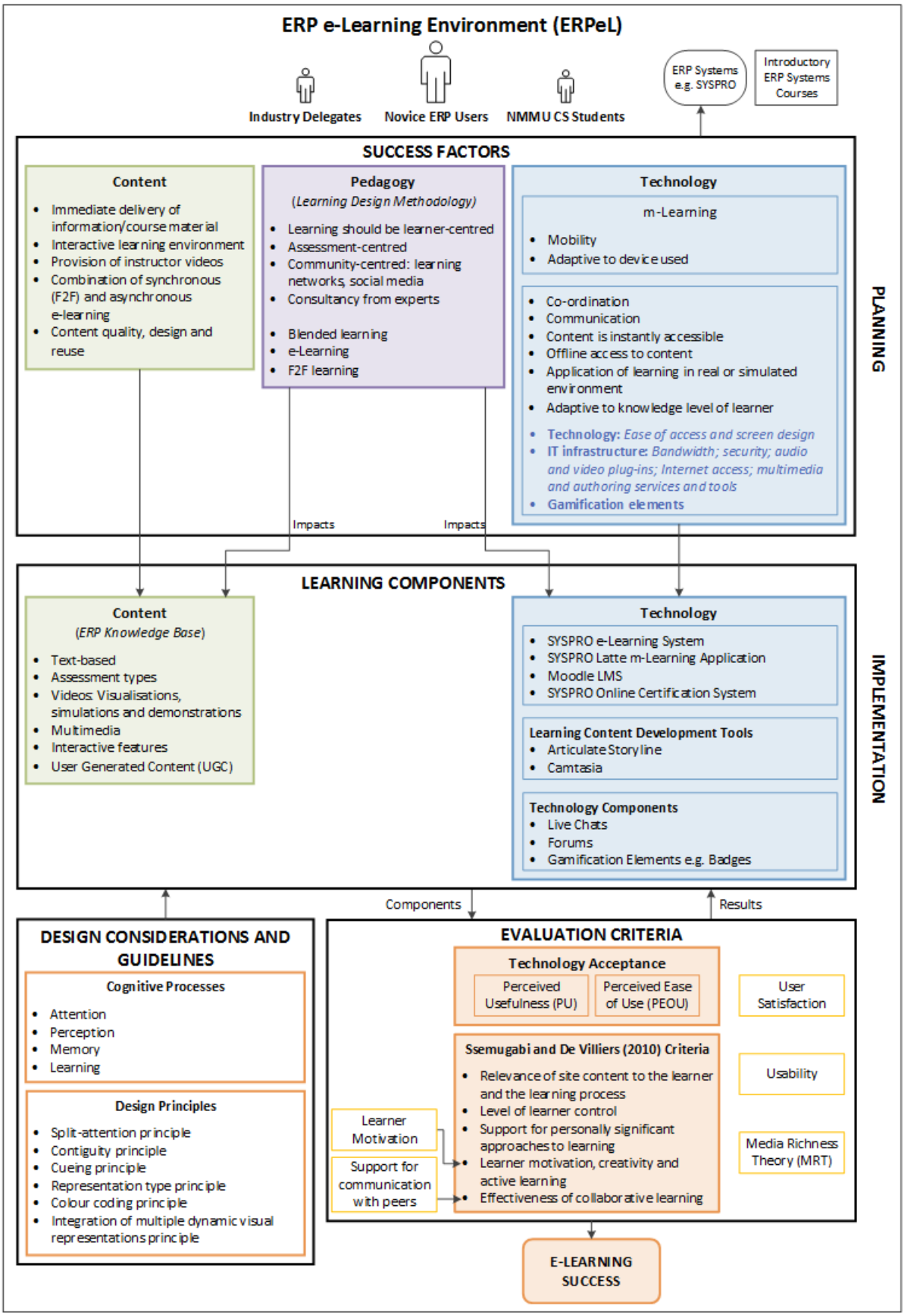

Figure 5-7: Updated Environment for e-Learning of ERP Systems (Version 2) [Author's Own Contribution]

Chapter 6. Development and Evaluation (Cycle 4)

6.1 Introduction

In the previous chapter the objectives and design considerations of the ERP e-Learning Environment (ERPeL) were discussed. This chapter focuses on Phase 3 (Develop Solution) and Phase 4 (Evaluate in practice) of the DBR methodology and will include the development and evaluation of an ERP e-Learning Environment (Cycle 4) which was guided by design principles and technology as well as its evaluation.

This chapter will address the following research questions:

RQ5: *What combination of components can present an e-learning environment which has the highest levels of success for introductory ERP systems education?*

RQ6: *How successful is the proposed ERP e-Learning Environment (ERPeL)?*

The layout of Chapter 6 and the research objectives and deliverables addressed in this chapter are shown in Figure 6-1. The relevant components that will be designed in this cycle will be discussed in the development of a proposed ERPeL solution (Section 6.2). Heuristic evaluations were conducted in order to determine any problem areas (Section 6.3). The designed and developed learning components are then evaluated in practice using the DASIK ERP course (Section 6.4). Based on the results that are obtained from the evaluations conducted, various conclusions are made and a functional ERPeL is proposed (Section 6.5).

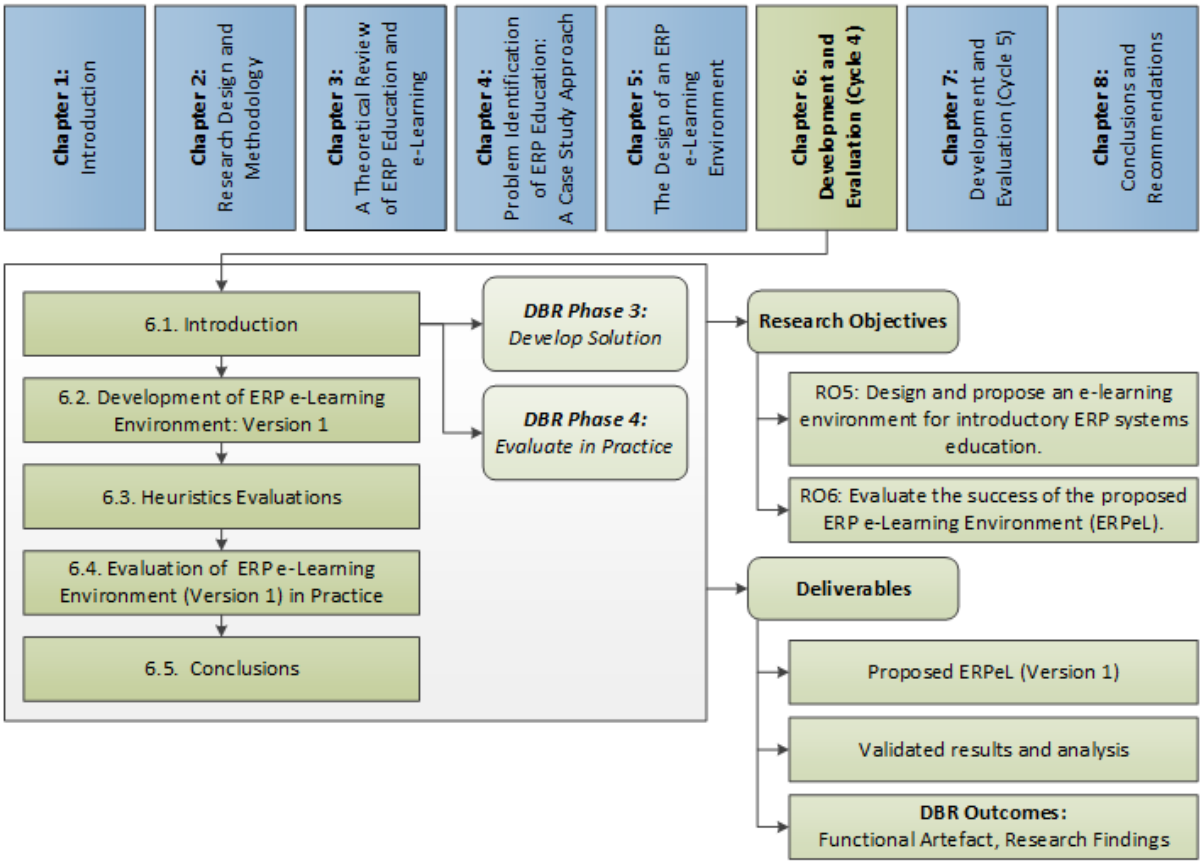

Figure 6-1: Chapter 6 Layout and Deliverables

6.2 Development of ERP e-Learning Environment: Version 1

The sample for this cycle evaluation consisted of attendees of the DASIK ERP course (both student and industry attendees). Moodle was chosen as the LMS since it is the LMS of choice at NMMU, there is no cost involved in using it and it is open-source software. The main element of the ERPeL is the LMS (Moodle), which will form part of the development of the environment and its related components. Various learning content was provided and the components for the ERPeL consisted of:

- The Moodle page (Section 6.2.1);
- Videos (visualisation) in the form of demonstrations and animated simulations (Section 6.2.2);
- Badges, an element of gamification (Section 6.2.3);
- Online assessments in the form of quizzes and SCORM assessments (Section 6.2.4); and
- The SYSPRO Latte m-learning application (Section 6.2.5).

6.2.1 Development of Moodle Page (Version 1)

The Intended Learning Outcomes (ILOs) of the ERP course were categorised according to two ERP competency categories (ERP Transactions and ERP Theory and Concepts) (Section 3.2). The ERPeL was designed to provide content that addressed all the ILOs (Tables 6-1 and 6-2). By contrast, the SYSPRO e-Learning System has limited content and resources, especially in terms of the theoretical knowledge of ERP systems.

The various learning components and content were all uploaded onto the ERP Moodle page. Content was organised into Pre-Course Work Preparation (which was mostly e-learning) and a different section on the page was allocated for each day of the course, for example Day 1. Once the attendees were enrolled they had access to the Moodle page and all communication in the form of announcements and instructions were conducted through the Moodle News Forum from which the enrolled users were sent emails via Moodle. Emails were sent so that users were able to receive communication even when they were not logged into Moodle.

6.2.2 Learning Content and Videos

Content which was given to the attendees included two ERP guides in pdf format (Part 1 and 2) which mapped onto the content covered in ERP Video 1 and 2. This gave the participants a choice depending on their learning style preferences. Therefore some of the text-based material was replaced with videos. The popularity of representing learning content visually has been reported (Section 3.8.1). Based on the ILOs of the course the following six videos were developed:

1. An Introduction to ERP Systems (Part 1);
2. An Introduction to ERP Systems (Part 2)*;*
3. SYSPRO Case Study;
4. Introducing Inventory - Interactive *(SCORM package)* (Figure 6-2);
5. Inventory Control; and
6. Prospect-Transact-Care.

Table 6-1: Intended Learning Outcomes (ILOs) - ERP Theory and Concepts Competencies

CORE ERP: ERP Theory and Concepts Competencies	ERP e-Learning Environment	SYSPRO e-Learning System
Introduction to ERP Systems (Part 1)		
1. Differentiate a business process from a business function and SCM	✓	✓
2. Define ERP systems and explain the growth and benefit of these systems	✓	ERP definition & purpose
3. Explain some potential benefits and returns for implementing an ERP system	✓	
4. Identify several challenges associated with ERP implementations	✓	
Introduction to ERP Systems (Part 2)		
1. Identify the market demand for ERP systems	✓	
2. Explain the ERP market, the tiers and some products/vendors in each tier	✓	
3. Identify the typical modules of ERP	✓	
4. Identify the elements of core and extended components of ERP	✓	
5. Describe the history and development of ERP systems	✓	
6. Compare MRP, ERP, extended ERP and ERPII and ongoing developments in ERP	✓	
7. Explain ERP for mid-sized companies and SaaS	✓	
8. Identify the factors (management and technological), that led to the development of ERP systems	✓	
9. Identify the key technical and interpersonal skills of ERP consultants	✓	
Inventory		
1. Define inventory and explain the different types of inventory (raw material, work in progress and finished goods)	✓	✓
2. Differentiate between dependent and independent demand for inventory	✓	✓
3. Explain consignment inventory, inventory in a bonded warehouse and inventory serving as a buffer	✓	✓
4. Identify the various inventory functions	✓	✓
5. Define inventory control and related inventory control activities (stock take, cycle count and stock write-off)	✓	✓

Table 6-2: Intended Learning Outcomes (ILOs) - ERP Transactions Competencies

CORE ERP: ERP Transactions Competencies	ERP e-Learning Environment	SYSPRO e-Learning System
CORE ERP: ERP Transactions Competencies		
1. The ability to create and master data and perform transactions in finance.	✓	✓
2. The ability to create and master data and perform transactions in sales.	✓	✓
3. The ability to create and master data and perform transactions in procurement.	✓	✓
4. The ability to create and master data and perform transactions in other modules.	✓	Limited

The design principles (Section 5.3.1) and cognitive processes (Section 5.3.2) were used to guide the design of these videos. Of the six videos, five were standard theory-based videos and one was an interactive video where the learning was placed in the hands of the user and they could click on specific labels and headings to expand

definitions (Figure 6-2). The idea behind the videos is that the videos would sound as if the student (listener) was having a conversation with a peer or class mate and that by giving the people talking (characters) names and faces (avatars) they could relate more easily to using the videos as learning content and a learning aid (Section 3.8.1 and 3.8.2). Students generally feel more comfortable sharing with their peers and thus development of the videos in such a way that would increase the students' eagerness and interest in learning was the main objective of these videos. If the students are able to work through the content at their own pace and in their own time, it should increase learner satisfaction and learning. With the videos, the learning process can be tailored to specific learning preferences and needs, for example, just listening to the videos, just watching (no audio) or both. Hopefully once the videos are more relatable they can have a positive impact on learning and training (Plass et al., 2009).

The design of each video included consulting a variety of resources which included previous lecture slides and notes as well as the SYSPRO e-Learning System. Once the actual content was decided on, scripts were drawn up and thereafter the slides for the video were put together. Once that was complete the audio recordings were recorded. The videos were developed using both Articulate Storyline and Camtasia. Articulate Storyline was used for the media arrangement, transitions and to record the voice-overs whereas Camtasia was used to record on-screen activities, for editing purposes and to publish the videos in MP4/WMV format.

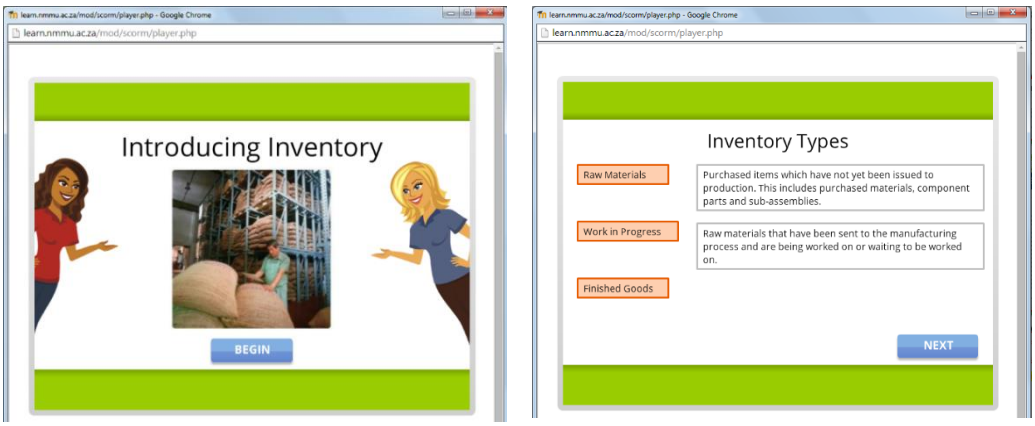

Figure 6-2: Sample Screens of Interactive ERP Video

6.2.3 Badges

Badges were created to be awarded to users if specified tasks and activities were completed. The badges were created in Microsoft PowerPoint with the use of shapes and added onto Moodle (Figure 6-3). Moodle allows for criteria to be set up for the

allocation of badges; for example, badges can be awarded for the completion for a specific set of activities.

Figure 6-3: Sample Badges for Cycle 4

6.2.4 Assessment

Three standard Moodle quizzes were developed using the Moodle templates and one SCORM assessment was developed using Articulate Storyline. The assessments were:

- Quiz 1: Introduction to ERP Systems (Part 1) - *Standard Moodle quiz with multiple choice questions* (Figure 6-4);
- Quiz 2: Introduction to ERP Systems (Part 2) - *SCORM package assessment* (Figure 6-5);
- Quiz 3: Inventory Concepts and Require-Procure-Pay - *Standard Moodle quiz*; and
- Quiz 4: Prospect-Transact-Care - *Standard Moodle quiz.*

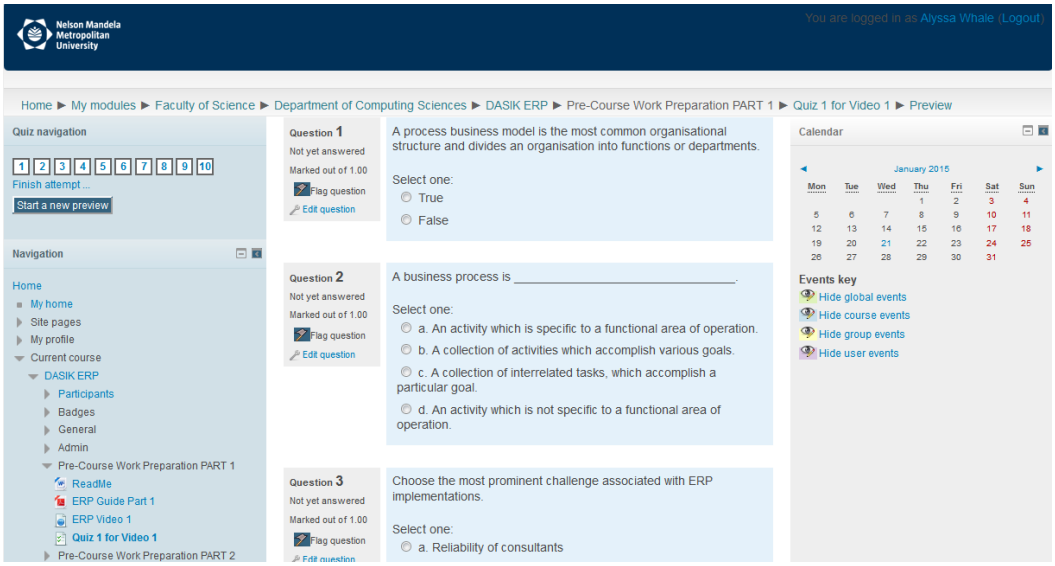

Figure 6-4: Sample Standard Moodle Quiz

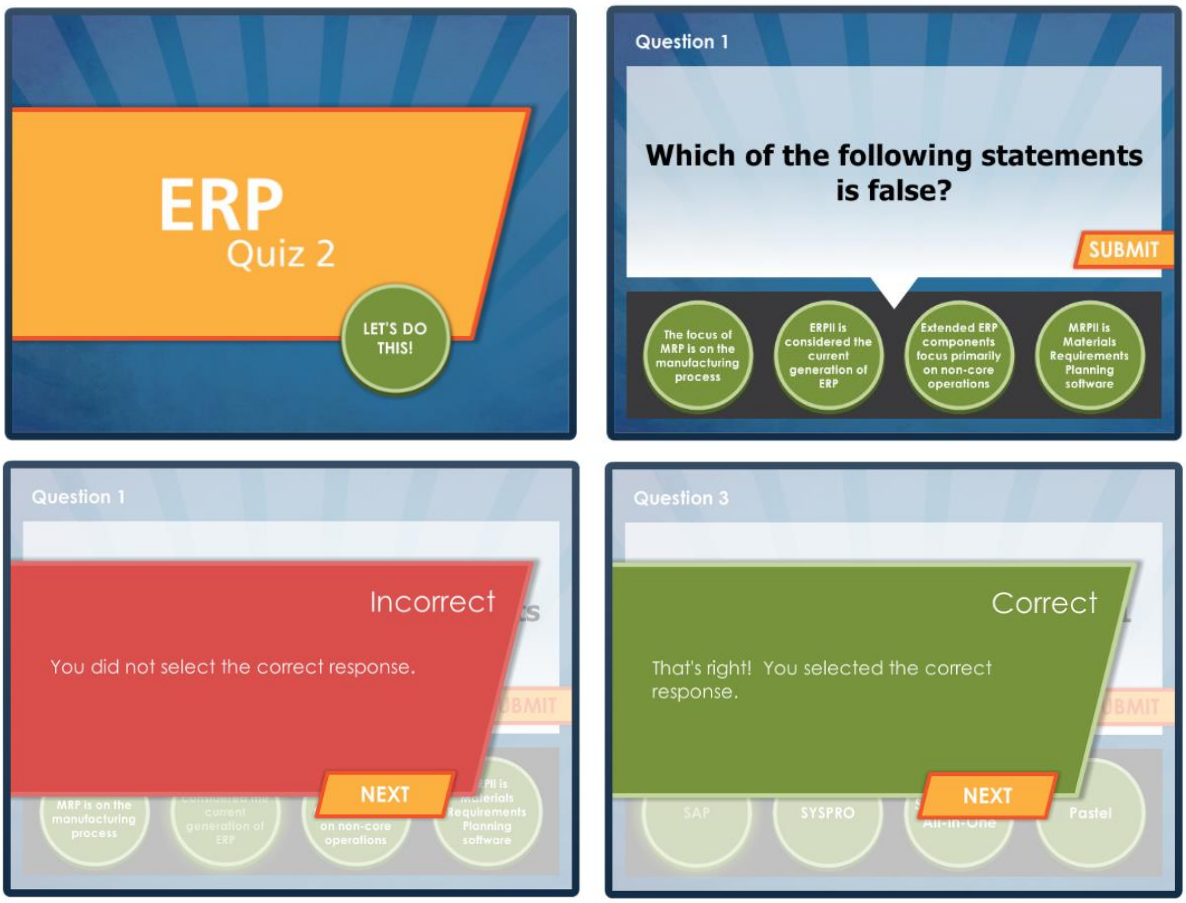

Figure 6-5: Sample SCORM Assessment Screens

A major difference between the two types of assessment is that the SCORM package gives immediate feedback whereas a Moodle quiz usually does not, unless a specific setting is enabled. In terms of actual marks and grading for the Pre-Course Work quizzes (Quiz 1 and 2), the attendees were able to attempt the quizzes as many times as they liked, so they could repeat the quiz until they achieved 100%, if they were so inclined. The quizzes, however, did not indicate the correct answers when the incorrect option was stipulated therefore marks were only given in terms of completion and not accuracy. The remaining quizzes were limited to only one attempt and that mark was recorded. One of the disadvantages with SCORM packages is that they only work properly when Google Chrome is used as the browser.

6.2.5 SYSPRO Latte m-Learning Application

It was evident from the evaluations that were conducted by Kapeso (2014) that the hands-on simulation feature of the SYSPRO Latte m-learning application was deemed to be positive (Section 4.4.3). Since interactivity is a success factor of m-learning and e-learning, the application itself can thus be considered successful. The results of the

evaluations showed that SYSPRO Latte is ideal for tablet computers; however, any smaller screen will bring about challenges. The SYSPRO Latte m-learning application is therefore incorporated into the proposed ERPeL.

6.3 Heuristic Evaluations

Heuristic Evaluations were conducted on both the SYSPRO e-Learning System (Section 6.3.1) and the new proposed ERPeL (Section 6.3.2) by two academic expert users and two industry expert users. The academic experts were senior lecturers from NMMU and the industry experts were from SYSPRO. The experts were given three documents, namely:

- Heuristic Evaluation Criteria (Appendix H) ;
- Heuristic Evaluation Task List (Appendix I); and
- Heuristic Evaluation Rating Scale.

The *Criteria* document contained a comprehensive set of heuristic as suggested by Ssemugabi and De Villiers (2007) for the evaluation of WBL environments (Section 5.3). The experts were instructed to take these into consideration when identifying problems. The *Task List* document included the outcomes, pre-requisites, tools used, ILOs as well as specific task lists for the ERPeL (Part 1) and the SYSPRO e-Learning System (Part 2). It was recommended that the experts complete Part 1 of the *Task List* document and then proceed to the *Rating Scale* document to complete the relevant tables and then return to the *Task List* document to complete Part 2. The *Rating Scale* document included the severity of problems scale[4] which was used to rate the severity of the problems encountered (Appendix G). The experts were also asked to specify the two features/aspects they liked (best features) and disliked (worst features) about both learning environments.

6.3.1 SYSPRO e-Learning System

According to Academic Expert 1, there was one catastrophe problem, three major problems, five medium problems, one minor problem and two cosmetic problems with the **SYSPRO e-Learning System** (Table 6-3). The SYSPRO e-Learning System had far more problems relating to navigation and inconsistency, than the ERPeL according to Academic Expert 1. Academic Expert 2 identified three major problems, two medium

[4] 0 = No Problem; 1 = Cosmetic Problem; 2 = Minor Problem; 3 = Medium Problem; 4 = Major Problem; and 5 = Catastrophe.

problems and one cosmetic problem with the SYSPRO e-Learning System. Generally most of the problems identified by Academic Expert 2 related to navigation, layout and design and were not related to specific tasks, but to the SYSPRO e-Learning System as a whole. Industry Experts 1 and 2 reported that there were no problems with any of the tasks for the SYSPRO e-Learning System. This could be due to the fact that they had used the SYSPRO e-Learning before, whereas the academic experts had not.

Table 6-3: Academic Expert 1's Problem Severity for the SYSPRO e-Learning System

Problem Description	Task Number	Severity Rating (0 - 5)
When clicking on a task (selected the 1st task) in the task list, there is no way to go to "previous" screen - it opens up a new browser window? Don't understand why?	6	5
Clicked on Cycle Count, then back/previous → then I was taken to Unit 8… > Tasks (where I've not been)?	6	4
Clicked on Stock write of in image; back/previous takes me to Cycle Count and not my previous screen	6	4
A clicked link turns grey - expect for cases where definitions are presented in pop-ups. No feedback to show "link" was clicked, but mouse-over is same colour to that of real links	4	3 / 4
ERP page: Did not quite expect to have to click on e.g. What is an ERP system? To have the blue block filled with text. Same with the Purpose question	4	3
Inconsistent way of explaining concepts - in some cases pop-up; in other case a blue block that is filled with text once concept is clicked		3
Inventory control handled differently - now I have to click on an image - other images were not clickable? Confusing.	6	3
Linking to previous comment - Functions of Inventory handles in yet another way?	5	3
Click on NEXT (at bottom of index page) → there is no NEXT, only an arrow →, which I assume to be next	3	2
Are the colour schemes used for mouse-over and clicked links standard for Chrome?	4	1
The "i" Click on blue bold… inconsistently placed on pages		1

Academic Expert 1 identified *"Indication of duration"* as a like/best feature of the SYSPRO e-Learning System and *"Inconsistencies - way of accessing e.g. description of concepts and placement of 'i' into*" as a negative feature. Academic Expert 2 liked the *"'Prettier' layout/colour compared to Moodle"* and *"videos played in browser"* (Table 6-4). Academic Expert 2 did not identify any dislikes. Industry Expert 1 indicated *"Ease of use"* and *"Simulations are great"* as positive features and *"Plenty tasks"* as a negative feature. Industry Expert 2 also identified *"Easy to use"* as well as *"Tasks are easy"* as positive features and *"Few unit errors where it jumps from Unit 2 to 6 then back down"* and *"Not complex enough"* as negative features of the SYSPRO e-Learning System.

Table 6-4: Academic Expert 2's Problem Severity for the SYSPRO e-Learning System

Problem Description	Task Number	Severity Rating (0 - 5)
Blue "clickys" are annoying. What is the purpose of this? Changing fonts? What for?		4
Navigation arrows move around		4
No clear/obvious way of knowing completed a unit of work		4
"Bold blue text" links change colour after first click		3
Cannot see progress through learning material (as go along)		3
Blue/grey table formatting inconsistent		1

6.3.2 ERP e-Learning Environment

According to Academic Expert 1, there were two major problems, one medium problem and three minor problems with the ERP e-Learning Environment (Table 6-5). It is evident from Academic Expert 1's feedback that problems were experienced with the badges and the videos in terms of pausing and not being able to see the duration. Academic Expert 2 identified one medium problem and one minor problem with the ERPeL. The medium problem identified was that the *"videos not playing on my browser"* and the minor problem was stated as *"do not use [Microsoft] Word documents unless really necessary. Download to open is clumsy".* Industry Expert 1 indicated that there were no problems with any of the tasks and just highlighted that *"I preferred the style of this quiz* [SCORM assessment] *to the first quiz* [Standard Moodle quiz] - *makes it fun!"*. Industry Expert 2 also indicated that there were no problems with any of the tasks for the ERPeL.

Table 6-5: Academic Expert 1's Problem Severity for the ERP e-Learning Environment

Problem Description	Task Number	Severity Rating (0 - 5)
No badge received once Part 1 completed - not sure if it was because I submitted the Quiz (Quiz 1 for Video 1) without answering questions? Received Part 2 badge upon Part 1 completion	6	4
Part 2 badge received after completing Part 1	8	4
Once form is submitted (Evaluation Form), a blank screen appears, leaving user confused - what now?	7	3
Feedback on task completed (the ✓'s in the boxes) only appear after a while, not immediately after completion	5, 7	2
Would like to be able to pause video (although there is a Resume option if video is re-opened)	5, 7	2
Would like to be able to see duration of video (or indication of # of slides) - or at least some indication of how long such an item will take to complete	5, 7	2

Academic Expert 1 stated that the ERPeL was *"easy to use, once you get to know Moodle"* and that there were a *"Variety of options available - can mix and match content offering as well as assessment types"*. Academic Expert 2 liked the *"progress tracking of task completion"* and the *"centre panel/task tracking navigation nicer than*

tree structure". Industry Expert 1 stated that the ERPeL had *"Sufficient information and had a clear understanding of what was expected"* and was *"user friendly"*. Industry Expert 2 reported that *"easy to use"* and *"good structure"* were the best features of the ERPeL.

Academic Expert 1 and Industry Expert 2 did not have any dislikes/worst features of the ERPeL. Academic Expert 2 stated that the *"Badges do not promote competition (in my opinion). Maybe rankings better for this kind of thing"*. Industry Expert 1 identified *"Certain forms were not compatible with Internet Explorer (minor)"* as a negative feature. The problems which specifically related to the ERPeL have been summarised and an indication as to what was done to correct these problems has also been specified (Table 6-6).

Table 6-6: Heuristic Evaluation: Problems and Plan of Action (Cycle 4)

Problems or Recommendations	Plan of Action
Sending and receiving of badges	• Check Moodle settings and criteria specified for the sending of badges. • Check Internet connection, could be the cause of the delays in sending out the email notifications of badges being awarded OR reflection on Moodle.
Form (URL) submission	• Might have just been a time delay, due to connection. • Add a 'thank you' message once the submission has been successful completed. • Check Moodle settings.
Task completion ticks on Moodle	• Moodle problem - out of researcher's control. • General Internet problem.
Pause and resume options on videos	• Re-visit videos and ways of adding this. • Currently videos stored in DropBox and accessed via an URL link. • Advise users to download videos and then watch using Windows Media Player.
Duration of videos	Encourage students to download the videos and watch them using Windows Media Player.

6.4 Evaluation of ERP e-Learning Environment (Version 1) in Practice[5]

For the purposes of the Cycle 4 evaluation data is mainly sourced from two questionnaires: the *Pre-Course Work Preparation Questionnaire* (Appendix J) and the *SYSPRO Latte (m-Learning) Questionnaire* (Appendix K). There were 29 attendees who attended the DASIK ERP course. These attendees had varying levels of expertise and experience in the field of ERP systems. Biographical details and experience were obtained which included statements related to their experience (computer experience,

[5] Some of the results reported on in this section were published as a full paper in a double-blind peer reviewed conference at International Development Informatics Association (IDIA) in November 2015. Whale, A.M., Scholtz, B.M. and Calitz, A.P. Components of e-Learning for Enterprise Systems' Education in Developing Countries. IDIA Conference. Nungwi, Zanzibar. **(Appendix L)**

computer literacy, knowledge of computing fundamentals) that they had to rate using a five-point Likert scale where 1 indicates *Very Poor* and 5 indicates *Very Good*. They were also asked to rate their experience and knowledge of ERP concepts and systems. Finally, they were asked to rate their knowledge of business and business processes.

The reliability of evaluation criteria was analysed making use of Cronbach Alpha coefficients (Section 6.4.1). This cycle evaluation was divided into the evaluation of the pre-course work and learning content (Section 6.4.2) and the SYSPRO Latte evaluation (Section 6.4.3). After the discussion of results, the reflection phase was conducted where various recommendations and improvements were suggested and determined (Section 6.4.4).

6.4.1 Cronbach Alpha Coefficients (Cycle 4)

Six criteria were used to evaluate the Cycle 4 components and ERPeL (Version 1). In order to determine internal reliability, Cronbach Alpha (α) coefficients[6] for the criteria were calculated. Usually a high coefficient indicates high internal consistency, whilst a low coefficient will thus indicate a low internal consistency. Thus, it can be noticed that overall reliability of the pre-course work preparation and learning content is good (α = 0.75) and the overall reliability of the SYSPRO Latte m-learning application is excellent (α = 0.91) (Table 6-7). All of the criteria have Cronbach Alpha coefficients greater than α = 0.6 which indicates that their reliability is either acceptable, good or excellent. However, the factor *"Relevance of site content to the learner and the learning process"* does not have a Cronbach Alpha coefficient since standard deviation of one of the items was equal to zero.

Table 6-7: Cronbach's Alpha Coefficients (Cycle 4)

Criteria	α	n
Relevance of site content to the learner and the learning process	0.64	24
Level of learner control	0.69	
Support for personally significant approaches to learning	0.85	
Overall *for DASIK Pre-Course Work Preparation and Learning Content*	0.75	
Relevance of site content to the learner and the learning process	N/A[7]	24 (Group n = 8)
Level of learner control	0.76	
Support for personally significant approaches to learning	0.84	
Overall *for DASIK SYSPRO Latte m-Learning Application*	0.91	

[6] α < 0.50 (Unacceptable); 0.50 - 0.59 (Poor); 0.60 - 0.69 (Acceptable); 0.70 - 0.79 (Good); 0.80 + (Excellent) **(Venter, 2015)**

[7] Two items of which one item has the same response for all cases (S.D. = 0)

6.4.2 Pre-Course Work and Learning Content Evaluations (Cycle 4)

The pre-course work preparation of the DASIK ERP course required the attendees to complete certain tasks using an e-learning approach before attending the actual course. An evaluation was conducted on the e-learning components used and data was collected in the form of an online questionnaire (Appendix J). Of the 29 attendees, 24 of them consented to participate in the study. Of the 24 consenting attendees 11 were NMMU students, seven were industry ERP users and six were NMMU academic staff (Figure 6-6).

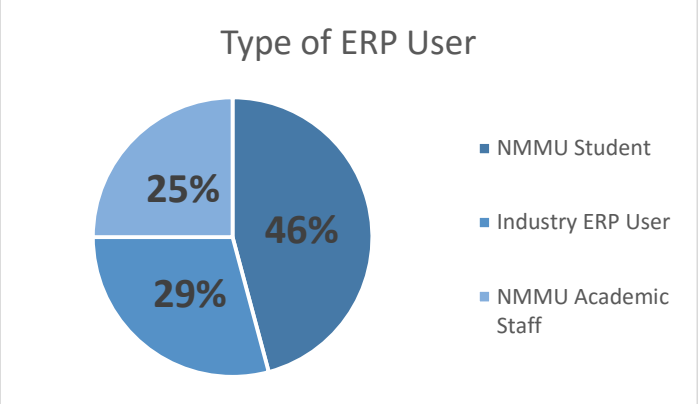

Figure 6-6: Student Industry Split - Type of ERP User in Attendance

The attendees were asked to indicate their years of ERP experience as well as their years of IT experience (Figure 6-7). In terms of ERP experience the majority (88%) of the attendees had no experience or between one to three years of experience and thus they can be classified as novice users. In terms of IT experience there were more attendees (n = 7; 29%) with seven or more years of IT experience. Only a limited number (n = 3) indicated that they had no IT experience (0 years).

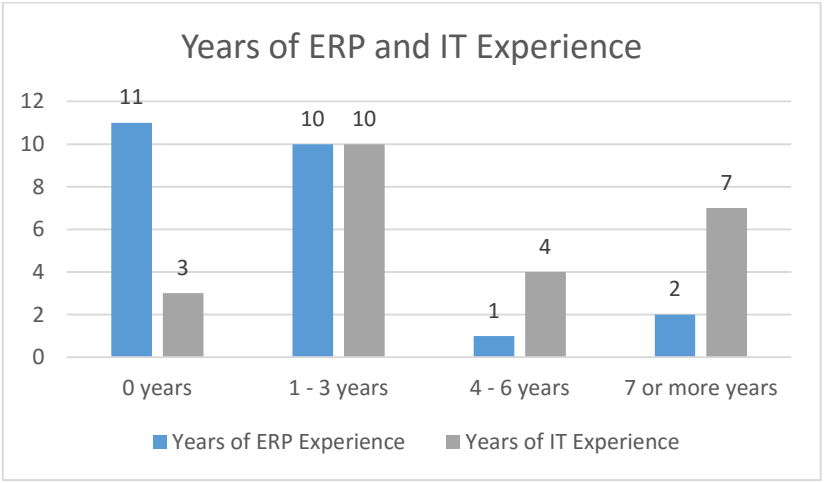

Figure 6-7: DASIK ERP Course Years of Experience - ERP and IT

The evaluation questionnaire consisted of the following sections:

- ERPeL's learning content;
- Types of assessments;
- Videos (visual presentation);
- Badges; and
- Overall ERPeL.

The attendees had to rank the ERPeL's learning content according to 11 criteria (Figure 5-4) which were classified into three categories, namely: 1) relevance of site content to the learner and the learning process; 2) level of learner control; and 3) support for personally significant approaches to learning. Ranking was done by making use of a seven-point Likert scale where 1 represented *Strongly Disagree* and 7 represented *Strongly Agree*. The following statistical ranges were applied: negative [1 to 2.71), neutral [2.71 to 5.29] and positive (5.29 to 7][8].

The highest ranking criterion for the DASIK pre-course work preparation and learning content, with specific reference to the ERPeL was the fact that the material does not have any biases (μ = 6.71) (Table 6-8). The second highest criterion was the engagement, relevance, appropriateness and clarity of content on the ERPeL which was rated positively (μ = 6.21). The lowest rated criterion was in fact the customisation of the site for personal learning strategies, which was seen to be neutral (μ = 4.58). It can thus be noticed that the assessment of the ERPeL's learning content was positive for most of the criterion evaluated.

In terms of central tendency and dispersion, for the criteria *"Relevance of site content to the learner and the learning process"* the majority of scores in this category were positive, with the last 25% of the scores from *Somewhat Agree* (5) to *Agree* (6). For the *"level of learner control"* criteria the ranges of central tendency and dispersion were greater than those of the first criteria mentioned, the scores were between neutral and positive. The third criteria, *"Support for personally significant approaches to learning"* also had scores ranging from neutral to positive. The full set of central tendency and dispersion data is included in Appendix M.

[8] **[** indicates starting from and including
) indicates up until, but not including

Table 6-8: Cycle 4 Pre-Course Work Preparation Descriptive Statistics (n = 24)

CYCLE 4: PRE-COURSE WORK PREPARATION AND LEARNING CONTENT	Mean	Standard Deviation
Relevance of site content to the learner and the learning process	**6.46**	**0.64**
Content is engaging, relevant, appropriate and clear to learners using the WBL site.	6.21	0.72
The material has no biases such as racial and gender biases, which may be deemed offensive.	6.71	0.55
Level of learner control	**5.52**	**1.03**
Apart from controlling the interactions with the site, learners have some freedom to direct their learning, either individually or collaboratively, and to have a sense of ownership of it.	5.83	0.96
Learners are given some control of the content they learn, how it is learned, and the sequence of units.	5.83	0.96
Individual learners can customise the site to suit their personal learning strategies.	4.58	0.97
Where appropriate, learners take the initiative regarding the methods, time, place, content, and sequence of learning.	5.83	1.24
Support for personally significant approaches to learning	**5.64**	**0.89**
There are multiple representations and varying views of learning artefacts and tasks.	5.25	1.03
The site supports different strategies for learning and indicates clearly which styles it supports.	5.38	1.17
The site is used in combination with other mediums of instruction to support learning.	5.79	0.78
Metacognition (the ability of a learner to plan, monitor and evaluate his/her own cognitive skills) is encouraged.	5.96	0.69
Learning activities are scaffolded by learner support and by optional additional information.	5.83	0.76

Questions were posed which related to the **types of assessments** and which type of assessment the participants preferred. The majority (67%) indicated the *Normal* [standard] *Moodle Quiz (Quiz 1 for Video 1)* and the rest indicated the *SCORM Assessment (Quiz 2 for Video 2)* (33%). The participants were also asked to indicate why they made this choice. Where thematic analysis was possible and viable it was used in analysing the results and findings of this questionnaire. In terms of the likes and dislikes the frequency of responses (*f)* for each theme were identified.

Those participants who preferred the *Standard Moodle Quiz* had chosen this type of assessment because it consistently showed them their progress in a particular quiz and participants were able to re-visit, go back, skip and change answers ($f = 5$) before submitting for grading. Moodle quizzes also allowed participants to view their marks after completing the quiz numerous times and users were able to review the actual quizzes, sometimes even indicating the incorrect answers with the correct answers being identified. Some participants felt that the standard Moodle quiz was easy to use and preferred its layout to that of the SCORM package and that was their reasoning behind choosing the standard Moodle quiz.

Those participants who said the *SCORM Assessment* was their preferred type of assessment reported several reasons for this. One reason was the immediate feedback provided since after each question it could be seen whether the answer was correct or incorrect. Another reason reported was the theme, style and colours used and the subtle humour on the last screen, “Get me out of here!”. The fact that the SCORM Assessment was interactive and that users could focus on one question at a time and did not have to rely on memory was another reason why preference was given to the SCORM Assessment as opposed to the standard Moodle quiz. One participant stated that this type of assessment was more challenging than that of the standard Moodle quiz. One participant stated that “*A combination of the visual appeal of SCORM together with the answering style of Moodle would be ideal*” which would be the best of both worlds, combining the strengths of both types of assessment into one unique assessment type.

The participants were asked to list one feature they liked about the standard Moodle quiz and one feature they disliked (Table 6-9). A positive feature was the fact that users are able to re-visit, go back, skip and change answers (*f* = 7), which confirms the reasons for selecting a standard Moodle quiz as their preference. Other common likes identified were the feedback that is received after a quiz has been graded (*f* = 5) and that it is easy to use (*f* = 5). In terms of negative features of the standard Moodle quiz some felt that the interface was visually lacking, boring and could use more colour (*f* = 6).

Table 6-9: Positive and Negative Features of Cycle 4 Standard Moodle Quizzes (n = 24)

Positive Features		
Themes	***f***	**Sample comments**
Re-evaluate	7	*Ability to revise and\or change my answers before final submission*
Feedback	5	*Feedback at end of quiz*
Easy to use	5	*Easy to follow*
Negative Features		
Themes	***f***	**Sample comments**
Interface	6	*The interface is somewhat boring*

The participants were asked to identify one like and one dislike of the SCORM assessment (Table 6-10). The positive features identified were the fact that the SCORM assessment’s interface is more appealing (*f* = 6) in terms of colours and layout as well the interactive (*f* = 5) nature of this type of assessment and the fact that

it adds the element of fun (*f* = 3). The theme that had the highest frequency of responses for negative features was that answers could not be re-visited, skipped or changed (*f* = 5). The fact that the users did not know where they were in the quiz in terms of progress (*f* = 2) was disliked as well as the fact that this type of assessment gave immediate feedback (*f* = 2). It is important to note that immediate feedback regarding the assessments was viewed positively by five participants and negatively by two.

Table 6-10: Positive and Negative Features of Cycle 4 SCORM Assessment (n = 24)

Positive Features		
Themes	***f***	**Sample comments**
Interface	6	*Visually stimulating*
Interactive	5	*It is very interactive*
Fun	3	*Fun to use*
Negative Features		
Themes	***f***	**Sample comments**
Cannot revisit answers	5	*The fact that you could NOT go back and check your answers before submitting. You had NO option to skip a question and come back to it*
Progress	2	*I am not aware of the length of the quiz. I prefer to know where I am in terms of progress*
Immediate feedback	2	*Knowing immediately that I have received wrong answers made me feel a little bit intimidated*

Assessment of the videos (visual presentation) was conducted by posing the question of listing two features they liked and disliked about the ERP videos (Table 6-11). Some of the popular likes with regard to the videos included the clear quality of the audio (*f* = 6), the fact that the voices changed with the topics/sections (*f* = 6) and also the pace (speed) of the content (*f* = 5). Additional likes included the characters (avatars), the graphics and general overview of the content and slides and the fact that the videos were downloadable. There were some features which some participants viewed in a positive light and others were disliked. For example some did not like the voices (*f* = 3) and the presenters (*f* = 5) and thought they spoke in a monotonous voice and lacked presentation skills. Additional dislikes were the duration of the videos and the voice content which sounded too scripted. Another negative feature reported was the fact that there was no pause or rewind feature, which was also previously identified as a problem in the heuristic evaluation (Section 6.3).

Table 6-11: Positive and Negative Features of Cycle 4 Videos (n = 24)

Positive Features		
Themes	***f***	**Sample comments**
Clear audio	6	*Voice recordings clear and easy to listen to*
Voices	5	*Change in characters and voices per section*
Pace of content	5	*Both videos were short and clear*
Negative Features		
Themes	***f***	**Sample comments**
Presenters	5	*Presentation skills of presenters*
Voices	3	*Irritating voices at the end* *Mono tone voice that they used*

Participants were asked whether they liked the idea of working towards a **badge** (reward). The majority of participants (88%) responded *Yes*, with only three participants responding negatively. The participants were also asked in terms of working towards the badge whether they agreed with the following statements: 1) I was motivated by myself (self-motivation); 2) I was motivated by my peers and 3) I like the idea of adding some type of competition. The participants were able to select more than one option. The majority (79%) of the participants selected option 1, followed by option 3 (42%) and only eight percent selected option 2. Thus, it can be deduced that this group of individuals was self-motivated as opposed to peer-motivated and like some competition.

The participants were asked to identify one feature they liked about the badges as well as one feature they disliked (Table 6-12). Motivation (*f* = 5) was seen as a positive feature of the badges. Other positive features were the sense of completion (*f* = 5) and achievement (*f* = 3). There were also participants who did not identify any positive features of the badges (*f* = 3). There were participants who did not like being awarded badges just on completion (*f* = 2). Other dislikes were the fact that you were emailed once you received a badge, badge image was slow to download, they felt pressurised to get a badge, they did not want a badge and it served no purpose.

Table 6-12: Positive and Negative Features of Cycle 4 Badges (n = 23)

Positive Features		
Themes	***f***	**Sample comments**
Motivation	5	*It was motivational and kept me going*
Completion	5	*It acts as a marker to ensure that I completed everything I was supposed to*
Achievement	3	*Some form of achievement for something you would usually just do and would not get any recognition for*
Negative Features		
Themes	***f***	**Sample comments**
Just for completion	2	*The idea that it is simply for submitting and not related to a level of achievement diminishes the value of the idea of badges*

The participants were asked their preference in terms of the method of instruction, teaching and learning. More than half 58% (n = 14) of the participants selected *This ERP e-Learning Environment* and 42% (n = 10) indicated a *F2F (traditional) Environment*. The participants were given the opportunity to make additional comments, related to the ERPeL (Table 6-13):

Table 6-13: Additional Comments for Cycle 4 (n = 23)

Additional comments	**Quote**
Scoreboard - highest to lowest scores	*To motivate students I would have a list of all the participants taking part in the e-learning [environment] and grade them [based on] the marks they got in the questions to be seen by everyone and show them in highest to lowest scores. This motivates students a lot because no one wants to be in the last position.*
More readily available written material	*I would include more written material which is readily available.*
Links to other (additional) videos and sources	*It think the e-learning environment could provide links to other videos or sources of importance in the area.*
More questions (quizzes)	*Have more questions per segment of a video.*

One participant said that the use of incentives such as badges should be more carefully considered because they can possibly diminish and/or hamper as opposed to positively affecting the learning process.

6.4.3 SYSPRO Latte Evaluation (Cycle 4)

Although, SYSPRO Latte has already been previously evaluated, it has not been evaluated as part of this proposed e-learning environment. Thus, SYSPRO Latte is considered to form a vital component of the e-learning environment, specifically focusing on the component of m-learning. The SYSPRO Latte m-learning application was also evaluated by means of an online questionnaire (Appendix K). For the Cycle 4 evaluation, the 29 DASIK ERP course participants were divided into groups and each group was given a tablet computer with SYSPRO Latte pre-loaded. There were eight groups with group sizes ranging from two to five members. The groups were asked to work through the various components of the application as follows:

- Read the theoretical content;
- Watch the videos;
- Work through the hands-on simulation; and
- Complete the evaluation questionnaire.

The attendees had to rank the m-learning application in terms of the criteria for e-learning components (Table 5-3). Ranking was done by making use of a seven-point Likert scale where 1 represented *Strongly Disagree* and 7 represented *Strongly Agree*. The following statistical ranges were applied: negative [1 to 2.71), neutral [2.71 to 5.29] and positive (5.29 to 7]. The attendees were also asked to identify two features they liked about the SYSPRO Latte m-learning application and two features they disliked.

The statement addressing “the material has no biases” was the highest positively rated item (μ = 7.00) with a perfect score of seven from all groups (Table 6-14). This was followed by “metacognition is encouraged” (μ = 6.50) and that the site is used in combination with other mediums of instruction (μ = 6.50) which were both positively rated. The highest ranking criteria category was “relevance of the site content to the learner and the learning process” which had a positive mean rating (μ = 6.38). The lowest ranked criterion was the customisation of the site for personal learning strategies (μ = 5.25) and is a neutral rating.

In terms of central tendency and dispersion (Appendix N), the scores of all three criteria categories were between neutral and positive. All criteria were rated positively and this confirms that the m-learning application was successful and well received by the sample and that it is an important component of the ERPeL.

The common *positive features* identified by the participant groups were ease of use and that the app allows learning to be self-paced (Table 6-15). Other likes were its interactivity, mobility and usability. On the other hand, some common themes for *negative features* were the size of writing and content and that there is no zoom capability.

Table 6-14: Cycle 4 SYSPRO Latte Descriptive Statistics (n = 8)

CYCLE 4: SYSPRO LATTE M-LEARNING APPLICATION	Mean	Standard Deviation
Relevance of site content to the learner and the learning process	**6.38**	**0.58**
Content is engaging, relevant, appropriate and clear to learners using the WBL site.	5.75	1.16
The material has no biases such as racial and gender biases, which may be deemed offensive.	7.00	**0.00**
Level of learner control	**5.78**	**0.89**
Apart from controlling the interactions with the site, learners have some freedom to direct their learning, either individually or collaboratively, and to have a sense of ownership of it.	5.88	1.13
Learners are given some control of the content they learn, how it is learned, and the sequence of units.	6.00	0.93
Individual learners can customise the site to suit their personal learning strategies.	5.25	1.49
Where appropriate, learners take the initiative regarding the methods, time, place, content, and sequence of learning.	6.00	1.07
Support for personally significant approaches to learning	**6.18**	**0.71**
There are multiple representations and varying views of learning artefacts and tasks.	5.75	1.04
The site supports different strategies for learning and indicates clearly which styles it supports.	5.75	1.16
The site is used in combination with other mediums of instruction to support learning.	6.50	0.76
Metacognition (the ability of a learner to plan, monitor and evaluate his/her own cognitive skills) is encouraged.	6.50	0.53
Learning activities are scaffolded by learner support and by optional additional information.	6.38	0.92

Table 6-15: Cycle 4 SYSPRO Latte Evaluation Likes and Dislikes

Group	Likes	Dislikes
1	• It is easy to use • It is very informative	• The writing is too small, there should be an enlarge feature • Lack of controls to control what you can do
2	• Easy to use. Mobile • Self-paced and user friendly	• Need more simulations • More complex
3	• The learner can select the functions he or she wants to begin with • No section of learning is thrust upon the user	• The evaluation is almost childish in its attempts to get you to click buttons without thinking or learning anything
4	• Mobility	• Not easy to use
5	• The instructions were clear, easy to use and it was appropriately set up • It gave a good demonstration and support for learning	• The use of the touch screen had a few issues regarding the size and ability to use it • It didn't have much detailed information or links
6	• Interactivity • Simulation	• None
7	• The use of graphical interface helps with the following of instructions • It is simplistic software. It is essential for accounting system.	• Touch screen
8	• Usability • Performance	• None

6.4.4 Reflection

From all the findings and feedback, overall conclusions can be made as well as a list of recommended improvements which can be taken into consideration and improved on for the next cycle evaluation.

6.4.4.1 Course Evaluation and Feedback

Of the 29 attendees, 19 attendees completed the final course evaluation. The attendees were asked to indicate how useful they found the e-learning platform (Moodle) which was used in the module by using a five-point Likert scale where 1 indicated *Not useful* and 5 indicated *Very useful*. On average the attendees found that the e-learning platform, specifically Moodle was indeed useful (μ = 4.47).

The attendees were also asked: 1) if they felt their knowledge of the ERP domain was increased and 2) if they recommend that this course be presented in a similar format in the future using a five-point Likert scale where 1 indicated *Not at all* and 5 indicated *Greatly/Definitely*. Generally, the attendees felt that their knowledge had significantly increased in the domain of ERP (μ = 4.37). The mean rating for recommending the course format for the future was in the positive range (μ = 4.37), confirming that the ERPeL was successful. One attendee stated that the videos were clear and useful and said that *"Moodle used in conjunction with lectures was a good combination (reviewing when at home)".* One attendee said that *"I really enjoyed the way the course was presented. It catered to a multitude of learning styles and I think the marks should reflect the effectiveness thereof."*

6.4.4.2 Recommended Improvements

From the feedback received, the following improvements to the ERPeL can be recommended:

- New, improved badges;
- Consider using badges for achievement and not just for completion;
- Add an instruction section at the top of the Moodle page, for example *"Use Google Chrome for SCORM packages"*;
- Split the pages for the standard Moodle quizzes, for instance have one question per page;
- Facilitate more group discussions and encourage participation in forums;
- Send out emails for incomplete and outstanding Moodle tasks; and
- Provide zoom capability for SYSPRO Latte.

Problems were identified relating to delayed completion ticks on Moodle for completed activities, however, this is a Moodle issue which thus cannot be changed and/or improved by the researcher. Comments such as the videos not having a pause or

rewind option will be addressed in that an information section will be included at the top of the Moodle page. This page will include instructions about which browser to use, in this case Google Chrome, together with any software installs which are required for full functionality of the Moodle page and the various components. Learners will be advised to download the videos and open them using Windows Media Player which will allow for pause and rewind capabilities and will indicate the progress and duration of the videos. The comments that were made requesting more videos and interactive-simulations are encouraging because they confirm that the users like these components. However, due to time constraints, no more videos will be created in this study. Recommendations which will not be implemented in this study, but could be future work are a badge scoreboard and ranking students from highest to lowest.

6.5 Conclusions

In this chapter various learning components were developed consisting of the initial environment (Section 6.2.1), learning content and videos (Section 6.2.2), badges (Section 6.2.3), assessment (Section 6.2.4) and the SYSPRO Latte m-learning application (Section 6.2.5). Many of the problems identified in the heuristic evaluations were Moodle specific settings which needed to be checked again or Internet connections problems. All issues were considered and dealt with efficiently in order for smooth implementation and evaluation in the DASIK ERP course. In general, mostly minor and medium problems were identified by the experts.

The components of the ERPeL were evaluated making use of online questionnaires and an adapted set of Ssemugabi and De Villiers (2010) criteria. The criteria that were measured and evaluated are considered to be reliable (Section 6.4.1). From the results it can be concluded that the ERPeL was positively received by the participants. This chapter was able to answer research questions five and six:

RQ5: *What combination of components can present an e-learning environment which has the highest levels of success for introductory ERP systems education?*

RQ6: *How successful is the proposed ERP e-Learning Environment (ERPeL)?*

Although the ERPeL was very positively rated by this sample group, some problem areas and recommendations were also identified. The problems where no changes will be implemented (Table 6-16), the problems which will be changed and addressed for the next cycle (Table 6-17) and future recommendations (Table 6-18) experienced

in this cycle have been summarised. The way in which they are to be approached and handled have also been stipulated in a plan of action for each problem or recommendation identified.

Table 6-16: Problems (NO Change) and Plan of Action (Cycle 4)

Problems ***(Negative features)***	**Component**	**Plan of Action**
Combining the visual appeal of SCORM together with the answering style of Moodle	Assessment	Leave as-is, since assessment will not be the focus of the next cycle.
Interface: Visually lacking, boring and could use more colour	Assessment: Moodle Quizzes	Nothing can be done to change the default Moodle layout, apart from adding headings and labels or deciding to put all questions on one page or each question on a new page.
No immediate feedback		Moodle does not allow feedback after each question.
Presenters' voices	Videos	Out of researcher's control, cannot change someone's voice.
Length of videos		There is a great deal of content to work through, thus the videos will be long. Future videos can be split up to take time into consideration.

Table 6-17: Problems (Change for Next Cycle) and Plan of Action (Cycle 4)

Problems ***(Negative features)***	**Component**	**Plan of Action**
More questions (quizzes)	Assessment: Suggestion	Investigate adding more questions to the quizzes. Consider making use of pools of questions where each student will complete a unique set of questions within a Moodle question bank.
Revisiting, skipping questions and modifying answers	Assessment: SCORM	Make use of more Moodle quizzes.
Quiz progress		
No pause or rewind features	Videos	Encourage students to download the videos and watch them using Windows Media Player.
Just award based on completion	Badges	Explore the use of different kinds of badges, for example also award badges for achievement.
Poor image of the badges		Create new designs for the next cycle. Improve quality and correct size of badge images.
Font size - enlarge feature, zoom capability (also recommendation)	m-Learning App (SYSPRO Latte)	Consider requesting that the developer make some improvements to SYSPRO Latte.
Need for more simulation and more complexity		
Scoreboard - highest to lowest scores	Suggestions	Consider implementing a leader board.
More readily available written material		Provide students with additional learning material, for example current and relevant journal papers and conference proceedings.
Links to other (additional) videos and sources		

Table 6-18: Future Recommendations and Plan of Action (Cycle 4)

Recommendations	Component	Plan of Action
New, improved badges Consider using badges for achievement and not just for completion	Badges	*See badges comments in Table 6-17.*
Add an instruction section at the top of the Moodle page, for example “Use Google Chrome for SCORM packages”	Moodle	Will add a general information/instructions section at the top of the Moodle page.
Split the pages for the standard Moodle quizzes, for instance have one question per page	Assessment: Moodle Quizzes	Setup Moodle quizzes where one have every question on a new page and others with all the questions on the same page. Get feedback from the participants as to which layout they prefer and proceed from there.
Facilitate more group discussions and encourage participation in forums	Communication	Explore the use of Moodle forums, live chats and additional forms of communication.
Send out emails for incomplete and outstanding Moodle tasks		Will not be able to automatic something like this on Moodle. News Forums used to communicate with the class (enrolled students) as a whole.

Therefore, taking the ERPeL (Version 1) into consideration, improvements will be made based on the recommendations and an improved environment will be developed and evaluated in Chapter 7.

Chapter 7. Development and Evaluation (Cycle 5)

7.1 Introduction

Version 1 of the ERPeL was developed and evaluated in Chapter 6. This chapter also focused on Phase 3 (Develop Solution) and Phase 4 (Evaluate in Practice) of the DBR methodology where improvements and recommendations will be made to the proposed ERPeL of Chapter 6. Thus, an updated ERPeL (Version 2) will be considered as DBR Cycle 5 where the ERPeL will be evaluated by the WRER301 2015 course which will be presented as implementation of a real-world solution. The major deliverable of this chapter will be the updated ERPeL which will form part of the practical contribution of this study, together with additional research findings. This chapter will discuss and answer the following research questions:

RQ5: *What combination of components can present an e-learning environment which has the highest levels of success for introductory ERP systems education?*

RQ6: *How successful is the proposed ERP e-Learning Environment (ERPeL)?*

The layout of Chapter 7 and the research objectives and deliverables addressed in this chapter are shown in Figure 7-1. The components to be designed in this cycle will consist of as-is and updated components from the previous cycle, together with new components that are to be developed and evaluated (Section 7.2). The proposed ERPeL (Version 2) will be evaluated in practice in the WRER301 2015 ERP course (Section 7.3). Several conclusions are made (Section 7.4).

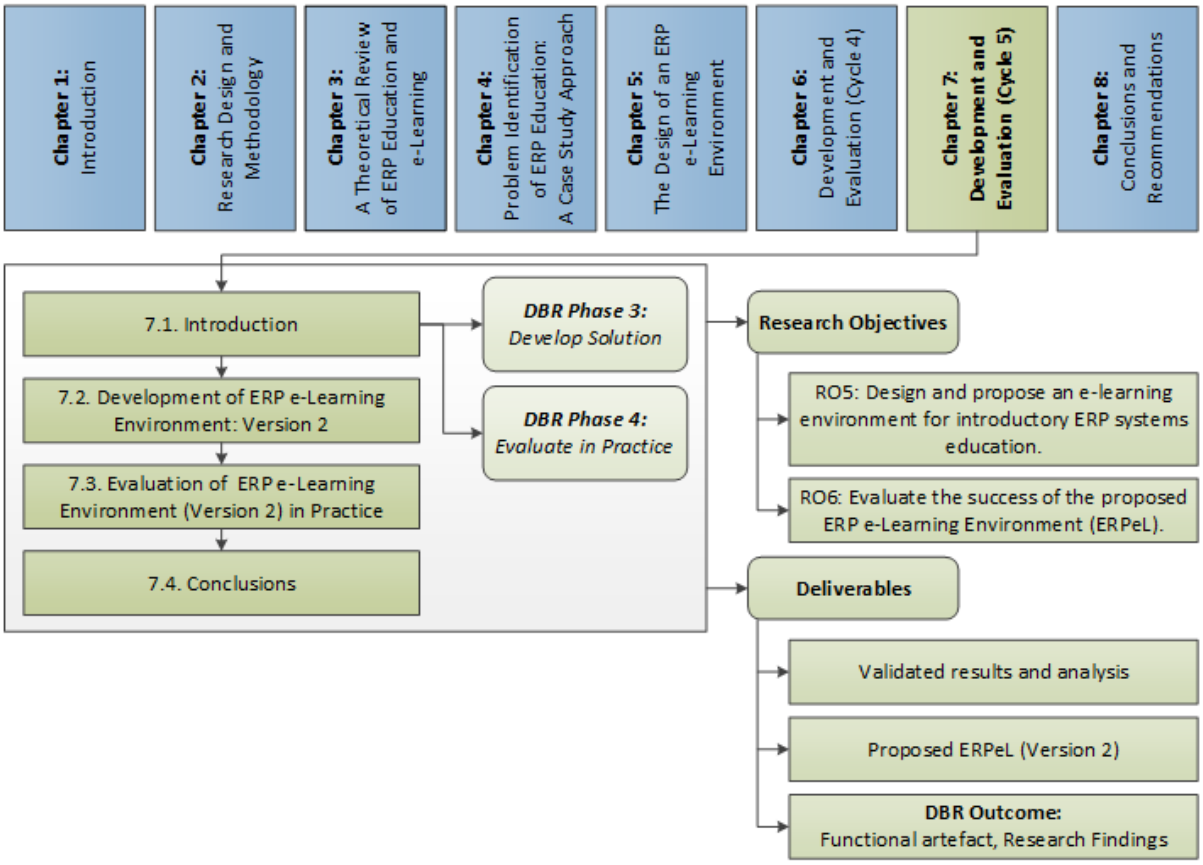

Figure 7-1: Chapter 7 Layout and Deliverables

7.2 Development of ERP e-Learning Environment: Version 2

This cycle was conducted over a seven week period in the ERP systems module (WRER301 2015) at NMMU which consisted of seven practical sessions. The practicals were broken down as follows:

- Practical 1: Introduction to ERP Systems **(e-learning)**;
- Practical 2: Inventory and SYSPRO Navigation **(F2F)**;
- Practical 3: Require-Procure-Pay **(blended)**;
- Practical 4: Purchase Orders and Receipts **(blended)**;
- Practical 5: Prospect-Transact-Care **(F2F)**;
- Practical 6: Plan-Produce-Distribute *(Guest Lecture)* **(blended)**; and
- Practical 7: Assignment 1 Section B Workshop **(blended)**.

The practicals also took on a variety of formats, ranging from pure e-learning, to F2F learning and also blended learning approaches were used. **Practical 1** was pure e-learning where the students had to complete the practical tasks at home, in their own time and was considered self-study. **Practicals 2 and 5** were F2F practical sessions

and were conducted in a computer lab where student assistants gave instructions and addressed common problems on a data projector. Participants were able to ask questions and the student assistants would answer them as best as possible. **Practical 3** involved some F2F aspects when the SYSPRO Latte m-learning application was evaluated and then an e-learning approach was adopted for the remainder of the session where students entered a live chat session with the student assistants and posted questions. The student assistants were no longer in the same venue as the students. Therefore Practical 3 can be considered to have adopted a blended learning approach.

Practical 4 also adopted a blended learning approach where another live chat was conducted during the practical session; however, there were also student assistants physically present in the computer labs. **Practical 6** took on a blended learning approach where there was an expert guest lecture from industry who presented theoretical concepts and the students were able to post forum questions after the session, which were to be answered by the expert. Students were also able to access a live video recording of the guest lecture afterwards. **Practical 7** can also be considered to have made use of blended learning since F2F workshops were conducted with lecturers and student assistants as well as peer reviewing workshops taking place on online.

Evaluation data was sourced from a variety of feedback methods; mainly *Introduction to ERP Systems Practical 1 Questionnaire* (Appendix O); *Week 2 Feedback Activity* (Appendix P); *Week 3 and 4 Feedback Activity* (Appendix Q) and *Introduction to ERP Systems Week 7 Questionnaire* (Appendix R).

In this fifth cycle there were some components which were kept as-is. Other components were improved based on the feedback obtained in the previous cycle evaluation. New components were added to the environment to provide a more comprehensive environment for ERP education. The components that make up the ERPeL (Section 7.2.1) that were developed and evaluated in this cycle are:

- Learning Content (Section 7.2.2);
- Videos (Section 7.2.3);
- Gamification elements: Badges (Section 7.2.4) and a leader board (Section 7.2.9);

- Assessment (Section 7.2.5);
- SYSPRO Latte m-learning application (Section 7.2.6);
- Communication: Forums and live chats (Section 7.2.7);
- Integration: Executive panes (Section 7.2.8);
- Consultancy with experts (Section 7.2.10);
- Peer reviewing (Section 7.2.11); and
- SYSPRO ERP Certification (Section 7.2.12).

7.2.1 Development of Moodle Page (Version 2)

The WRER301 Moodle home page is similar to the one used in Cycle 4; however, there are various additional features which were added. All the components and learning content were uploaded onto or created in Moodle and were organised in chronological order according to topic covered. Every week the relevant topic was highlighted.

During the semester the amount of content increased significantly, therefore it was decided to change the general layout of the WRER301 Moodle page and thus limit scrolling. The original layout has all the topics and sections visible at the same time and since the page is in chronological order, the most recent topic is in fact at the bottom of the page and the users have to scroll to the bottom of the page to access the current content.

In order to limit scrolling, a new and improved layout was recommended by the NMMU CTLM Teaching Development Professional (Goldstone, 2015) where the following setting: ***Module Administration > Course format > Course layout > "show all sections on one page"*** was changed to ***"show one section per page"***. The "new" layout shows the section or topic title and then the number of each type of Moodle activity under that particular section heading.

Participants are required to click on the heading (bold blue font) of the topic or section and then a detailed view of that particular section is displayed on the page (Figure 7-2). The detailed/full view allows the users to go back and forth to the previous and next topics (indicated by the red blocks), at the top and bottom of the section. In order to "jump to" a specific section users can also select the section name from the drop down list (indicated by the green block), at the bottom of the section.

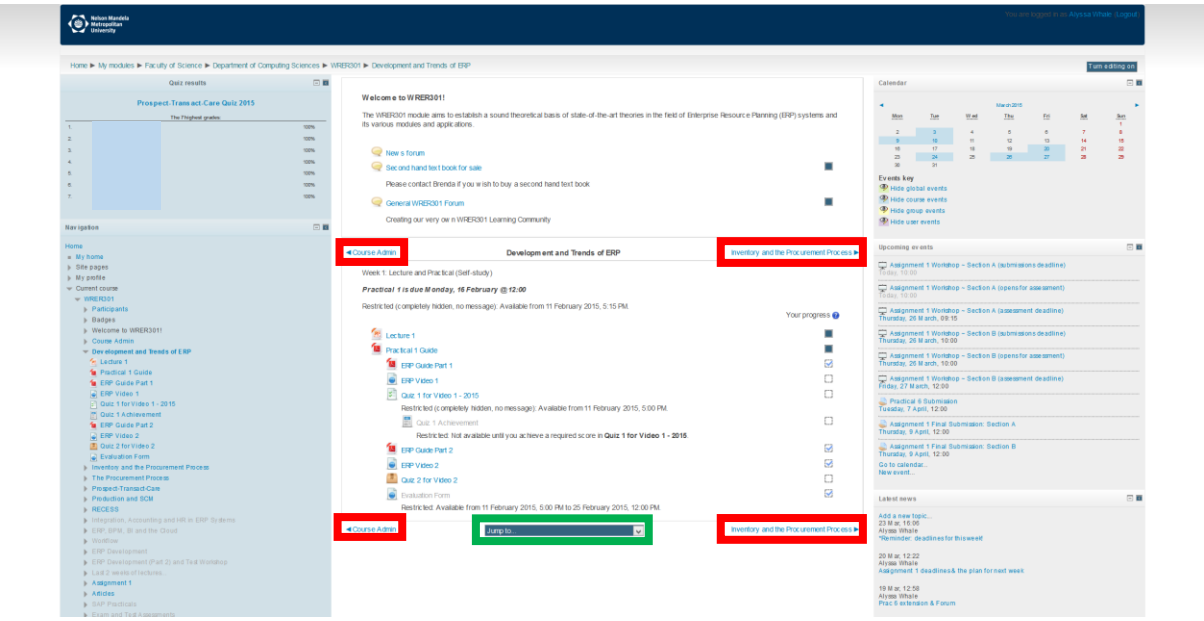

Figure 7-2: Sample of the New Layout (Limited Scrolling)

After some informal discussions with the students, the students were asked to vote on which layout option they preferred. The majority of the students voted for the scrolling layout, since they are able to see an overview of all the activities under a topic and clearly see what they still have outstanding and what they have already completed. They find it quicker to scroll through the whole page because they have become familiar with the layout and know where everything is. Only two students indicated that they in fact prefer the “new” layout because of how the content is grouped, one page per topic/section. After this discussion the Moodle page layout reverted back to the scrolling layout. It is possible that the students could have preferred the “old” layout just because they were familiar with it. If they had started off with the “new”, limited scrolling layout their opinions might have been different.

In order for the users to have access to certain features and for these features to be able to work properly, certain settings in Moodle need to be set by each user (student). In order for the users to receive email notifications posted from forums and other notifications, they need to enable ***“My profile settings > Messaging”*** and configure their notification methods for incoming messages, either in a pop-up notification (only when logged into Moodle) and/or via email. Another setting was required in order to ensure that their peers, fellow users, were able to view the badges they had been awarded on their profile pages. This is done by ensuring that the following setting is selected: ***“My profile settings” > Preferences > Make sure “Automatically show***

badges I earn on my profile page". The users were also encouraged to add profile pictures so that their fellow peers could "put a name to a face" and thus be able to approach their peers F2F or send messages; this was, however, optional.

The Moodle version that NMMU was running at the time of evaluation was Version 2.5.9 (Build 20141110). The latest available version of Moodle is in fact Version 2.8 (specifically Version 2.8.5). Due to the older version of Moodle that is being used at NMMU, the researcher was restricted and limited in the use of some of the latest plug-ins available because they are not compatible with the older version. These were the ranking block plug-in which is considered another element of gamification. The ranking block would have considered course completion in its entirety and given the students points ("marks") for activities completed on Moodle and would thus have been able to rank the students for the module as a whole. The ranking block was only made available after the evaluation was complete. Due to these limitations the researcher made use of a Quiz results block in the form of a leader board (Section 7.2.9). Alternatives to the ranking block include a "badger block" and a "my latest badges" block. The "my latest badges" block can be added to the home page of Moodle to indicate the latest badge that has been awarded or earned (Figure 7-3).

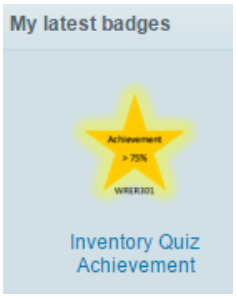

Figure 7-3: Sample "My latest badges" Moodle Block

7.2.2 Learning Content

The ultimate goal of this research would be to eliminate the SYSPRO e-Learning System from the environment completely; however, at this stage this is still not possible. Certain units of the SYSPRO e-Learning System were replaced by the videos created in the previous cycle because of the shortcomings identified (Table 4-4, 6-1 and 6-2). The SYSPRO e-Learning System's Unit 2: Supply Chain, ERP and SYSPRO Business Processes was replaced with the ERP Videos 1 and 2. Unit 3: Introducing Inventory was replaced with the Introducing Inventory video and Unit 8:

Inventory Control was partially replaced with the Inventory Control video, however, the SYSPRO tasks within that unit were still used.

The participants were also involved with creating their own learning content which they had to do as part of an assignment for their third year ERP systems module (Figure 7-4). The participants, were required to form groups of three to four people and design and present a storyboard for a graphical interactive simulation video on the manufacturing process in an ERP system. The storyboard had to include a video script as well as diagrams and/or slides to be used in the video. The designs would be used by the researcher and a postgraduate student to develop into a video once the best design had been chosen. For each practical session, participants were provided with a detailed guide that consisted of instructions, intended learning outcomes (ILOs), tasks and deadlines (Appendix S).

Figure 7-4: Samples of Some of the Learning Content Designed by the Students

7.2.3 Videos

The videos were kept as-is and were reused for this cycle. Participants were encouraged to download and save the videos and then open them using Windows Media Player. A live recording of the expert lecture was conducted by a video producer from the NMMU Integrated Media Centre. The video producer had two cameras present which were used to record the actual presenter as well as the data projector

screen. The footage from the two cameras was then “mixed” together using editing software to produce a final product, the video. The video producer also installed software, Camtasia, onto the laptop of the presenter so that when the actual ERP software was used for presentation purposes this could be recorded and then added into the video as well. The final product was received on three DVDs and thus the expert guest lecture was split into three parts due to the size and length of the video.

7.2.4 Badges

New badges were created for this cycle and were awarded to the participants based on various criteria that had to be specified in Moodle. Not only were completion badges awarded, badges were also awarded based on *achievement*, “Gold Star” badges were awarded to those users who achieved greater than 75% in particular quizzes (Figure 7-5). In order for an achievement badge to be awarded a ‘blank’ Page Moodle Activity needed to be created, which only allowed access to users with a specific mark for a specific activity. (Figure 7-6). Then by accessing this page, the gold star badge would be awarded. Ultimately, this is not the ideal way of implementing achievement badges; however, it is the only way of doing something like this with the current version of Moodle which NMMU is running. Moodle does allow for users not being awarded the badge even though they have qualified, but have not accessed the “achievement page”.

Figure 7-5: Sample Badges for Cycle 5

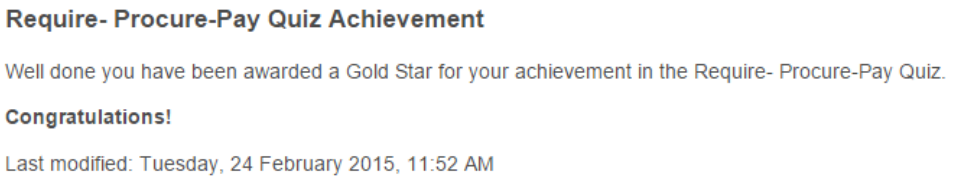

Figure 7-6: Sample Achievement Page used for Achievement Badge

Blue stars were awarded for completion of practicals and green stars were awarded for homework. The sizing of the actual badges was corrected to be that of 90 x 90 pixels. However, after the badges had been evaluated, it was noticed that there was limited interest and negative feedback that was obtained and thus the badges were not implemented for all seven weeks of the evaluation.

7.2.5 Assessment

The SCORM assessment (Quiz 2 for Video 2) was used as-is from the previous cycle. Quiz 1 for Video 1 was updated with minor changes and additional quizzes were also compiled. Three new assessments were created and developed in Moodle. From the feedback from the Cycle 4 evaluation, some participants had indicated that they preferred the layout of the quiz to be one question per page while others preferred all the questions on the same page. Thus, for the purposes of this cycle evaluation a combination of the two layouts was used for different quizzes.

The following quiz assessments were conducted over the seven week period:

- Quiz 1 for Video 1 2015 - *Standard Moodle quiz (updated);*
- Quiz 2 for Video 2 - *SCORM package assessment (as-is);*
- Inventory Quiz - *Standard Moodle quiz (new);*
- Require-Procure-Pay Quiz - *Standard Moodle quiz (new);* and
- Prospect-Transact-Care Class Quiz - *Standard Moodle quiz (new).*

7.2.6 SYSPRO Latte m-Learning Application

For this cycle, improvements were made to SYSPRO Latte in the form of an interactive process flow diagram (Figure 7-7). The interactive process flow diagram is specific to the Require-Procure-Pay business process of SYSPRO. Interactivity is achieved by “touching”, selecting the actual process, for example Requisition Processing, and then a window pops up with a detailed description of that sub-process. Users are then able to decide whether they want the “Reader” to read out the text and listen to the audio or alternatively, they can read the text themselves. The “Cancel” option then allows them to return to the process flow diagram.

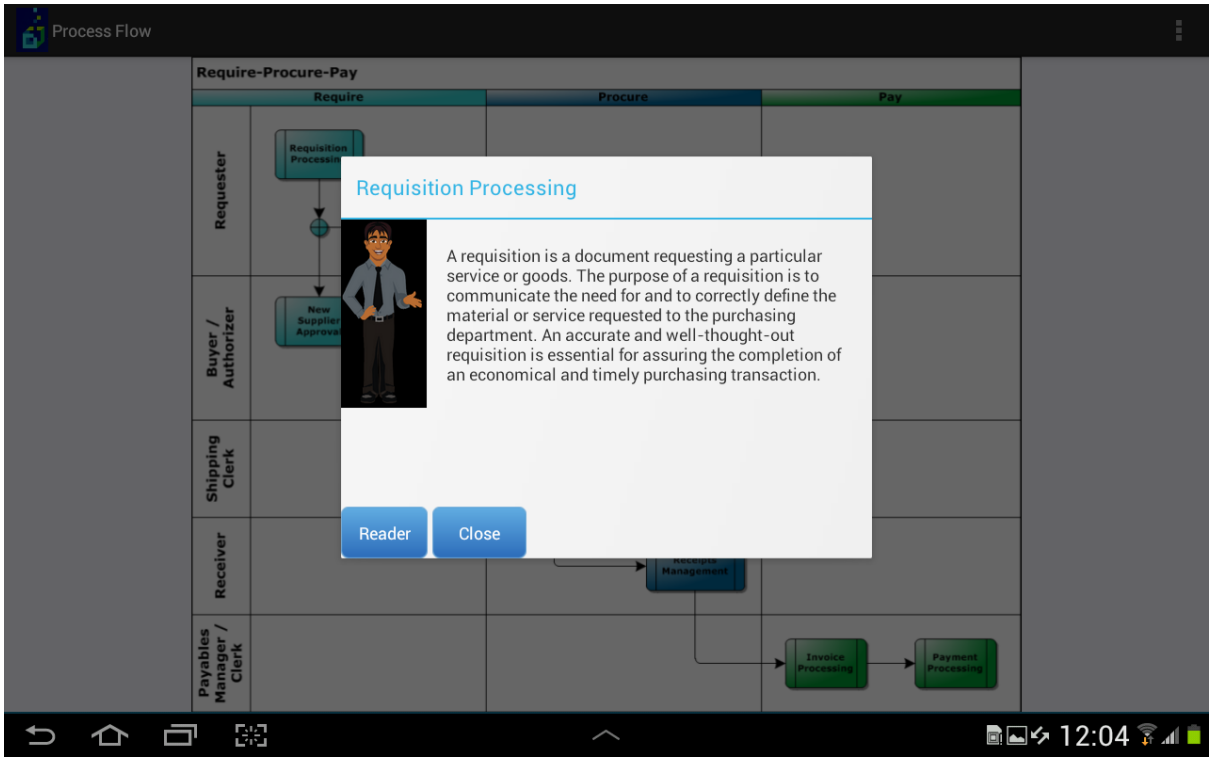

Figure 7-7: Screenshot of SYSPRO Latte Interactive Process Flow Diagram

7.2.7 Communication

Communication as a whole was not only improved, a wider variety and range of communication was used and implemented in this cycle evaluation. The main form of communication used with the students was the **Moodle News Forum**. This forum is used to relay information, instructions and announcements to the students, serving as an online noticeboard. A valued feature is that the lecturer has the option to “Mail now” which will send the students the forum in the form of an email. This is especially useful since the students are not permanently logged into Moodle. However, the News Forum only allows for Lecturers to post to the forums, thus students are not able to reply to news forum posts.

A general WRER301 Forum was created so that the students were able to reply to the forum posts, for example to confirm group allocation. The aim of the general WRER301 Forum was also to create a learning community amongst the students and promote them making use of the forum amongst their fellow peers and not only when the lecturer initiated a forum discussion. A **Manufacturing Process Forum** was also created with an expert from industry and will be discussed in more detail under consultancy with experts (Section 7.2.10).

Live Chats were another form of communication that was adopted in this cycle evaluation. The live chats were conducted in conjunction with the practical sessions in the hope of reducing the cost of having student assistants physically available in the practical sessions. After a live chat is created and opened, users are able to enter the chat. When users have entered into the live chat a pop-up window of the live chat is displayed together with those users that have also entered into the live chat.

Users type their posts in the bar towards the bottom of the window and select 'Send'. When there are multiple users entered into the live chat users can 'beep' posts to a specific user to get their attention or post directly to them. The live chat can be seen by all users enrolled in the course and a favourable feature is the fact that users are able to refer back to the live chats at a later stage and once they have been closed (Figure 7-8). *The black lines are for anonymity purposes.*

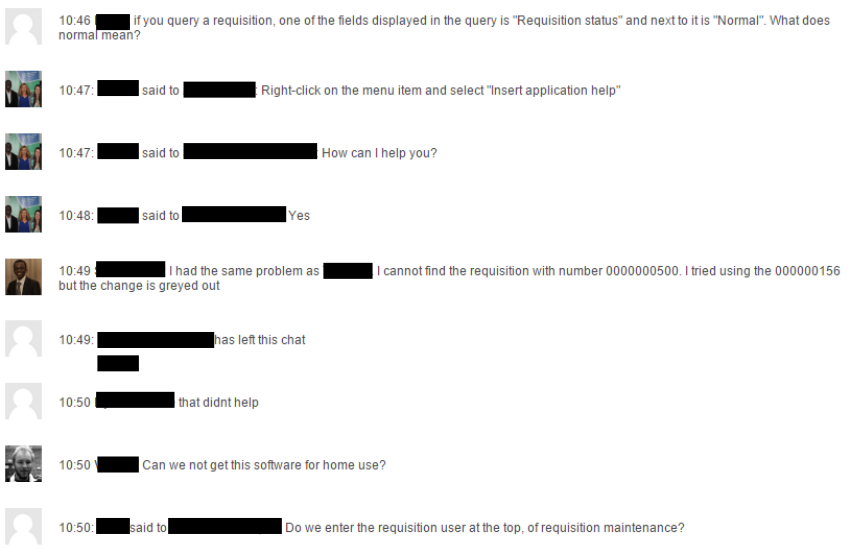

Figure 7-8: Sample Live Chat (Access Afterwards)

Over the course of this cycle two types of live chats were used, categorised and uncategorised. In the first practical that made use of a live chat an uncategorised live chat was used. An uncategorised live chat indicates that all questions pertaining to that practical session were posted and answered in the same live chat. There was no classification or grouping, thus posts ranged from general to practical to social were all in the same live chat. In this session the live chat was monitored by only one student assistant.

The second practical which made use of a live chat was categorised according to the relevant practical tasks and also catered for a separate social and general chat (Figure 7-9). This was decided upon based on feedback received from the student assistants, lecturers and students from the uncategorised live chat. Each task had its own specific live chat. This time around there were two student assistants monitoring the live chat. Each type of live chat has its benefits and downfalls, which are dependent on the role of the user. Students might have varying opinions, which are different to those of the student assistants and/or lecturers. A benefit of the categorised chat is that when referring back to the live chat posts, users can easily find what they are looking for based on the category and task name. Alternatively, for the uncategorised live chat users would have to shift through all the posts to potentially find what they are looking for.

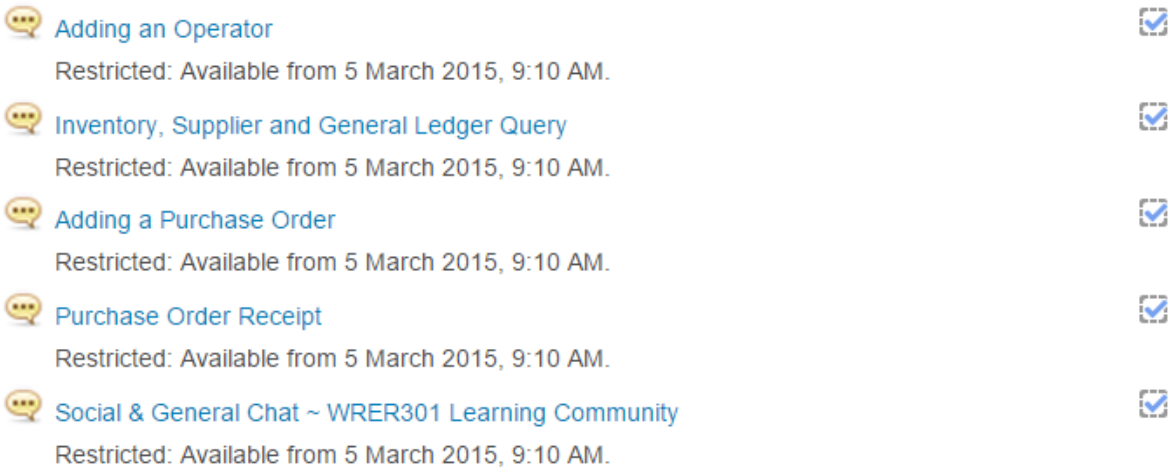

Figure 7-9: Categorised Live Chat

The **Moodle Feedback Activity** can also be considered a different form of communication with the students which was used for evaluation purposes and the collection of data. The Feedback activity was used when only a limited number of questions had to be answered by the student participants and this was seen to be an alternative to an online questionnaire. Setup of such a Feedback activity is relatively easy; however, it is definitely limited in terms of formatting and layout. Additional limitations include editing and numbering of questions, which can result in time delays because of the poor interface of this activity.

A positive feature of the Moodle Feedback activity is the fact that analysis of the results is conducted automatically and depicted in bar graphs (Figure 7-10). It is also easily

exported to Microsoft Excel for further statistics. The data is recorded and displayed in graphs, however, the data can be exported to Microsoft Excel, but the graphs cannot. Thus, if the graphs need to be used, screenshots will have to suffice or the graphs have to be redrawn. It is the researcher's recommendation that Moodle Feedback Activities are ideal for fewer than five questions.

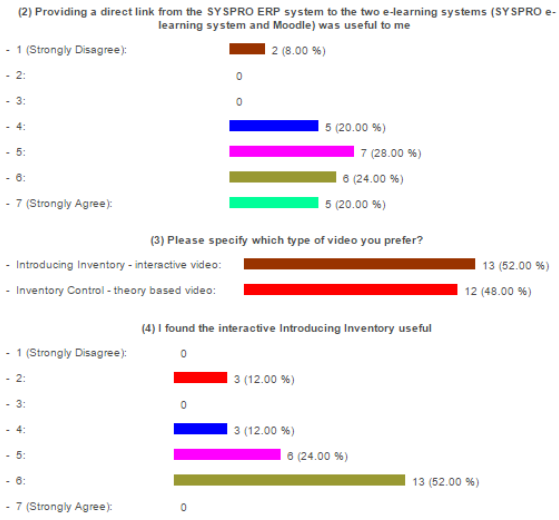

Figure 7-10: Sample Moodle Feedback Activity Analysis and Graphs

7.2.8 Integration

Integration for this ERPeL was achieved by making use of SYSPRO's executive panes. ***Executive (or customised) panes*** in SYSPRO are part of SYSPRO's Power Tailoring capabilities which allow for the SYSPRO software to be personalised to meet the requirements of companies (SYSPRO, 2015). User-defined views can be created making use of a variety of components, for example web applications, and can be constructed by using built-in templates. A benefit of using customised panes within SYSPRO ERP System includes the integration of external data for a single interface across all systems.

Within the SYSPRO ERP System, two separate executive panes were created in order to integrate SYSPRO ERP System with that of SYSPRO e-Learning System and Moodle, specifically the WRER301 Moodle page (Figure 7-11). The students were instructed to add the executive panes by following eleven steps (Appendix T). Thus with the use of the executive panes this environment has become more integrated since it allows for all the components of the environment (apart from the SYSPRO Latte m-learning application) to be accessed from within one system.

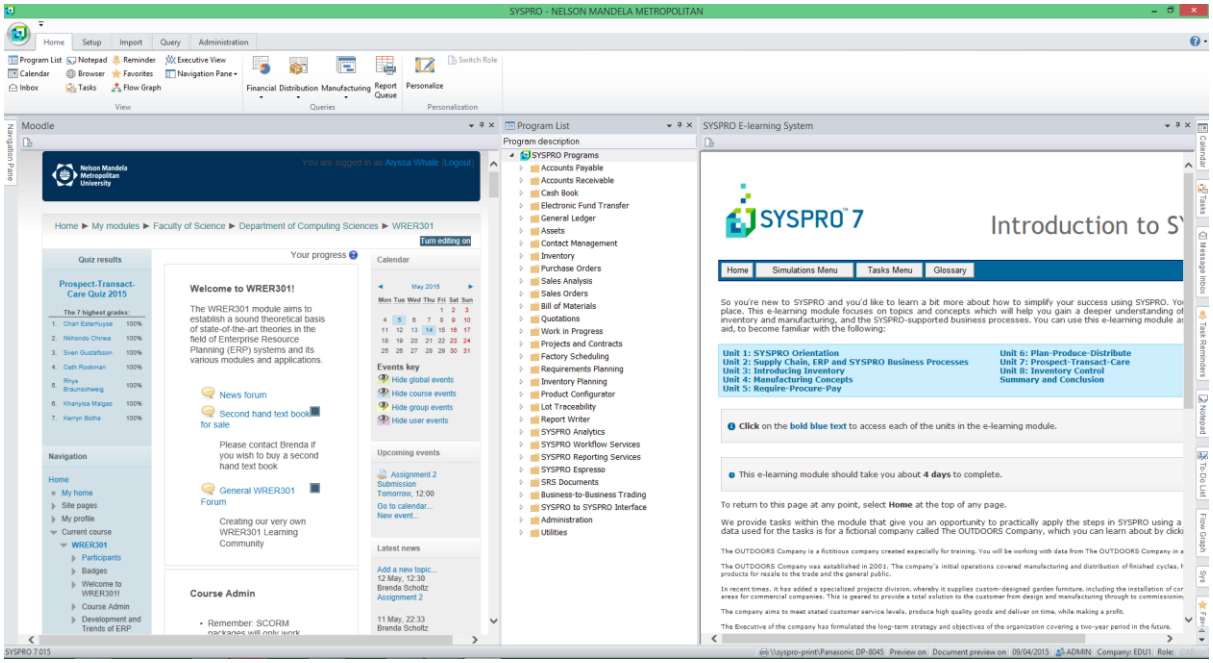

Figure 7-11: Moodle and SYSPRO e-Learning System Executive Panes

7.2.9 Leader board

Another element of gamification (Section 3.6.4), the leader board, was added to the ERPeL in order to increase competition and motivation. The leader board indicated the *"Top 5 Achievers"* in the quiz for the week or session. The number of students that are shown can be changed to a Top 3 or Top 10. In some cases when more than five students had the highest marks, this had to be adjusted.

Every week the achievers of the week were placed in the top left corner of the Moodle page in order for everyone to see when they log into the module's home page (Figure 7-12). When the new leader board for the week is placed in the top left, the "old" quiz results leader board is moved down to the bottom of the left side panel of the Moodle page. This was done so that the students could monitor when and whether they had been featured in the *"Top 5 Achievers".* Ultimately, the researcher would have liked to make use of a ranking block plug-in, but due to the old version of Moodle that NMMU is running, this could not be achieved.

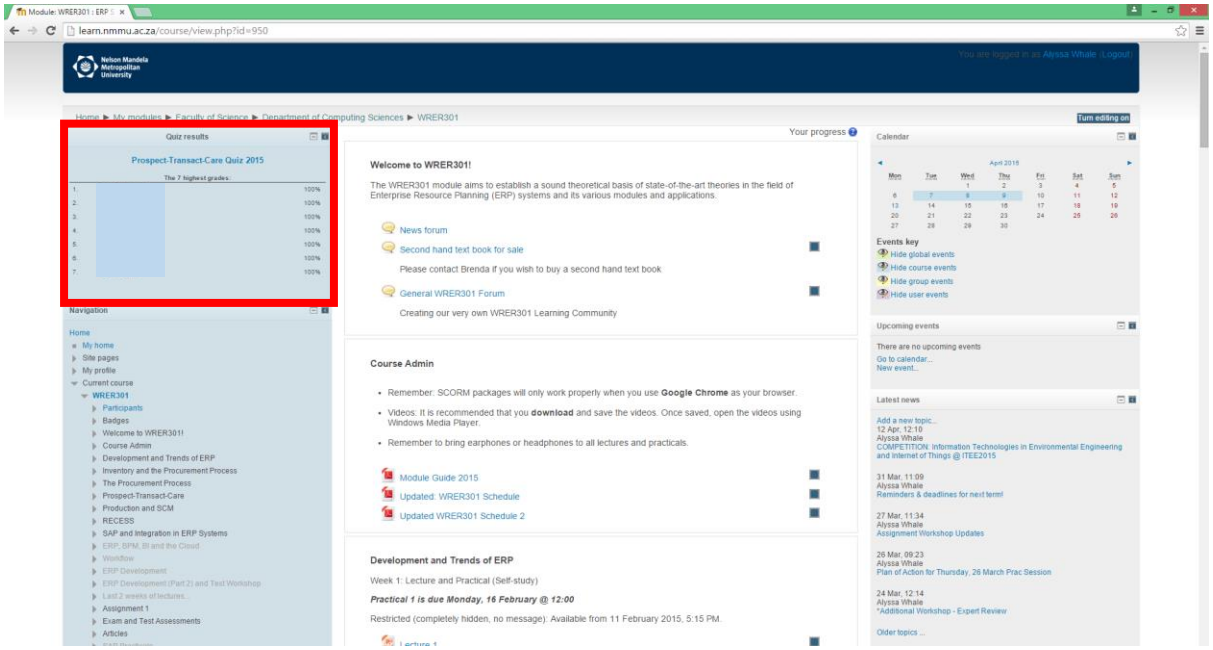

Figure 7-12: Leader Board Top Left of WRER Moodle Home Screen

7.2.10 Consultancy with Experts

Consultancy with experts was identified by Scholtz and Kapeso (2014) as being a factor for improving the success of e-learning projects. In this case consultancy with experts consisted of: 1) an Expert Guest Lecture; 2) a Manufacturing Process Forum with an Expert; 3) Access to the expert guest lecture afterwards, for instance, in the form of a video and 4) an Expert Review.

The **Expert Guest Lecture** was conducted by a Business Development Executive (De Matos, 2015) from SYSPRO in the form of a F2F lecture during one of the practical sessions. The expert gave real-world examples and expertise on theoretical topics the students were covering in the module. The **Manufacturing Process Forum with an Expert** was setup so that the students were able to post questions to the expert (Figure 7-13). The students were encouraged to post the questions and the expert would reply to these posts over a given time period. The students were allowed **access to the expert guest lecture afterwards in the form of a video**. The video was filmed and created by a Video Producer from the NMMU Integrated Media Centre (Section 7.2.3).

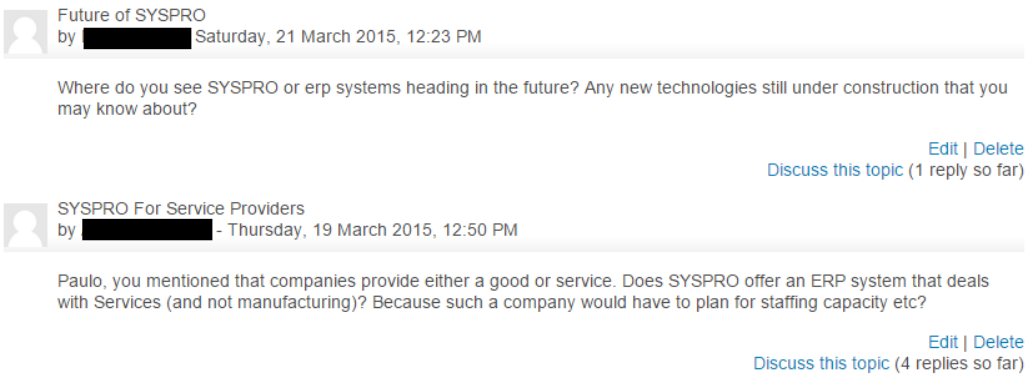

Figure 7-13: Sample of Questions Posted by Students to the Expert Forum

7.2.11 Peer Reviewing

Peer reviewing was promoted by the Moodle Workshop Activity which allows for automated, online peer reviewing. In order for a Moodle Workshop to be set up correctly and successfully there are various settings which need to be checked and modified. Deadlines for the various phases also need to be pre-determined. There are four main phases in a Moodle Workshop (Figure 7-14), mainly:

1. Setup Phase;
2. Submission Phase;
3. Assessment Phase;
4. Grading Phase; and
5. Closed.

In the **Setup Phase** the description of the workshop is set, the instructions for submission stipulated and the assessment form is edited. Criteria (aspects) for evaluation are added in the assessment form as well as the best possible grade for each criterion. In the **Submission Phase** instructions for assessment are provided and submissions are allocated. Allocation can either be manual, random or scheduled. The Submission Phase opens for submissions on a particular date at a particular time and then also has a closing deadline, date and time. In the Submission Phase the users will actually submit their work to the Moodle Workshop. The next phase is the **Assessment Phase** and also has opening and closing deadlines. The submissions have now been allocated to reviewers.

One problem identified is that if a student does not submit, they are not allocated anyone else's work to review either, thus they are not part of the review process whatsoever. The reviewers can now assess the submission allocation to them based

on the assessment form. In the **Grading Phase** the submission and assessment grades are calculated, since the split can be stipulated between the two grades for the final mark. A conclusion is also provided for the activity. The workshop is then **Closed** which then allows the users to see their marks in the gradebook, view their submission and view their submission assessment.

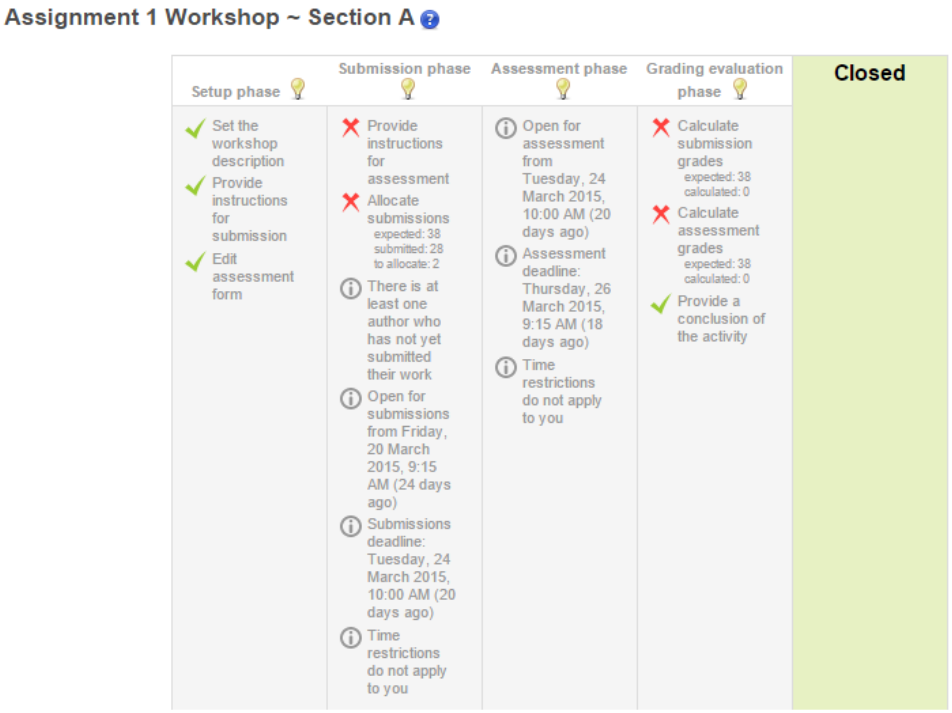

Figure 7-14: Phases in a Moodle Workshop Activity

7.2.12 SYSPRO ERP Certification

SYSPRO and NMMU have a University Alliance, which allows NMMU third year ERP students, to obtain access to SYSPRO ERP certifications. Logins to the Info Zone (http://infozone.syspro.com/SYSPRO7/) were acquired for each student and they were able to register for disciplines and certifications. For the purposes of introductory ERP systems and novice users, the focus is on the **SYSPRO 7 End User Foundation Certification** which comprises of three different disciplines, namely: Purchasing, Sales and Manufacturing. Each discipline has content and resources available to enrolled and registered users and each discipline has an exam which allows 30 minutes to answer 30 questions. There are banks or pools of roughly 150 questions for each exam and thus users will all write different tests. The Purchasing Cycle Exam, Sales Cycle Exam and Manufacturing Cycle Exam all need to be passed in order for each discipline to be passed. For example, if a user passes the Purchasing Cycle

Exam, then they will pass the SYSPRO Purchasing Discipline. Only once a user has passed all three disciplines will they be able to write the Certification Discipline which is the Introduction to SYSPRO Exam. Once the user has passed this final exam then they will receive their SYSPRO 7 End User Foundation Certification. A roadmap is provided of all the exams that form part of the SYSPRO 7 End User Foundation Certification (Figure 7-15). For all SYSPRO certifications the pass mark is 80%.

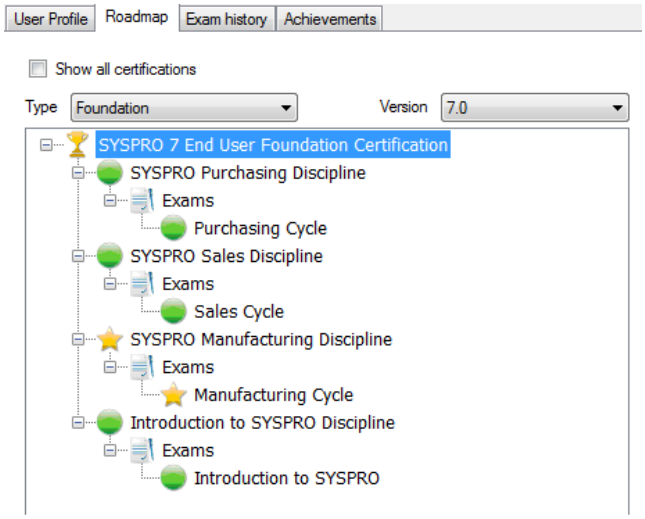

Figure 7-15: SYSPRO 7 End User Foundation Certification Exam Breakdown

Material and resources for each of the certifications and disciplines are accessible from the InfoZone where pdf guides as well as the SYSPRO e-Learning Systems are available for download. There are various types of SYSPRO Certification, mainly: Foundation; Support; Implementation and Development. Under each type there are numerous certifications available which contain different disciplines which are required before certification is obtained and awarded. Two main fields are available for certification, mainly the end user or reseller route. The SYSPRO Certification app also makes use of badges (Figure 7-16). These badges focus on where a user is in their process of becoming certified, for instance pending, passed or expired. The badges legend comes into use here in indicating the progress or status of the relevant disciplines. This process is summarised into nine easy steps by SYSPRO (Figure 7-17). Additional background into SYSPRO Online Certification is included in Appendix U.

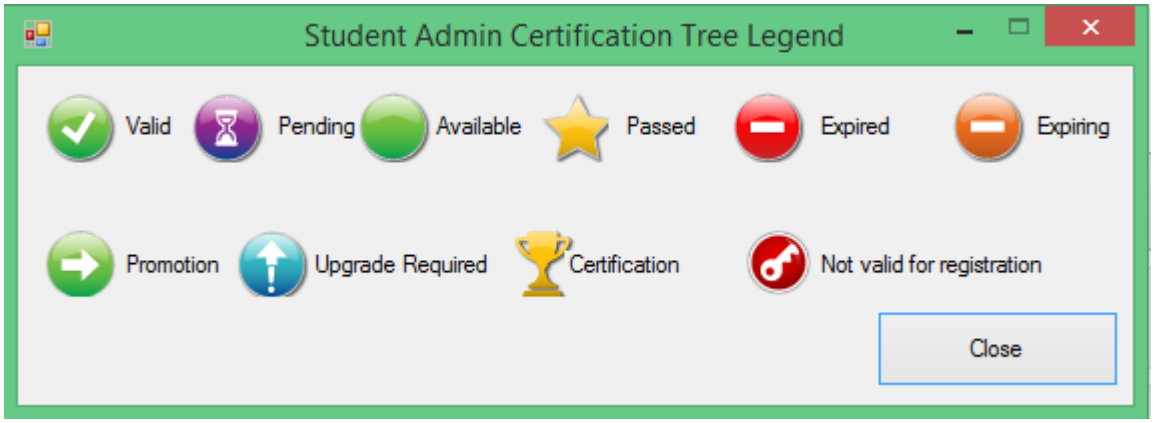

Figure 7-16: SYSPRO Certification Legend (Badges)

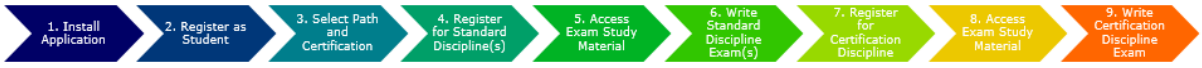

Figure 7-17: Summary of the SYSPRO Certification Process

Students were required to do the Purchasing Discipline Exam as one of their semester tests for their ERP Systems (WRER301) module. The remaining disciplines: Sales and Manufacturing that make up the SYSPRO 7 End User Foundation Certification were optional and the students could complete them in their own time within one month, if they wanted to. Of the 32 students in the class, 21 successfully obtained their SYSPRO 7 End User Foundation Certification.

7.3 Evaluation of ERP e-Learning Environment (Version 2) in Practice[9]

Numerous evaluations were conducted over the seven week evaluation period where the various components of the ERPeL were evaluated in practice by third year NMMU ERP students (WRER301 2015). The students are all undergraduate students enrolled for a semester module on introductory ERP systems. There were 32 students enrolled for the module at the start of the semester.

The Cronbach Alpha coefficients were calculated in order to determine the reliability of the criteria (Section 7.3.1). Weekly evaluations were conducted where different components were evaluated (Sections 7.3.2 - 7.3.6) and a post-test evaluation was

[9] Some of the results reported on in this section were published as a full paper in a triple-blind peer reviewed conference at South African Institute of Computer Scientists and Information Technologists (SAICSIT) in September 2015. Whale, A.M., Scholtz, B.M. and Calitz, A.P. Classification of Heuristic for Components of e-Learning. SAICSIT Conference. Stellenbosch, South Africa. **(Appendix V)**

also conducted (Section 7.3.7). Once all the data was properly analysed and discussed, the Cycle 5 evaluation was specifically reflected upon (Section 7.3.8).

7.3.1 Cronbach Alpha Coefficients (Cycle 5)

In terms of Cronbach Alpha coefficients[10] calculated for the criteria used in this cycle (Table 7-1) it is noticeable that there was no coefficient for the first factor: "*Relevance of site content to the learner and the learning process*". Reasons being there was only one item for that factor which could be used in the calculation. All of the criteria have Cronbach Alpha coefficients greater than α = 0.6 which indicates that their reliability is either acceptable, good or excellent (which is similar to the results of Cycle 4). However, there is one exception. For the factor of *"Level of learner control"* the overall reliability was determined to be poor (α = 0.57). This indicates that the reliability and internal consistency for the summated score is low which can imply inaccuracies in the estimate being measured and thus results should be treated with caution due to the small sample size.

Table 7-1: Cronbach Alpha Coefficients (Cycle 5)

Criteria	α	n
Relevance of site content to the learner and the learning process	-	27
Level of learner control	0.57	
Support for personally significant approaches to learning	0.73	
Overall *for WRER301 2015 ERPeL's Evaluation (Practical 1)*	0.60	
Badge motivation	0.97	
Overall *for Badges*	0.60	
SYSPRO Latte m-Learning Application	0.78	28
Moodle Quiz Leader Board	-	
Live Chat	0.88	
Overall *for WRER301 2015 Practical 3 and 4*	0.61	
Effectiveness of collaborative learning	-	17
Level of learner control	0.83	
Learner motivation, creativity and active learning	-	
Support for personally significant approaches to learning	0.89	
Overall *for Practical 7*	0.80	

7.3.2 Practical 1: Introduction to ERP Systems (Week 1)

For the first practical of the semester the students were required to do self-study on the introduction to ERP systems using an e-learning approach. There were given a detailed practical guide detailing the learning outcomes, tasks and instructions for the week. The students were required to familiarise themselves with Moodle in order to

[10] α < 0.50 (Unacceptable); 0.50 - 0.59 (Poor); 0.60 - 0.69 (Acceptable); 0.70 - 0.79 (Good); 0.80 + (Excellent) **(Venter, 2015)**

have access to the course information. The tasks for the week consisted of the watching of videos, reading of text-based .pdf guides and completing online quizzes. The students were also awarded badges based on achievement and completion of the practical tasks. Data was collected in the form of an online questionnaire (Appendix O). Informed consent and information pertaining to this research study were provided to the students on the first page of the evaluation form where they had to give their voluntarily consent to participate in this study. For Practical 1, 27 students participated in the evaluation for the week.

The majority (67%) of the students had no ERP experience and a third (33%) of the students had one to three years ERP experience (Figure 7-18). In terms of IT Experience, most of the students (48%) have one to three years IT experience, followed by seven students (26%) having seven or more years of IT experience, four students (15%) have between four and six years and three students (11%) have no IT experience (0 years).

Practical 1's evaluation questionnaire evaluated the following components:

- ERPeL's Learning Content;
- Types of Assessments;
- Videos (Visual Presentation);
- Badges; and
- Overall ERPeL.

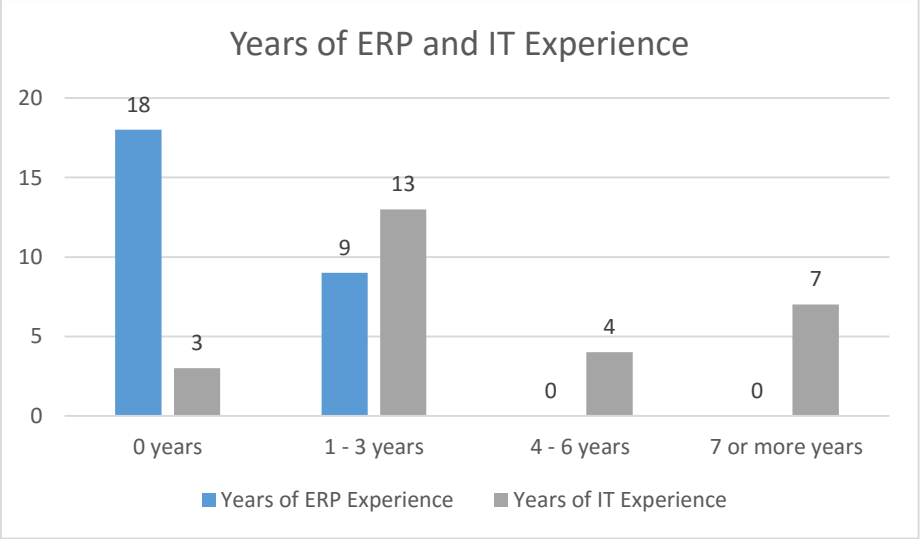

Figure 7-18: WRER301 Years of Experience - ERP and IT

The students had to rank the **ERPeL** in terms of the following high-level criteria: 1) relevance of site content to the learner and the learning process; 2) level of learner control and 3) support for personally significant approaches to learning. These high-level criteria were the same set of criteria used in Cycle 4 (Table 5-4). Ranking was done by making use of a seven-point Likert scale where 1 represented *Strongly Disagree* and 7 represented *Strongly Agree*. The following statistical ranges are applied to all descriptive statistics discussed in this study: negative [1 to 3.6), neutral [3.6 to 4.4] and positive (4.4 to 7].

It can be noted that a trend is forming in that the highest ranked criterion is yet again the fact that the material of the ERPeL containing no biases, racial or gender or otherwise, was ranked positively (μ = 6.37) (Table 7-2). The second highest ranked criterion , the ability of the ERPeL to be used in combination with other mediums of instruction (μ = 5.89), followed by, where appropriate, learners being able to take the initiative regarding the methods, times, place, content and sequence of learning was rated positively (μ = 5.67). The lowest rated criterion was yet again the customisation of the site for personal learning strategies, which was seen to be neutral (μ = 4.07). Therefore from these results it can be deduced that the ERPeL, as a whole, was ranked positively, since there were no negatively rated criteria.

Table 7-2: Cycle 5 ERP e-Learning Environment's Learning Content Descriptive Statistics (n = 27)

CYCLE 5: WRER301 2015 PRACTICAL 1 ***ERP E-LEARNING ENVIRONMENT***	**Mean**	**Standard Deviation**
Relevance of site content to the learner and the learning process	**5.97**	**1.19**
Content is engaging, relevant, appropriate and clear to learners using the WBL site.	5.56	1.05
The material has no biases such as racial and gender biases, which may be deemed offensive.	6.37	1.33
Level of learner control	**4.95**	**0.81**
Apart from controlling the interactions with the site, learners have some freedom to direct their learning, either individually or collaboratively, and to have a sense of ownership of it.	5.04	1.16
Learners are given some control of the content they learn, how it is learned, and the sequence of units.	5.04	1.19
Individual learners can customise the site to suit their personal learning strategies.	*4.07*	1.49
Where appropriate, learners take the initiative regarding the methods, time, place, content, and sequence of learning.	5.67	1.04
Support for personally significant approaches to learning	**5.58**	**0.95**
There are multiple representations and varying views of learning artefacts and tasks.	5.52	1.22
The site supports different strategies for learning and indicates clearly which styles it supports.	5.33	1.39
The site is used in combination with other mediums of instruction to support learning.	5.89	0.85

The central tendency and dispersion (Appendix W), of the WRER301 2015 ERPeL Learning Content evaluation were between negative and positive, with the maximum for each item being *Strongly Agree* (7) and the lowest scoring items received *Strongly Disagree* (1). Criterion such as *"The material has no biases such as racial and gender biases, which may be deemed offensive"* and *"Individual learners can customise the site to suit their personal learning strategies"* had minimum scores as low as *Strongly Disagree* (1).

The majority (81%) of the students indicated that they prefer the *standard Moodle Quiz (Quiz 1 for Video 1)* and the rest (19%) indicated the *SCORM Assessment (Quiz 2 for Video 2).* The students were required to indicate why they made this choice. Those students who preferred the *standard Moodle Quiz* stated that they had chosen this type of **assessment** because it allowed for questions and answers to be reviewed multiple times before final submission (*f* = 8). The simple layout (*f* = 4) of the Moodle quizzes and the fact that the students were familiar with Moodle (*f* = 4) were also reasons reported for preference for the standard Moodle quiz. Other participants reported that the Moodle quizzes are faster, easier, and more convenient with no hassles when being compared to the SCORM assessment. Some students did complain about access (*f* = 3) to the SCORM assessment and that it was childish.

Alternatively, those students who prefer the *SCORM assessment*, specified that immediate feedback (*f* = 4) and being told whether a question is correct or not directly after completing the questions, were reasons why they preferred the SCORM assessment. Additional reasons for preference of the SCORM assessment include interactivity (*f* = 3) and UI. One student did identify that he/she did not like only receiving his/her mark at the end of the test, such as in the standard Moodle quizzes.

Students were asked to specify one feature they liked about the standard Moodle Quiz as well as one feature they disliked (Table 7-3). Only the top three positive and negative features will be discussed. The most popular positive feature identified by the students was the fact that questions and answers could be reviewed multiple times before submission (*f* = 10). Another commonly liked feature that was identified was the simplicity (*f* = 8) of using the standard Moodle quiz as well as non-rigours sequence (*f* = 4), there is no set order of completion. UI (*f* = 4) and the familiarity of using the Moodle quiz format was also reported as a positive feature. In terms of negative

features that were identified, the fact that the students were not given immediate feedback or informed of correct and incorrect answers (*f* = 10) was the most highly reported dislike. The unappealing and lack of engaging UI (*f* = 6) was also noticeably deemed a negative feature of the standard Moodle quiz.

Table 7-3: Positive and Negative Features of Cycle 5 Standard Moodle Quiz (n = 27)

Positive Features		
Themes	***f***	**Sample comments**
Reviewing	10	*The ability to review all your answers and make changes before submitting them*
Simplicity	8	*Simple to use*
Sequence	4	*Option to jump between questions*
User Interface	4	*I am just used to that format*
Negative Features		
Themes	***f***	**Sample comments**
Answers and Feedback	10	*I dislike how it does not inform you of which questions you got wrong at the end of the quiz*
User Interface	6	*Not visually appealing*

The students were asked to list one feature they liked about the SCORM Assessment as well as one feature they disliked (Table 7-4). The positive feature which was identified most often was the fact that the SCORM assessment allowed for immediate feedback (*f* = 10), after each and every question was submitted. Additional positive features identified include the use of colour (*f* = 8), visual effect (*f* = 4) and the fact that the SCORM assessment was interactive (*f* = 4). Of the negative features of the SCORM assessment, the inability to review questions and answers (*f* = 10) was noticeably the most popular dislike. Access (*f* = 6) and problems with loading and speed were also a noticeably negative feature.

Table 7-4: Positive and Negative Features of Cycle 5 SCORM Assessment (n = 27)

Positive Features		
Themes	***f***	**Sample comments**
Immediate Feedback	10	*I like that it gives immediate feedback on the answers provided before proceeding to the next question*
Colours	8	*Bright, colourful…*
Visual effect	4	*It is visually stimulating*
Interactivity	4	*Interactive interface*
Negative Features		
Themes	***f***	**Sample comments**
Reviewing	10	*Inability to review answers*
Access	6	*Takes forever to load*

The students were required to **assess the ERP videos (visual presentation)** by identifying two features they liked and disliked about the videos, with specific reference to ERP Videos 1 and 2 (Table 7-5). There were definitely vast and varying views and opinions to do with the videos as can be noted in the top scoring positive and negative features being the same thing. The audio in terms of the voices being clear, concise and audible (*f* = 10) was identified as the most popular reported positive feature. The voice overs of the different characters in the videos (*f* = 9) were deemed annoying, irritating, unprofessional, high pitched, not upbeat and whiny. This showcases to the varying views and opinions of this sample. The explanations (*f* = 8) included in the videos both verbal (audio) and text were mentioned as a positive feature together with the way in which the content and theory had been summarised (*f* = 6). Negative features included speed (*f* = 5) in terms of the audio being too slow as well as too fast. Other negative features included the fact that the videos were boring (*f* = 3) and that definitions, content and theory lacked thorough explanations (*f* = 3).

Table 7-5: Positive and Negative Features of Cycle 5 Videos (n = 27)

Positive Features		
Themes	***f***	**Sample comments**
Audio	10	*The voice recordings are clear and concise*
Explanations	8	*Slides were not just read out. Concepts were explained in fair detail.*
Summary	6	*The information is summarised*
Negative Features		
Themes	***f***	**Sample comments**
Voice	9	*The voice over needs some work, especially the closing bit, "I'm TRISHA and I'm EMMA, GOODBYE!" I think the voice over ladies need to work on their delivery. They do not need to speak to us like we are children; they need to make it a little more professional. Possibly aspire to deliver the content like a news anchor.*
Speed	5	*The speakers spoke very slowly* **VERSUS** *they might be moving at a high pace*
Boring	3	*Boring. I would rather read the content than have it read to me.*
Explanations	3	*Not all the important definitions were displayed. Not all acronyms or terminology were clearly explained.*

The students were asked to rank their motivation of both the achievement and completion **badges**. Both were received positively and thus it can be deduced that the students felt that the achievement badge (μ = 5.44) and the completion badge (μ = 5.30) were motivating (Table 7-6). Overall the motivation of both badges was viewed positively (μ = 5.37).

Table 7-6: Frequency Distributions of Cycle 5 Badges (n = 27)

WRER301 2015 PRACTICAL 1: BADGES	Mean	Standard Deviation
Badge motivation	**5.37**	**1.63**
I felt that the achievement badge was motivating	5.44	1.65
I felt that the completion badge was motivating	5.30	1.66

The students were asked to provide one positive and one negative feature about the badges (Table 7-7). The most regularly mentioned positive feature was motivation (*f* = 10) in that students felt motivated to excel since they wanted to be awarded a badge. Achievement (*f* = 6) was also a positively identified feature, together with the reward (*f* = 3) and a sense of pride (*f* = 3) that is associated with badges. However, negative features were also identified including the limited view ability (*f* = 3) of the badges and a student felt that they could be showcased in a better way in order to provide more continuous motivation. Some students also thought that there should be different badges (*f* = 2) for different levels of achievement. For example, a student who passes the quiz, but does not get a distinction. Three different badges such as a gold, silver and bronze set of badges could be considered.

Table 7-7: Positive and Negative Features of Cycle 5 Badges (n = 27)

Positive Features		
Themes	***f***	**Sample comments**
Motivation	10	*It motivates you to actually sit with the quiz and try to do your best, rather than just wanting to get it over and done with*
Achievement	6	*Recognition of a certain level of achievement!*
Rewarding	3	*It is rewarding*
Pride	3	*Sense of pride*
Negative Features		
Themes	***f***	**Sample comments**
Viewable	3	*Should be displayed in a way that it is seen regularly to provide constant motivation*
Childish	2	*Seems a little childish*
Different Badges	2	*There is not a lower level badge to encourage those who did not* **and** *different badges for different levels of achievement*

The students were then required to assess the **overall e-Learning Environment**. The students were asked whether they liked the idea of being sent course communications via the Moodle News Forum and the majority (81%) indicated *Yes* and the rest (19%) indicated *No.* The students who had indicated yes stated that communications were sent out over two mediums (*f* = 9) or means of communication, being the Moodle news forum and via email. They found it pleasing that they had easy access (*f* = 8) to the information and communication and that it was convenient (*f* = 5). The news forum

kept them up-to-date (*f* = 4), they liked the layout (*f* = 2), it was effective (*f* = 2) and it assisted them with their own, personal time management (*f* = 2). The students also feel that the news forum is a modern take on the old noticeboard, it is easy to use, it gives the students more interaction with lecturers and it is always available. Those that indicated no, indicated that they prefer to be merely sent emails (*f* = 4) and that the actual news forum serves no real purpose.

The students were asked to indicate their preferences in terms of the method of instruction, teaching and learning with specific reference to Practical 1. Most (70%) of the students indicated *"I liked the use of multimedia (e.g. videos)",* others (22%) stated *"I liked the .pdf guides"* and the remaining (7%) reported that *"I would prefer a face-to-face practical session"*. This confirms the study of Liu et al. (2009) stating that the use of multimedia in courses is preferred (Section 3-10).

Other general comments included access to quiz answers after the quiz closed or the possibility of a star counter, similar to a leader board, where it could count how many stars a particular students had achieved over the course of the module. Another student, stated that he/she appreciated the fact that videos are being used in this module as a form of instruction and learning, especially since he/she suffers from dyslexia and has trouble reading.

7.3.3 Practical 2: Inventory and SYSPRO Navigation (Week 2)

During the second week of evaluation the students were required to complete navigation tasks in the SYSPRO ERP system by using the tasks specified in the SYSPRO e-Learning System. This was the first time that the students were using these systems and thus were also required to familiarise themselves with the navigation and layout of both systems. The practical session took on a traditional F2F approach. The homework took on an e-learning approach, which involved videos and a quiz. Thus, evidently week 2 took on a blended learning approach where integration (executive panes) and badges were also implemented.

Data was collected by means of a Moodle Feedback Activity and was limited to seven questions. The criteria used to evaluate, for this week was PEOU and PU (TAM) (Section 3.9). Additional closed and open-ended questions were also posed which needed to be ranked by making use of a seven-point Likert scale where 1 represented

Strongly Disagree and 7 represented *Strongly Agree*. For Practical 2, 25 students participated in the evaluation for the week.

Generally, the students were positive towards the **SYSPRO e-Learning System** and felt that it was easy to use (f = 2), contained descriptive and complete definitions and explanations (f = 2) and it gave them control over their own learning experience (f = 2). Alternatively, there were some students who felt differently and thought that the SYSPRO e-Learning System was tedious (f = 4) and they preferred working solely in the SYSPRO ERP system (f = 2). Other students reported that they felt the SYSPRO e-Learning System was boring (f = 2) and had too many tasks (f = 2) that needed to be completed. Others found the SYSPRO e-Learning System to be complicated and that there was a lot going on at the same time. Students also indicated that they prefer the video and .pdf guides approach and felt that they were merely "button clicking". Some students felt the SYSPRO e-Learning System could have had more detail and that it was too complex.

The students were also asked whether they thought providing a **direct link** from the SYSPRO ERP system to the two e-learning systems, namely SYSPRO e-Learning System and Moodle would be useful to them. This component which promotes integration amongst the different systems was viewed neutrally (μ = 5.12).

The students were asked to specify which type of **video** they prefer in terms of the two inventory videos for the week. The results were very close with the *Introducing Inventory - interactive video* (52%) only slightly higher than that of the *Inventory Control - theory based video* (48%). Thus, identifying that both the interactive and theory based videos were able to get some positive feedback from the students. The students were asked to rank whether they found the interactive Introducing Inventory video useful and this item was neutrally received (μ = 5.04). The results for the Inventory Control theory based video were also positive (μ = 5.40).

The students were asked in terms of the **Moodle quizzes** which layout or format of the questions they prefer. The majority (91%) stated that they prefer *"All the questions on the same page"* with the remaining (8%) stating that they prefer *"Each question on a new page".* A question was posed to the students where they had to rank whether they prefer some content to be available as a video which they can watch in their own

time or would they rather have a F2F lecture. The responses indicate that the students positively agree that more video content should be made available (μ = 5.68).

7.3.4 Practical 3: Require-Procure-Pay and Practical 4: Purchase Orders and Receipts (Week 3 and 4)

Practical 3 (Week 3) covered the Require-Procure-Pay SYSPRO business process and Practical 4 (Week 4) addressed purchase orders and receipts. Both practicals made use of live chats. *Practical 3* commenced with an overview and evaluation of the SYSPRO Latte m-learning application with the focus being on the added interactive process flow diagram. Thereafter, students were required to complete Require-Procure-Pay related tasks making use of the SYSPRO ERP and e-Learning systems. On commencement of the practical tasks, so commenced the live chat where students had to communicate with their student assistants using the live chat (as opposed to F2F). The Moodle Quiz leader boards were introduced in week three. Practical 4 took on a similar format to that of Practical 3 and involved the students completing tasks pertaining to purchase orders and receipts (no posting) which had been complied by the lecturer. Thus, the SYSPRO e-Learning System was not used in week four. The live chat in week four was categorised according to the tasks, whereas week three made use of an uncategorised live chat.

For Practical 3 and 4, 28 students participated in the evaluation where the focus was on the SYSPRO Latte m-learning application, the Moodle Quiz leader board and the live chats. Data was collected at the end of Practical 4 by means of a Moodle Feedback Activity which consisted of 17 questions. Only one item per specified main criteria was used in this week's evaluation. Additional open-ended questions were also posed to the students. Closed-ended questions needed to be ranked by making use of a seven-point Likert scale where 1 represented *Strongly Disagree* and 7 represented *Strongly Agree*.

The highest ranked criterion of the **SYSPRO Latte m-learning application** was the PU result (μ = 5.14) which indicates that the students feel that the SYSPRO Latte m-learning application will be of use and benefit to them (Table 7-8). From the results for PEOU (μ = 5.11) it is evident that they students feel that the SYSPRO Latte m-learning application is in fact easy to use, which is the second highest ranked criterion. All of the criteria that were used to evaluate SYSPRO Latte were ranked positively.

Table 7-8: Cycle 5 SYSPRO Latte m-Learning Application Descriptive Statistics (n = 28)

CYCLE 5: WRER301 2015 PRACTICAL 3 & 4 ***SYSPRO LATTE M-LEARNING APPLICATION***	**Mean**	**Standard Deviation**
Relevance of site content to the learner and the learning process		
Content on the SYSPRO Latte m-learning app is engaging, relevant, appropriate and clear to learners.	4.89	1.31
Support for personally significant approaches to learning		
In terms of the SYSPRO Latte m-learning app there are multiple representations and varying views of learning artefacts and tasks.	4.64	1.47
Perceived Ease of Use		
I found the SYSPRO Latte m-learning app easy to use.	5.11	1.64
Perceived Usefulness		
I think the SYSPRO Latte m-learning app will be of use and benefit to me.	5.14	1.41
Further Usage		
I would like to make use of the SYSPRO Latte m-learning app again	4.82	1.76

The students were asked to comment on the SYSPRO Latte m-learning application and specify what they thought of the application. There were some positive and some negative opinions and comments that were reported. Students stated that they found the SYSPRO Latte m-learning application easy to use (f = 7) and that it would and did benefit their learning (f = 5). The students found the application to be helpful (f = 3), engaging (f = 3), useful (f = 3), interactive (f =3) and had an overall positive attitude towards it (f = 3). Other students indicated that they like the modern twist on the learning experience, they found the application user friendly, innovative and requested further access to it. There were also some students who felt that the application needed more exploration (f = 2) in order to be able to master usage. Others felt that the SYSPRO Latte m-learning application was long, the instructions were unclear, usage was tedious and too simple. Additional comments which were deemed negative included that there were technical problems, it was tiring, challenging, no real knowledge was required to use the application and that something similar already exists.

In terms of the **Moodle Quiz Leader Board,** having content and interactive features that attract, motive and retain learners and that promote creativity on the part of the learners, was rated neutrally (μ = 5.04) (Table 7-9). The students were required to list one benefit and one disadvantage of the Moodle Quiz leader board (Table 7-10). A benefit of the Moodle Quiz leader board that was reported was the healthy competition (f = 9) that is created amongst the class as well as motivation (f = 9) within themselves and seeing their own name on the leader board or striving for it to be there. Others found that seeing which peers and classmates were achieving at the top (f = 4) was beneficial. There were also disadvantages which were reported namely the fact that

names were visible (*f* = 4) and shown for the whole class to see. Others felt that the leader board was demotivating (*f* = 4) and discouraging (*f* = 3), since most students will probably not achieve in the Top 5 and thus see their name on the leader board.

Table 7-9: Cycle 5 Moodle Quiz Leader Board Descriptive Statistics (n = 28)

CYCLE 5: WRER301 2015 PRACTICAL 3 & 4 ***LEADER BOARD***	**Mean**	**Standard Deviation**
Learner motivation, creativity and active learning		
The leader board has content and interactive features that attract, motivate and retain learners and that promote creativity on the part of the learners	5.04	1.69

Table 7-10: Positive and Negative Features of Cycle 5 Moodle Quiz Leader Board (n = 28)

Positive Features		
Themes	***f***	**Sample comments**
Competition	9	*It creates healthy competition*
Motivation	9	*Motivates me to study and do the work. It feels good to see my name there.*
Seeing peers on top	4	*You can see who does well in each quiz*
Negative Features		
Themes	***f***	**Sample comments**
Names visible	4	*Maybe the names should be left off because I do not want people seeing my marks even if they are amongst the top*
Demotivation	4	*I think for people who struggle it may be demotivating to see others achieving such great marks when they are struggling*
Discouraging	3	*Could discourage some learners, because they are not part of the top*

Over the two week period for this part of the evaluation, two **live chats** were conducted. The first live chat was conducted in Practical 3 and was uncategorised (Live Chat 1). The second live chat was conducted in Practical 4 and was categorised (Live Chat 2). In terms of the PEOU for Live Chat 1 is can be noted that the students found the uncategorised live chat easy to use (μ = 5.00) (Table 7-11). Comparatively they were more neutral with their PU for Live Chat 1 with regard to whether it would be of use and benefit to them (μ = 3.86). For Live Chat 2, the students also neutrally indicated that they found the categorised live chat easy to use (μ = 5.04). However, with regard to whether Live Chat 2 would be of use and benefit to them, the students also ranked it neutrally (μ = 4.07). Thus, is can be deduced that both live chats where rated higher in terms of PEOU as opposed to PU. It can also be noted that Live Chat 2 has relatively higher scores for both PU and PEOU when being compared to Live Chat 1. In general the students felt neutrally about the peer-to-peer help during the live chat sessions (μ = 4.79). The students neutrally stated that the live chats would promote access during and after sessions (μ = 4.82).

Table 7-11: Cycle 5 Live Chat Descriptive Statistics (n = 28)

CYCLE 5: WRER301 2015 PRACTICAL 3 & 4 *LIVE CHAT*	Mean		Standard Deviation	
	Live Chat 1	Live Chat 2	Live Chat 1	Live Chat 2
Perceived Ease of Use (PEOU)				
I found the Live Chat easy to use.	5.00	5.04	1.72	1.69
Perceived Usefulness (PU)				
I think the Live Chat will be of use and benefit to me.	3.86	4.07	2.05	2.09
Peer-to-peer help and assistance				
The Live Chat sessions on Moodle allowed me to make use of peer-to-peer help.	4.79		1.95	
Access				
The Live chat allows for access to information and answers to questions during the live chat session as well as afterwards.	4.82		1.66	

The students were asked to list one benefit and one disadvantage of the live chats in general (Table 7-12). The most prevalent benefit of the live chats as stated by the students was the peer-to-peer help (*f* = 9) which was evident throughout the practical sessions and the further development of their very own learning community. The students also identified the fact that their fellow students were experiencing similar problems (*f* = 6) and thus they avoided asking the same question and could potentially find the solution as well. The fact that the live chats prompted immediate help (*f* = 5) and assistance from the student assistants was also seen to be beneficial. Alternatively, the lack of F2F communication (*f* = 4) was deemed a disadvantage since the students felt it was sometimes difficult to convey questions and queries via the live chat and F2F relation building was also restricted. The students felt that a significant period time was spent on waiting (*f* = 3) for feedback and that making use of the live chat was in fact time consuming (*f* = 3).

Table 7-12: Positive and Negative Features of Cycle 5 Live Chat (n = 28)

Positive Features		
Themes	***f***	**Sample comments**
Peer-to-peer help	9	*Peer help is sometimes easier to grasp than that of a lecturer*
Similar problems	6	*If there is a problem or question, I can check the live chat if there is a solution or for any help*
Immediate help	5	*Being able to quickly ask a question and get a quick response!*
Negative Features		
Themes	***f***	**Sample comments**
Talking F2F	4	*It is not as easy to convey a message as it is in person*
Waiting	3	*You never really know if someone is busy answering your question or not, you kind of just have to wait.*
Time consuming	3	*Time consuming and does not notify you who sends messages when out of the window of the chat*

Additional feedback was obtained from the student assistants and lecturers involved with making use of the live chats on a report back (interview) basis. One student assistant noticed that the students were making use of the “beep” functionality to chat to each other (peer-to-peer help) instead of directly to the student assistant. The first time a live chat was used in a practical session (uncategorised) there was a great deal of “noise” and the topics discussed were unrelated to the practical work. The student assistant also felt that the questions were never out of control and thought that students were helped in due time or were referred to an alternative student assistant. The “beep” functionality was a beneficial feature for the student assistant monitoring the live chat because students were able to draw the attention of the student assistant if there was an urgent matter which needed attention. The “talk” functionality was also useful in directing comments to specific students and was used throughout the live chats. Prompting questions were not used, even though, they were prepared. Often the students would discuss a problem or query amongst themselves before one of them would post a question on the live chat, this shows that the students tried to resolve the issues themselves and collaborate amongst each other in the class. The student assistant noticed improvements in the flow and quality of the live chat as time progressed as students became occupied with the work.

When the live chat (categorised) was used the following week the student assistants felt that the categories (multiple chats) was worse than an uncategorised live chat because there was too much to co-ordinate at the same time. Some categories had more of an influx of questions as opposed to others, which can be expected. However, the categorised live chat does seem to be more beneficial to the students and for analysis purposes. Students had got used to making use of the live chat activity and thus were keen to post tips to other students who had come across the same or similar issues. The student assistants also noticed that often the students had difficulty conveying their questions and issues via instant message and most probably would have been easier to convey in person. Delays in posting were also experienced and some of the students were easily distracted by the constant posts coming in catering to the “live” aspect of the chats.

No evaluations were conducted during Practical 5 since it took on a traditional F2F approach where students were required to complete tasks pertaining to the Prospect-

Transact-Care business process by making use of the SYSPRO ERP and e-Learning Systems.

7.3.5 Practical 6: Plan-Produce-Distribute *Guest Lecture* (Week 6)

For the Practical 6 session an expert guest lecture was conducted by a Business Development Executive (De Matos, 2015) at SYSPRO. The students were required to complete practical tasks concerned with manufacturing concepts and the Plan-Produce-Distribute business process by making use of the SYSPRO ERP and e-Learning Systems. The students were also able to make use of the Manufacturing Process Forum where they were able to post questions relating to the manufacturing process in general and specific to SYSPRO. The questions posted were then answered by the expert (Section 7.2.10) for a certain period of time.

Data was collected by means of a Moodle Forum Activity and was limited to three forum questions (f = the number of forum posts per question), namely:

1. What did you enjoy the most about the Expert Guest Lecture? (f = 4);
2. What did you not enjoy about the Expert Guest Lecture? (f = 5); and
3. Did you find the Expert Guest Lecture useful? (f = 7).

7.3.6 Practical 7: Assignment 1 Section B Workshop (Week 7)

For the seventh week of evaluation the practical session took on a workshop approach where the students were required to peer review each other's work by making use of a Moodle Workshop. The students were tasked with the designing of a storyboard for a video of the manufacturing process in an ERP system. Peer reviews were conducted on these designs. Data was collected by means of an online questionnaire. Relevant criteria (Table 5-1) were used to evaluate the students' creation and development of their own learning content and consultancy with experts. Closed-ended questions needed to be ranked by making use of a seven-point Likert scale where 1 represented *Strongly Disagree* and 7 represented *Strongly Agree*. Supporting open-ended questions were also asked. Practical 7 reported on the views and opinions of 17 student participants.

The students were required to **evaluate the creation and development of their own learning content**. The students ranked the effectiveness of collaborative learning, specifically the encouragement of learner-learner and learner-teacher interactions positively (μ = 5.06) and it was also the highest ranked criterion (Table 7-13). The

students ranked the fact that creating their own learning content/material allows learners freedom to direct their learning, either individually or collaboratively, and to have a sense of ownership of it neutrally (μ = 4.94) with the second highest mean. On the other hand, the lowest ranked criterion in terms of the user generated content was the creation of their own learning content/material giving them control of the content they learn, how it is learned and the sequence of units (μ = 4.41) was, however, seen to be neutral.

Table 7-13: Cycle 5 User Generated Content Descriptive Statistics (n = 17)

CYCLE 5: WRER301 2015 PRACTICAL 7 ***USER GENERATED CONTENT***	**Mean**	**Standard Deviation**
Effectiveness of collaborative learning		
Creating our own learning content/material encouraged learner-learner and learner-teacher interactions.	5.06	1.39
Level of learner control	**4.66**	**1.22**
Creating our own learning content/material allows learners freedom to direct their learning, either individually or collaboratively, and to have a sense of ownership of it.	4.94	1.43
Creating our own learning content/material gave us some control of the content we learn, how it is learned, and the sequence of units.	4.41	1.06
Creating our own learning content/material allows individual learners to customise the learning content/material they created to suit their personal learning strategies.	4.65	1.80
Creating our own learning content/material allowed learners to take the initiative regarding the methods, time, place, content, and sequence of learning.	4.65	1.62
Learner motivation, creativity and active learning		
The learning content/material created has content and interactive features that attract, motivate and retain learners, and that promote creativity	4.88	1.41

The students were asked to list one positive and one negative feature about creating their own learning content (Table 7-14). The students reported that they felt that by creating their own learning content they improved their understanding and ultimately learnt more (f = 6). The students also felt that by tapping into their creative (f = 4) sides it made the learning experience fun and they had the freedom (f = 3) to include content and aspects which they thought were important. In terms of the content (f = 3) the students felt that is was an enriching exercise due to the fact that the assignment was group work and thus the content developed would be suitable for a diverse set of learning preferences, such as those aligned with the relevant group members. Alternatively, there were some negative features identified such as the fact that creating their own learning content was time consuming (f = 4) and there was some confusion as to which content to include (f = 3).

Table 7-14: Positive and Negative Features of Cycle 5 User Generated Content (n = 17)

Positive Features		
Themes	***f***	**Sample comments**
Learnt more	6	*Creating our own content meant that we had to have a better understanding of the work, to be able to apply it. Knowing more about the work is the positive.*
Creative	4	*The freedom of creativity we could have it made learning fun*
Freedom	3	*It gave us freedom to attempt the task the way we see fit*
Content	3	*Since we were working in groups, the different viewpoints and putting all those ideas together and we could pick what we wanted to be in the learning content*
Negative Features		
Themes	***f***	**Sample comments**
Time consuming	4	*It takes quite a lot of time*
Content to include	3	*Not knowing which components to use and which to leave out*

The students were required to **evaluate consultancy with experts**. In terms of the consultancy with experts allowing for multiple representations and varying views of learning artefacts (content) and tasks was ranked positively and was the highest rated criterion (μ = 5.35) (Table 7-15). Consultancy with experts enabling and supporting different strategies for learning and indicating clearly which styles it supports (μ = 5.24), along with it being used in combination with other mediums of instruction to support learning (μ = 5.18) were both seen to be neutral. Overall, the criteria of support for personally significant approaches to learning was viewed to be positive (μ = 5.25).

Table 7-15: Cycle 5 Consultancy with Experts Descriptive Statistics (n = 17)

CYCLE 5: WRER301 2015 PRACTICAL 7 *CONSULTANCY WITH EXPERTS*	**Mean**	**Standard Deviation**
Support for personally significant approaches to learning	**5.25**	**1.02**
Consultancy with experts allows for multiple representations and varying views of learning artefacts (content) and tasks.	5.35	1.17
Consultancy with experts enables and supports different strategies (e.g. visual, hands-on) for learning and indicated clearly which styles it supports.	5.24	1.09
Consultancy with experts is used in combination with other mediums (e-learning versus F2F) of instruction to support learning.	5.18	1.13

The students were also required to mention one positive and negative feature about the consultancy with experts (Table 7-16). The most positive feature of consultancy with experts was the real-life application (f = 6) of the theory and concepts learnt in class and applied in reality and everyday life. The students identified the fact that the consultancy with experts exposed them to individuals with industry experience (f = 5) and industry insight (f = 3) as positive features. Conversely, the length (f = 7) of the expert guest lecture was deemed to be too long and required a break in between and thus negatively impacted the attitudes of the students as well as their attention span.

Table 7-16: Positive and Negative Features of Cycle 5 Consultancy with Experts (n = 17)

Positive Features		
Themes	***f***	**Sample comments**
Real-life application	6	*You were able to see the theory and concepts we are taught being put to real-life practices*
Industry experience	5	*The opportunity to ask questions about the industry and valuable information from guest lecturer with a lot of experience*
Industry insight	3	*Expert gave in depth industry knowledge of ERP and its implementations*
Negative Features		
Themes	***f***	**Sample comments**
Length	7	*The lecture was very long, which makes it hard to focus throughout all of it*

The central tendency and dispersion (Appendix X), of the WRER301 2015 Practical 7 evaluation were between negative and positive, with the maximum for each item being *Strongly Agree* (7) and the lowest scoring items received *Strongly Disagree* (1). Only one item *"Creating our own learning content/material allows individual learners to customise the learning content/material they created to suit their personal learning strategies"* has a minimum score of *Strongly Disagree* (1). One item *"Creating our own learning content/material gave us some control of the content we learn, how it is learned, and the sequence of units"* has a maximum of *Agree* (6).

7.3.7 Post-test evaluation: SYSPRO Certification

After the seven week evaluation period was completed the students were required to complete a **post-test evaluation** where they evaluated the usefulness of ERP online certification. There were 27 students who participated in this feedback (Appendix Y). The students rated the fact that they thought ERP certification would be of use and benefit to them in the WRER course positively (μ = 6.56) which evaluated PU. They also ranked ERP certification being of use and benefit to them in their careers as positive (μ = 6.33). The students identified that having an ERP certification in terms of future careers, jobs and CVs (f = 21) as the most beneficial feature. One student stated that *"Certification is a key component of establishing a career in ERP and having this already by the time I leave university will hopefully help to launch my career".* Another student indicated *"ERP certifications provide evidence that we are getting the skills required in our future careers. They show future employers that we are good at things that we say we are good at. Therefore they will be of great benefit to us".*

7.3.8 Reflection

Overall conclusions can be made from the various findings and feedback collected during this cycle evaluation. Reflection will be conducted on problems encountered, a

focus group and a UGC competition were also conducted. Recommendations are also made for further improvements and will considered as future work.

T-test statistics were conducted on the data from Cycle 5 and the results were used to test the hypothesis that the mean factors scores are positive (Table 7-17). The “t” value is the t-test test statistic and the “d.f.” is the degrees of freedom (n - 1). The “p” value is used to determine whether the research hypothesis can be accepted, if $p < 0.05$. “Cohen’s d” is the practical significance statistic. For a result to be considered significant, it must be both statistically significant ($p < 0.05$) and practically significant (Cohen’s $d > 0.20$). The results highlighted in red indicated that the results are statistically and practically significant in this cycle evaluation. There are six criteria (variables) which have large practical significance[11], followed by three with medium practical significance and three with small practical significance. The remaining criteria are not practically significant. There are also criteria which are statistically significant and it can be reflected that a number of the variables evaluated possess statistical and practical significance.

[11] *Interpretation Intervals for Cohen’s d* < 0.20 (Not significant), 0.20 - 0.49 (Small); 0.50 - 0.79 (Medium); 0.80 + (Large) **(Gravetter & Wallnau, 2009, p. 264)**

Table 7-17: One-sample t-Tests: Bundle Factors Cycle 5

Variable	n	Mean	S.D.	t	d.f.	p	Cohen's d
Relevance of site content to the learner and the learning process							
Content is engaging, relevant, appropriate and clear to learners using the WBL site	27	5.56	1.05	5.72	26	**<.0005**	**1.10**
The material has no biases such as racial and gender biases, which may be deemed offensive	27	6.37	1.33	7.67	26	**<.0005**	**1.48**
Level of learner control	27	4.95	0.81	3.53	26	**.002**	**0.68**
Support for personally significant approaches to learning	27	5.58	0.95	6.49	26	**<.0005**	**1.25**
Badge motivation	27	5.37	1.63	3.10	26	**.005**	**0.60**
Overall Week 1	27	5.57	0.74	8.18	26	**<.0005**	**1.57**
PU of Interactive **Video**	25	5.04	1.34	2.39	24	**.025**	**0.48**
PU of Standard **Videos**	25	5.40	0.96	5.22	24	**<.0005**	**1.04**
SYSPRO Latte: Relevance of app content to the learner and the learning process, PU and PEOU	28	4.92	1.11	2.49	27	**.019**	**0.47**
The leader board has content and interactive features that attract, motivate and retain learners and that promote creativity on the part of the learners	28	5.04	1.69	1.99	27	.057	n/a
Live chats: PEOU, PU and peer-to-peer help	28	4.60	1.48	0.70	27	.490	n/a
Overall of Week 3 and 4	28	4.85	1.08	2.20	27	**.036**	**0.42**
Effectiveness of collaborative learning	17	5.06	1.39	1.95	16	.068	n/a
Level of learner control	17	4.66	1.22	0.88	16	.390	n/a
Learner motivation, creativity and active learning	17	4.88	1.41	1.41	16	.177	n/a
Support for personally significant approaches to learning	17	5.25	1.02	3.44	16	**.003**	**0.83**
Overall Week 7	17	4.96	1.00	2.32	16	**.034**	**0.56**

7.3.8.1 Problems Encountered

Several problems were encountered in this cycle and these are discussed in this section.

Assessment: SCORM video

Problems were experienced with the Introducing Inventory interactive SCORM video from the student side after the practical session (Section 7.2.5). The “student skip content structure page” setting in Moodle had to be changed from ‘always’ to ‘never’. It had worked perfectly during the practical, but not at home for the students. The students were not able to enter the activity at all, it just closed.

Communication: Forums

There are different types of forums available on Moodle (Section 7.2.7). The *Manufacturing Process Forum* was created where students were able to post questions to be answered by a member of industry after he had presented an expert guest lecture during one of the practical sessions. All students needed to be subscribed to the forum, however, even though the “Mail now” was not selected it still resulted in emails been sent out to everyone. The Subscription mode setting of the forum activity had to be changed from “forced” to “disabled” and then the users stopped receiving emails unless the “Mail now” was selected.

Moodle LMS: General Technical Problems

The ranking block plug-in on Moodle could not be used because NMMU is running an old version of Moodle and the researcher is unable to add such plug-ins (Section 7.2.1). Staff members who are in the CTLM had to do all the administration add-ons and extra features from their side. Terblanche (2015) did attempt to install this plug-in, however, it resulted in major errors and bugs on the NMMU Moodle system. There are various limitations due to the old version of Moodle at NMMU. The ranking block would have been ideal in ranking the enrolled students in terms of the entire module over the semester since it would take quizzes, assignments, participation and more into consideration and displaying it on a leader board.

One group was not able to submit their video on Moodle. The WRER301 Moodle page had been set to the limit of a maximum of 32MB, even though the separate activity only specifics 20MB. According to a Teaching Development Professional (Goldstone, 2015) at the NMMU CTLM even though the system advertises that its limit is 32MB, it is in fact far more than that, anything up to roughly 100MB. The group’s assignment was over 2GB and thus had to be handed in by making use of a flash drive.

Peer Reviewing: Workshop

As part of Assignment 1 the students were required to peer review each other’s work making use of a Moodle Workshop (Section 7.2.11). The first time the workshop activity was used there were various issues with reviewers being allocated. Groups had been set up in Moodle and the students had been assigned to their relevant groups. However, after consultation with a Teaching Development Professional (Goldstone, 2015) at the NMMU CTLM the researcher was advised that every member

in the group would have to submit a copy of their group's work in order for the peer reviewers to be allocated. This could not be done in groups. Thus, groups of two members got two sets of reviewer feedback and a group of four got four sets of reviewer feedback, this was the best workaround identified.

Allocation problems emerged in round one of the Moodle Workshop when students were allocated students in their own group to review. The researcher had to change a setting pertaining to groups to sort the problem out. Another problem came in when students had not submitted and there were late submissions. They could upload their work, but were not assigned a reviewer or allocated one. In this case, they were just manually assigned to a student's submission and that student then had more than one review. The student who submitted late, had to forfeit having their work reviewed because it was late.

The second time the Moodle Workshop was used for peer reviewing, the allocation and assignment of reviewers worked with no problems. However, when a student had completed their review by means of filling in a rubric and commenting, the review was lost. After submitting their review it vanished and did not record that a review had been done. The reason behind this is still unknown. However, after some testing it started to work again. It is not clear whether an increase of traffic on the WRER301 Moodle page could have been the cause or not.

In both cases, receiving feedback after the reviews were completed was a problem. For round 1, the students were able to see the completed rubric with marks and comments, however, their overall mark was still shown as zero. In other cases, particularly for round 2 and the expert review, the students did not see the feedback for a long period of time. It is as if the workshop does not automatically close on the closing date and time and this resulted in the students not being able to see their feedback at these times. The researcher had to manually close each workshop in order for the students to be able to view and access their reviewer feedback.

Moodle: Statistics Reports (Live Chats and Forums)

When the live chats and forums were set up, the Moodle statistics reports were taken into consideration in order to track participation logs of the students. The students were given marks for their participation in these activities, however, when actually running the "Course Participation" report together with other reports, the filtered results were

not a true reflection at all. All the students enrolled on the Moodle were in the list and when checking the actual live chats and forums, this was not the case. Thus, the researcher has to manually go through a class list and check who had or had not made a post(s) due to the various inaccuracies generated from the Moodle reports. This is a tedious exercise and can result in various errors for instance, leaving someone out that had participated or rewarding someone that actually did not participate.

7.3.8.2 WRER301 2015 Focus Group

In order to confirm the evaluation results, a focus group was conducted with 10 of the students, who were randomly selected (March 2015). The students were prompted with discussion points and questions in order to promote discussion (Table 7-18). The students are satisfied with making use of **Moodle** as their LMS, however, they did mention the problems experienced with peer reviewing not submitting their feedback. They identified various problems with submitting of assignments and homework on other LMS, such as Microsoft SharePoint, where other students in the class are able to view their submissions. The students admitted to looking at other student's submissions for ideas and references, which can also result in plagiarism and copying. The students reported that they definitely prefer submission on Moodle which is completely anonymous, where they cannot see each other's submissions. They feel that they are forced to work on their assignments and homework individually and thus work harder and better.

In terms of the ERP **videos** the students found them a bit annoying. However, if the same material had to be presented over an entire lecture session, then they definitely prefer the videos. Some focus group members did indicate that they in fact liked the videos since they could replay, re-watch and have access the videos at a later stage. They also identified fast forward, skip, pause and mute features positively. The videos allowed the students to be able to listen and watch them when they wanted to and they always had access to them, even from home and off-campus. The students reported that they liked the fact that the videos were downloadable and made learning easier. The students stated that they found tailoring and customising of the videos to their individual learning styles and preferences was far easier than F2F. They are able to mute the audio and read the text or merely listen to the audio. Many of these comments confirm what was identified in the Cycles 4 and 5 evaluations where the students identified positive and negative features of the videos (Tables 6-11 and 7-5).

In terms of their assignment which involved **UGC**, specifically the design of an interactive storyboard simulation the students stated that is was very time consuming; however, it did assist them in their learning process. The students commented on the fact that they were required to research the topic and at the same time keep in mind that other students would need to use their storyboard and content in learning about the given topic. The students indicated that they were eager to see their final products and to have their design implemented. The students enjoyed the fact that the assignment allowed for creativity and allowed their creative "juices" to flow. This feedback also links in with the quantitative (Table 7-13) and qualitative (Table 7-14) feedback received from the students.

In terms of the **badges**, the students reported that they did not find them to be very motivating; however, it was still identified as being the highest rated positive feature of the badges (Table 7-7). One student in particular, did not even know that there were badges. The students felt that an overall score board which took everything into account would be a better idea and more motivating. The students found the Top 5 achievers leader board more motivating than the badges. The students stated that all the top marks should be shown and not only limited to the Top 5, especially since sometimes more than five students would receive the top and joint highest marks.

In general the students prefer the standard Moodle quizzes **(assessment)** because they are able to go back and review their answers before submitting as opposed to the SCORM assessment. However, some did indicate that they in fact liked the SCORM assessment. The live chat seemed to be more popular amongst the students as opposed to the forums, even though both were allocated bonus marks for participation. The students stated that they like that the live chats to occur during a fixed time period in real time, facilitate immediate assistance and instant replies with minimum delays. A suggestion made by one of the students was to have a feature on the chats and forums which flagged when a specified problem had been solved. The students stated that they doubted if they would ever look back at the chats, maybe only if they were preparing for a test or exam or if they were experiencing a similar problem. The students reported that they felt it would be difficult to find the actual problems and that they would spend too much time working through the information, than actually finding the answers. Generally, the students seem to prefer the categorised live chat.

In terms of **communication**, specifically the notices that are sent out over the news forum which are then forwarded as emails, the students stated that they thought it was a good thing and they liked that it kept them informed and up-to-date. They like that the news forums contains instructions and thus they always know exactly that they need to do and what is required of them. The students reported that forums are not popular and are used infrequently even when bonus marks are awarded for participation. They mentioned that they refrain from using forums because everyone can see the questions that are being posted and consider this to be a bad thing and it is as if they are asking a “stupid” question.

The students indicated that they liked the idea of **peer reviewing** using an automated system, when it works. The students suggested that the peer reviewing on Moodle be improved by having ranking questions for the criteria and then only one general comment block at the end of the evaluation form, as opposed to having a comment block for each criteria. However, other students found that giving a mark was difficult and preferred the comments and suggested something along the lines of a “track changes” feature for reviewing purposes. Other students liked the combination of marks per criteria and comments. In terms of the expert review the students stated that they felt it was a good idea to receive input and feedback from experts.

The students’ general opinion of the **SYSPRO e-Learning System** was varied. Some students stated that they liked it and it did not bother them that various windows were opened. They liked the fact that once they had completed a task they could close the window. Some students mentioned that there were problems with errors in the tasks on the system. The majority of the students prefer electronic guides and manuals as opposed to paper versions. However, a few indicated that they would not mind paper versions if they provided more detailed explanations. Overall, it can be duly noted from this focus group that the students (the participant sample for this cycle) view the ERPeL positively and that the feedback obtained from the focus group does in fact confirm the quantitative and qualitative data was collected during the cycle evaluations.

Table 7-18: Focus Group Problems and Benefits

Benefits	Affected Component	Problems	Affected Component
Satisfied with Moodle as chosen LMS	Moodle LMS	Alternative LMS, peers able to see submissions	Moodle LMS
Moodle submission is anonymous (peers cannot see your submission)		Videos a bit annoying	Videos
Moodle forces them to work harder and better		Peer reviewing, not submitting feedback	Peer reviewing
Prefer videos to lectures	Videos	Assigned marks for peer reviewing (very subjective)	
Liked functionality of videos (fast forward, skip, pause, mute)		Various windows of SYSPRO e-Learning System	SYSPRO e-Learning System
Videos accessible off-campus		Did not find badges to be motivating	Badges
Videos enable customization of learning process (tailor to needs and preferences)		Not limited leader board to only Top 5	Leader board
User generated content assists with learning and promotes creativity	UGC	Doubt will ever re-visit live chat history (difficult to find solutions)	Communication
Automated peer reviewing	Peer reviewing	Forums not popular and used infrequently	
Prefer electronic guides (provided on SYSPRO e-Learning System)	Learning content	More practically oriented consultancy with experts	Consultancy with experts
Ability to review quiz questions in Moodle	Assessment		
Liked SCORM assessment			
Live chats more popular than forums (occur in fixed time period)	Communication		
Like news forum post which get emailed out (online noticeboard)			
View ERPeL positively	ERPeL		

7.3.8.3 User Generated Content Online Voting Poll

In order to potentially encourage the students to excel in the generation of their own learning content (Section 3.8.3), to increase motivation and ultimately to determine a “winner”, a round of presentations was decided (Section 7.2.2). The Top 4 groups were identified based on the marks received from their lecturers.

The groups presented their design to the class as well as to a panel of experts. The class voted in an online poll by making use of a Moodle Choice Activity (Figure 7-19). The panel of experts had to complete a scorecard (Appendix Z) for each group and then determine a ranking from first to fourth place. The votes from the online poll together with the rankings from the panel of experts were used to determine the winners who were awarded cash prizes determined on placement for their efforts. This competition in no way affected the marks of these students.

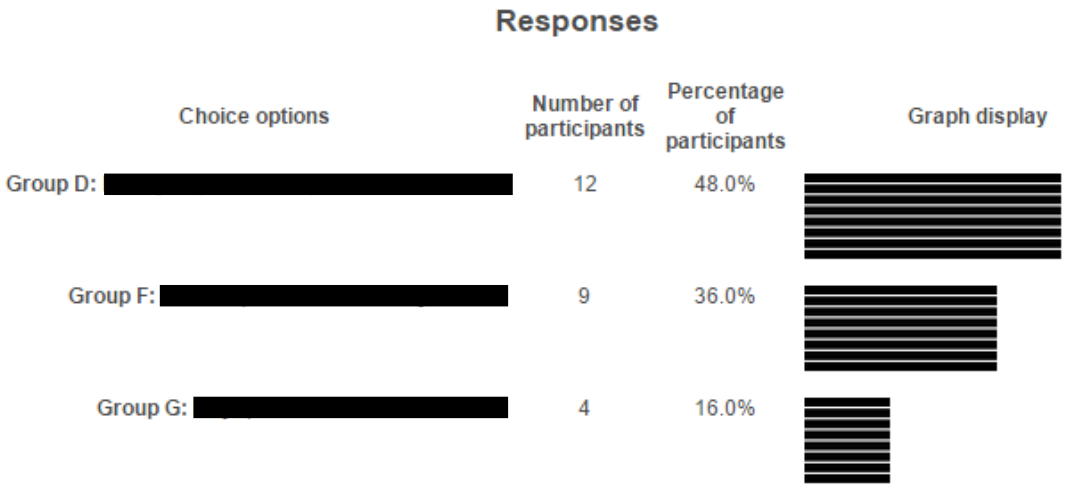

Figure 7-19: Results from the Moodle Choice Activity (Online Voting Poll)

7.3.8.4 Recommendations made by the Researcher

An added feature which would be of benefit to lectures, tutors and students alike is having the current topic or week displayed on the top of the module page. In terms of the Moodle Feedback Activity, the researcher recommends that this activity is ideal for fewer than five questions due to the design limitations and minimal modification capabilities. The Moodle Survey Activity was not used in this study since it provides a pre-set list of questions that can be used and questions cannot be changed or updated. However, the Moodle Survey Activity does have a more pleasant layout when being compared with the Moodle Feedback Activity. The Moodle Questionnaire Activity was also not used in this study because it was deemed to be easier and more efficient to make use of GoogleDocs forms as opposed to the Moodle Questionnaire Activity.

In terms of assessment, True and False questions are discouraged because when making use of online quizzes students will sometimes complete their quizzes at different times. True and False questions can promote the sharing of correct answers, however, standard multiple choice questions where students are not given the correct answer can decrease the sharing of quiz answers.

7.4 Conclusions

For this cycle evaluation a combination of learning approaches were used, consisting of F2F learning, e-learning and blended learning. The evaluation took place over an extended period of time, seven weeks, where minor improvements were made to the learning components even during the cycle. For example, uncategorised and

categorised live chats (Section 7.3.4). A few components were kept as-is and reused in this cycle evaluation, for example the videos (Section 7.2.3). The general layout of the Moodle page was kept similar, with the question of whether to change the layout to limit scrolling or not (Section 7.2.1). The general consensus amongst the participants was to leave the layout as-is. This could be due to the fact the participants become comfortable and familiar with the layout and thus changing the layout mid-way through the semester would then increase learnability of the new layout.

New learning components which were introduced in this cycle included UGC (Section 7.2.2), which was positively received and created additional motivation and competition within the class (Section 7.3.8.3). SYSPRO Latte had enhancements made to it in the form of an interactive process diagram which was a useful feature (Section 7.2.6). Additional components which were implemented in this cycle evaluation included communication in the form of forums and live chats (Section 7.2.7), further integration with the SYSPRO ERP and e-Learning systems with the help of executive panes (Section 7.2.8) and a leader board, which is another element of gamification (Section 7.2.9). The component of consultancy with experts was especially interesting to the students since they were able to interact with industry members and gain perspective into the operation and management of ERP systems in the real world (Section 7.2.10). Automated peer reviewing was conducted by making use of a Moodle Workshop, however, various problems resulted from implementation of this component (Section 7.2.11). The SYSPRO ERP Certification resulted in interest and enthusiasm from the student participants with the majority of the class receiving their SYSPRO 7 End User Foundation Certifications (Section 7.2.12 and 7.3.7).

From the Cronbach Alpha coefficients calculated, most of the criteria scored between acceptance and excellent reliability; however, one criteria *"Level of learner control"* for the ERPeL had poor reliability and is cause for concern, but since the sample size is small it can be justified. All the evaluations conducted were positively received by the sample. However, customising the ERPeL for personal learning strategies was rated neutral (μ = 4.07), which was yet again the lowest ranked criterion.

Generally, the badges that were implemented are visually stimulating and attractive, though the leader board was seen to be more motivating and created more competition amongst the class. Forums and live chats were ranked positively, but the

usefulness of these components is questionable. Since the general consensus seemed to reflect that these communication methods were more effort than use or benefit. Overall, the standard Moodle quizzes are preferred as opposed to the SCORM package assessments. The discussions conducted in the focus group confirmed the results and analysis of the weekly evaluations.

Even though, overall the components were positively ranked there were also some problems areas that were identified (Table 7-19) as well as specific technical Moodle errors (Table 7-20). The plan of action for these issues will more than likely result in a recommendation or future work, since Cycle 5 is the last evaluation cycle of this study.

This chapter was able to fully answer research questions five and six:

RQ5: *What combination of components can present an e-learning environment which has the highest levels of success for introductory ERP systems education?*

RQ6: *How successful is the proposed ERP e-Learning Environment (ERPeL)?*

Taking the ERPeL (Version 1) which was proposed in Chapter 6 and the components that were designed, implemented and evaluated in Cycle 5, an updated practical proposed ERPeL (Version 2) was implemented. ERPeL (Version 2) is based on the recommendations mentioned in Chapter 6, building on the ERPeL (Version 1) and taking into consideration the results and findings which were evident in this cycle evaluation. Thus, an updated environment was successfully implemented in a real-world context, as a real-world solution.

Success of the proposed ERPeL is highlighted and discussed in great detail in this chapter and is specifically emphasised by the very positive feedback received from the various participant groups.

Table 7-19: Problems and Plan of Action (Cycle 5)

Problems ***(Negative features)***	**Component**	**Plan of Action**
No immediate feedback	Assessment: Moodle Quizzes	*Identified in Cycle 4.* Possibly a newer, more updated version of Moodle would be able to address this. Nothing can be done to change the default Moodle layout.
Interface: Visually lacking, boring and could use more colour		
Revisiting, skipping questions and modifying answers	Assessment: SCORM	*Identified in Cycle 4.* Always a good idea to make use of a combination of assessment methods (Moodle quizzes and SCORM) in order to promote learning. Problems of one approach can be the benefits of another.
Presenters' voices	Videos	*Identified in Cycle 4.* Out of researcher's control, cannot change someone's voice.
Speed (audio too fast and too slow)		Speed is questionable, what is too fast or too slow. Features of pause, rewind and replay can assist with this matter.
Boring		It has been noted that F2F lectures are more boring. Have to cover specific ILOs and attempt to make it as exciting and interactive as possible.
Lack in explanation		Videos can only be so long before listener get distracted. Videos meant to be a high-level overview of the content to be covered.
Limited viewing ability	Badges	Visible on Moodle profile and also with the use of "my latest badges" block. Moodle limited in this regards.
Different badges for different levels of achievement (e.g. Gold, Silver, Bronze)	Badges: Suggestion	Something to consider for **future work**.
Tedious, too many tasks to complete	SYSPRO e-Learning System	Problem is that the system was designed for industry and not HEI education, thus an evident mismatch. SYSPRO designed and therefore is out of the researcher's control. Attempt to minimise and eliminate the process view problem.
Boring		
Button clicking (process view)		
More exploration needed	m-Learning App (SYSPRO Latte)	Increased learnability of the application is needed for some individuals.
Tedious and too simplistic		Supposed to be a high-level explanation of a specific business process. **Future** updates could possibly include more detail.
No real knowledge acquired		
Names visible	Leader board	If the names were to be removed, it would not have the same levels of motivation and competition amongst the class.
Demotivating and discouraging		Gamification is known to work both ways and it has shown increased motivation, competition and has encouraged students to learning harder and take more responsibility of their own learning process.
Lack of F2F communication	Live chats	F2F contact is limited since the live chats are pure examples of e-learning. Thus, F2F communication is eliminated completely.
Waiting time		This element has never been used in a practical session before, might have been a reason behind the time lag. Additional student assistants to monitor the live chat might be a good recommendation for **future work.** Time spent waiting similar to that of having to wait for a physical student assistant in the computer lab.
Time consuming		
Time consuming	User Generated Content	Since UGC involves the creation of learning content it will indeed be time consuming.
Confusion in terms of content to include		Same problem that lecturers (instructors) go through. More appreciation for teachers and the time spent of preparation.

Table 7-20: Technical Moodle Errors and Plan of Action (Cycle 5)

Problems ***(Negative features)***	**Component**	**Plan of Action**
Accessibility and speed	Assessment: SCORM	Moodle setting that needed to be fixed.
Viewing	Videos: Interactive	Moodle setting that needed to be fixed.
Emailing of forum posts	Communication: Forum	Moodle setting that needed to be fixed.
Upload size (max of 32MB)	User Generated Content	Moodle can only handle uploads of a specific size. The video thus had to be handed in on a flash drive. The video was later split into 3 parts which could be uploaded to Moodle.
Peer reviewer allocation, assigned reviewers in the same group	Peer reviewing	Allocation had to be done manually. Moodle problem.
Peer reviewer feedback not displaying		Workshop had to be manually closed. Moodle problem.
Late submissions peer review allocation		Allocation had to be done manually Moodle problem.

Chapter 8 is the final chapter and summarises this study. The chapter will review the research objectives and discuss the research contributions, problems experienced and the recommendations for future research.

Chapter 8. Conclusions and Recommendations

8.1 Introduction

This study investigated ERP education and the various problems with learning in this field, particularly in higher education. The main aim of this study was to design, implement and evaluate an e-learning environment to support ERP education. The main research question (RQ_M) for this study is: "***What are the elements of a successful e-learning environment for supporting ERP education?"*** and the main research objective (RO_M) of this study is: "***To implement a successful e-learning environment for ERP education"***. This chapter will discuss the findings from the study. The research objectives need to be reviewed in order to determine whether the study was successful (Section 8.2). Several theoretical and practical research contributions were made (Section 8.3). A few problems and limitations were experienced (Section 8.4). Recommendations are made for future work which can expand on this study (Section 8.5). The entire study is summarised (Section 8.6). This chapter will therefore discuss and answer the following research question:

RQ7: *What design principles and guidelines can be proposed for e-learning of ERP education?*

8.2 Research Objectives Reviewed

This study involved the analysis of a practical problem and the development of a solution which were informed by existing design principles and technological innovations (Amiel & Reeves, 2008; Van Wyk & De Villiers, 2014). Iterative cycles of evaluations were conducted and refinements were made to the solution in practice. Finally, reflection occurred where design principles were produced and enhancements could be made to the implemented solution. This study followed an adapted set of iterative DBR cycles (Figure 5-3) where the various processes of the DBR methodology were followed.

The first objective (RO1) was to identify problems with ERP systems' education. Some of the main problems with ERP education are *a lack of ERP specialists, a lack of understanding of underlying processes (process view), availability of instructional content and vendor-based content and training* (Table 3-1). These problems were then further investigated by using a case study approach where people from industry were

interviewed in order to investigate whether the problems with ERP education that are identified in literature are the same or similar to those problems experienced in real-world contexts (Table 4-6). The majority of the problems with ERP education were confirmed by the feedback that was obtained from the industry interviewees.

The second objective (RO2) was to identify success factors for e-learning of ERP systems. Previous authors (Scholtz & Kapeso, 2014) identified *nine* e-learning success factors and *eight* m-learning success factors. The Scholtz and Kapeso (2014) framework for e-learning of ERP systems was further expanded on and adapted. Additional success factors for e-learning that were added include: *technology, IT infrastructure and gamification elements;* thus proposing a complete set of 20 CSFs for e-learning (Table 3-7).

The third objective (RO3) was to identify criteria that can be used to evaluate the success of e-learning environments. The concept of *success* was defined and is said to encompass various aspects of technology acceptance, effectiveness, usability and user satisfaction. The TAM, PEOU and PU, were deemed appropriate for evaluating e-learning. However, the ATU and MRT are theories which could also be taken into consideration when evaluating the success of e-learning. After a thorough literature review, a set of evaluation criteria that was to be used in the relevant DBR cycles was proposed (Table 5-2). *Cycle 2* made use of the TAM (PEOU and PU) for evaluation purposes. *Cycle 4* made use of an adapted set of Ssemugabi and De Villiers (2007, 2010) criteria*. Cycle 5* made use of a combination of TAM (PEOU and PU) and the Ssemugabi and De Villiers (2007, 2010) criteria. Reasons for the use of these criteria and for adapting and combining them was decided on due to the limited evaluation criteria available for the evaluation of individual e-learning components and thus, the extended set of evaluation criteria is deemed to be the most appropriate choice.

The fourth objective (RO4) was to explore e-learning components that can be used to assist with ERP education. Various e-learning components were explored such as *visual presentation, SCORM packages, user generated content and online certifications* (Figure 5-6). The evaluation plan and framework of the various DBR cycles was stipulated together with the various e-learning components that were to be designed, developed and evaluated in the different DBR cycles (Chapter 5, Figure

5-3). Examples of these components were *videos, badges (gamification) and an m-learning application.*

The fifth objective (RO5) was to design and propose an e-learning environment for introductory ERP systems' education. Since this study followed various iterative DBR cycles, different versions of the environment were proposed based on the evaluations that were conducted (Chapters 6 and 7). Each cycle and version of the environment involved a thorough design and development phase where design guidelines and considerations (Section 5.3) were adhered to. Various e-learning components which formed part of the environment were developed, for example the videos and the environments were set up in the LMS, Moodle.

The sixth objective (RO6) was to evaluate the success of the proposed ERP e-Learning Environment (ERPeL). The environment and components were implemented into an introductory ERP systems course in order to evaluate their success. The environments were evaluated by various participants (student and industry). Overall, the different versions of the *ERPeL (Version 1, Chapter 6 and Version 2, Chapter 7)* were deemed to be successful since they were positively received by the different participant groups.

The seventh objective (RO7) was to propose a set of recommended e-learning design principles and guidelines for ERP education, which is the outcome of this final chapter (Chapter 8).

8.3 Theoretical and Practical Research Contributions

The research contributions are both theoretical (Section 8.3.1) and practical (Section 8.3.2). The contributions can be seen as the elements that are combined in the ERPeL.

8.3.1 Theoretical Contributions

The elements that are theoretical contributions are:

- Success Factors (Table 3-7);
- Evaluation Criteria (Table 5-2 and 8-1); and
- Environment for e-Learning of ERP Systems (Chapters 3 and 5, Figures 3-9 and 5-7).

The success factors that were proposed (Table 3-7) can be compared with the ERPeL in order to determine whether the environment was successful from a ***success***

factors point of view, but also to reaffirm the positive responses that were obtained from the participant groups who were involved in the evaluation of the ERPeL at various stages of its development.

However, problems are faced with *IT infrastructure* since these ERP courses were presented at an HEI where students who might not have had access to the Internet at home could have completed their e-learning specific tasks at university. Although, the Internet was provided in computer labs access and availability to the Internet and adequate bandwidth can never be guaranteed and thus IT infrastructure is an evident hindering factor on the success of the ERPeL. This comprehensive set of CSFs can be used in order to guide the success of an e-learning implementation initiative.

In terms of the ***evaluation criteria*** the aim was to potentially improve and update the Ssemugabi and De Villiers (2007, 2010) criteria. However, for this study it was deemed more suitable to make use of the already proposed criteria and adapt them to this study as well as combine them with other available criteria. Thus, an updated set of heuristic for evaluating e-learning components is proposed, highlighting the specific e-learning component that can be evaluated by making use of a specific criteria (Table 8-1).

The theoretical contributions of this study, mainly the success factors and the evaluation criteria can also be considered as ***design guidelines*** and can be applied to other research in the field of e-learning. The success factors and evaluation criteria that have been proposed can guide the design of a future e-learning initiative. Although, this study did focus on ERP education, the underlying and main principles focus on e-learning and thus can be applied to other e-learning studies which might focus on a different field of education.

The ***Environment for e-Learning of ERP Systems*** has gone through two versions of review in this study (Figures 3-9 and 5-7). Various research findings were investigated in literature and then further empirically researched in real-world contexts. The literature review conducted together with the empirical field studies and evaluations were then considered and compared.

Table 8-1: Updated Set of Heuristic for Evaluating e-Learning Components

Heuristic for the Evaluation of e-Learning Components and Environments	Example of e-Learning Component to evaluate
Criteria and sub-criteria	
1. Relevance of site content to the learner and the learning process	
• Content is engaging, relevant, appropriate and clear to learners using X.	m-Learning
• X has no biases such as racial and gender biases, which may be deemed offensive.	
2. Level of learner control	
• Apart from controlling the interactions with X, learners have some freedom to direct their learning, either individually or collaboratively, and to have a sense of ownership of it.	User Generated Content
• Learners are given some control of the content they learn, how it is learned, and the sequence of units.	
• Individual learners can customise X to suit their personal learning strategies.	
• Where appropriate, learners can take the initiative regarding the methods, time, place, content and sequence of learning.	
3. Support for personally significant approaches to learning	
• There are multiple representations and varying views of learning artefacts and tasks.	Consultancy with experts
• X supports different strategies for learning and indicated clearly which styles it supports.	
• X is used in combination with other mediums of instruction to support learning.	
• Metacognition is encouraged.	m-Learning
• Learning activities are scaffolded by learner support and by optional additional information.	
4. Learner motivation, creativity and active learning	
• X has content and interactive features that attract, motivate and retain learners, and that promote creativity.	Leader board
5. Effectiveness of collaborative learning	
• Facilities and activities are available that encourage learner-learner and learner-teacher interactions.	User Generated Content
Technology Acceptance Model (TAM)	
6. Perceived Usefulness (PU) • I think X will be is use and benefit to me. • Using X can improve my performance with Y. • Using X can enable me to accomplish Y more effectively. • I found X useful for my Y. • Using X can assist me with doing Y more efficiently (more productive).	Videos
7. Perceived Ease of Use (PEOU) • I found X easy to use. • Learning to use X was easy for me. • It was easy to become skilful at using X.	Communication e.g. Live Chat
8. Attitude Towards Usability (ATU)	
Learner motivation	
9. I felt that X was motivating.	Badges
Support for communication with peers	
10. X allowed me to make use of peer-to-peer help	Communication e.g. Live Chat
Media Richness Theory (MRT)	

8.3.2 Practical Contributions

The elements that are considered to be practical contributions are:

- The Actual e-Learning Components (Chapters 6 and 7); and

- Practical LMS Lessons Learnt (Chapters 4, 6 and 7).

The ***actual components of the ERPeL*** which were practically implemented into the introductory ERP systems' courses are seen to form part of the practical contribution of this study. These components were: videos, badges, a SCORM assessment and the SYSPRO Latte m-learning application. The components form part of the ERPeL; however, they are also stand-alone components which can be used in different environments. The Environment for e-Learning of ERP Systems can be implemented and applied to other ERP specific initiatives or adapted for alterative e-learning projects. The Moodle LMS was seen as the central point of the environment, since the ERPeL was specifically applied to Moodle, there are some ***practical LMS lessons learnt*** that can be used by fellow researchers investigating the use of Moodle, namely:

- Make use of Google Chrome (browser) when running SCORM packages;
- Create a test user account (student user) in order to be able to properly test activities and components;
- Use a variety of Moodle activities in the presentation and assessment of content;
- Make sure that all video (or other) uploads are less than 32MB;
- Make use of a cloud storage platform to store videos and then access via an URL link;
- Ensure that badges are 90 x 90 pixels to avoid poor quality and cropping of badge designs;
- Discuss a preferred layout with users before deciding on when to adopt a scrolling or none scrolling layout;
- Enable course tracking so that badges can be awarded and criteria can be assigned;
- Ensure that all of the initial settings are setup on your module page;
- Hide activities that are still in the draft phase;
- Remember to unhide or enable access to activities when they are needed;
- If you would like users to be able to reply to forum posts, ensure that the correct setting has been enabled to allow for this;

- Good idea to select “mail now” option when making forum posts so that users can receive the forums via email as well, since users are generally not always logged in;
- Assign student assistants to the tutor role;
- If making use of a leader board (quiz results block), ensure that the top achievers are all shown. Sometimes more than one student will receive the same mark and thus not all the achievers will be displayed;
- At the beginning of the course, setup an enrolment key so that only registered users can gain access to your module page and learning material;
- Careful planning, specifically in terms of dates and cut off times needs to be determined in advance before setting up of a workshop; and
- Settings are a vital component and thus it is important to check the settings whenever adding or editing an activity.

8.4 Problems Experienced and Limitations

A limitation that was experienced was the fact that only a small sample size was used and was available to participate and evaluate the e-learning components of this study. Since the main participation group were NMMU students, they were often not reliable in terms of completing the practical tasks, making use of the e-learning components or completing the questionnaires and online feedback. Due to this limitation the number of student participants did fluctuate quite considerably. However, since the evaluations are considered to be usability evaluations of the ERPeL, the number of participants was deemed to be appropriate. Another limiting factor can be that the research of this study was only conducted at one HEI.

Another limitation is that at the time of design and development of the environment NMMU was running an old version of Moodle. The university only decided to upgrade Moodle to a newer version in July 2015, after a year and a half of experiments and evaluations had already been conducted and thus it was deemed too late to make use of the newer version of Moodle which would have yielded additional and more variety of e-learning components to implement.

8.5 Recommendations and Future Research

Since e-learning is still considered to be a relatively new field of research, there is still plenty of research that needs to be conducted. Technology is constantly evolving and

thus new developments in technology that can be used for educational purposes can be further researched, particularly with regards to evaluation criteria. Since the videos were well received, future work in the form of additional simulations, for example a tutorial which integrates into the SYSPRO interface (ERP system) with context sensitive content and additional videos can be conducted. Additional content can be created by making use of different learning content designer software such as Adobe Captivate. The concept of user generated content can also be further explored. With the interest in use and availability of smartphones and tablet devices, future research could investigate incorporating more m-learning into the learning process. SYSPRO Latte itself, can be further enhanced and developed to address all of the SYSPRO business processes.

Newer versions of Moodle can be investigated as well as additional plug-ins such as the ranking block where gamification is expanded on. With this plug-in users are assigned points based on activity on Moodle and then these points are displayed on a scoreboard. Different badge designs and criteria for awarding badges could be explored. The use of badges to motivate students could be investigated. The aspects which were consisted to be out of scope for this project, mainly virtual learning, MOOCs and social media could provide useful research. Additional criteria should also be explored to add to the evaluation criteria already specified, especially in terms of the individual e-learning components such as videos and interactive features.

Finally, a recommendation for future work should be another study which verifies this study in a different organisation. Possibly conducted at another South African HEI, as well as an international HEI. The prospect of implementing this solution (environment) in industry is also a recommendation for future research that should be conducted.

8.6 Summary

This study had produced the artefact of the **ERPeL** which can be used by researchers and applied to other e-learning studies. The ERPeL can also be used to guide the setting up of an ERP course which makes use of e-learning. The ERPeL makes use of a variety of elements in order to achieve a common goal, in this case the successful education of HEI students on the topic of introductory ERP systems. The environment looks at various success factors which are evident in order for the implementation of e-learning to be successful, since there are various factors that affect and/or hinder

the success and adoption of e-learning. The environment also looks at learning components which are used in the education process, mainly different forms of content (guides and videos), pedagogy and learning design methodology (e-learning and blended learning) and technology (systems, apps and tools). The environment looks at the evaluation criteria that can be used to evaluate these learning components in order to determine whether they are successful or not. Thus, the environment is easily adapted to different types of learning components.

The ERPeL main objective is that it promotes learning amongst students and that with the use of e-learning students are able to choose whether they would sit in a “boring” F2F lecture or rather watch an interactive video in their own time. The “learners” of this generation are drawn to self-paced, customised learning and the ERPeL promotes such learning to take place.

ERPeL was successfully evaluated by mainly students, but also some industry participants. The results showed that the ERPeL was positively received by the participants groups and does assist with the e-learning of ERP systems. Hopefully from this research that was conducted the various problems that affect ERP education and learning can be alleviated in some way or other.

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Appendices