

Technology and educational innovation: A case study of the
virtual campus of the University of Pretoria

A thesis by

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ABSTRACT

This study investigates the creation and evolution of the virtual campus of the University of Pretoria as a case of educational innovation. The theoretical fields of *learning, instructional design, knowledge creation, knowledge management, organisational learning, change management, technology innovation* and *customer relationship management* are drawn upon to contribute to inquiry into educational innovation. These theories were selected because the case consists of *process, product* and *service* innovation components that require an interdisciplinary perspective to achieve a holistic analysis. *Process innovation* explores new processes that have been embedded in the institution to support the virtual campus. *Product innovation* explores web-supported courses and *service innovation* explores new web-based services that have been created. The theoretical framework contains important strategies that go beyond the field of technology innovation. Following an extensive literature survey, the researcher sketches the higher education landscape – focusing predominantly on virtual education. This serves the purpose of contextualising the case within a broader setting of higher education and the impact of technology on various aspects of higher education. Theoretical constructs are applied to *process, product* and *service* innovation components of the virtual campus to explore how they manifested in the case. Qualitative and quantitative research methods are used to investigate *process, product* and *service* innovation components of the case. The research contributes to knowledge about educational innovation by means of a case study of the virtual campus. In addition, the findings of the practice of the case contribute to various theories and can be used to improve upon current practice.

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Chapter 1 Introduction

“You cannot step twice into the same river, for fresh waters are ever flowing in upon you”.

Heraclitus

This research sets out to explore the following question:

What are we learning about technology and educational innovation? A case study of the virtual campus at the University of Pretoria.

Key words: virtual campus, learning, technology innovation, knowledge creation, knowledge management, organisational learning, instructional design, change management, customer relationship management (CRM).

In today's business environment there is no executive task more vital and demanding than that of sustained management of innovation and change...to compete in this ever-changing environment, companies must create new products, services and processes; to dominate they must adopt innovation as a way of life.

Tushman and Nadler (1986:74)

Quality in a service or product is not what you put into it. It is what the client or customer gets out of it.

Drucker (cited in Crego and Schiffrin, 1995:42)

This thesis investigates *process, product* and *service* innovation at a higher education institution. The virtual campus of the University of Pretoria was chosen as the case, because it is regarded as an example of educational innovation. As project leader of the virtual campus, the researcher managed the innovations in the case. As a result primary experience informs this study.

Technology innovation is an established field of research, but innovation in higher education (educational innovation) is an unexplored research area. The field of technology innovation is not adequate to describe and investigate all aspects of educational innovation. Therefore both learning and management theories are drawn upon to better understand the virtual campus as an educational innovation. An interdisciplinary framework is developed by exploring *knowledge, learning and design theory, organisational learning, knowledge creation, knowledge management, change management, technology innovation and customer relationship management*, and using it to identify critical success factors involved in educational innovation.

In the field of technology innovation a useful distinction is made between *process, product, and service* innovation as different types of innovation. Product or service innovation is associated with new product development. In a service organisation the product is supplying a service to the client. Process or procedure innovation relates to improving current procedures and processes used in the production of products. (Utterback and Abernathy, 1975). This distinction is relevant to this study because an analysis of the virtual campus as an educational innovation proves that it can be collapsed into three distinctive components: *process, product, and service* innovation. Process innovation is required to create and sustain new products and services. This cycle is illustrated in Figure 1.1.

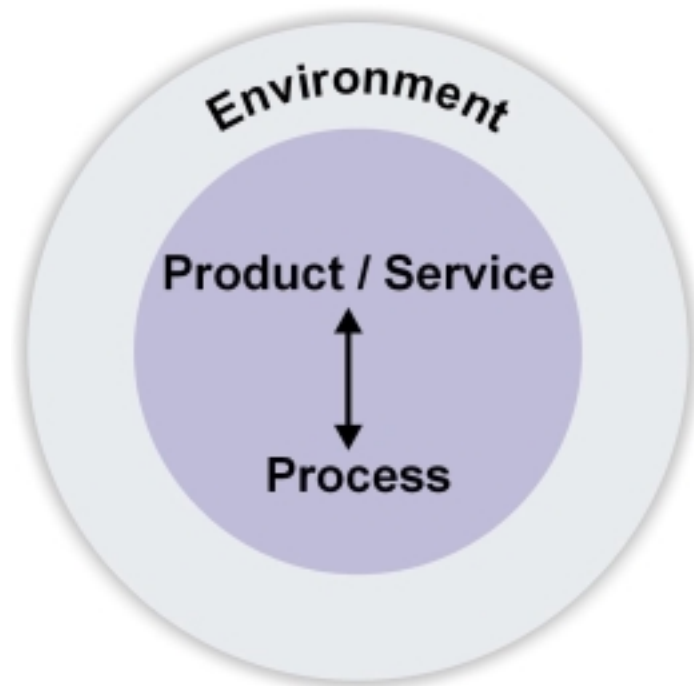


Figure 1.1 Innovation cycle

The focus on *Process innovation* refers to the implementation of structures, procedures and infrastructure to create and support the virtual campus.

The focus on *Product innovation* in this study refers to web-supported courses and the online yearbook and degree audit. The focus on *Service innovation* refers to web-based administrative facilities that were created for students and faculty.

Table 1.1 indicates the products and services of the virtual campus.

Product	Service
Online courses	Student Online Services
Online yearbook and degree audit	Online Application
	Online Payment
	Lecturers Online
	Online Registration

Table 1.1 Products and services of the virtual campus

The web-supported courses and web-based yearbook are regarded as new products and therefore as examples of *product* innovation. The various web-based administrative services are regarded as new services and therefore are regarded as examples of *service* innovation. The new structures, infrastructure and processes that were used on the one hand to create the new products and services of the virtual campus and which have been embedded in the institution to support and sustain the virtual campus on the other hand are considered to be examples of *process* innovation.

Figure 1.2 illustrates how the different theories are used to describe and interpret *process*, *product* and *service* innovation of the virtual campus. Disciplines drawn upon to develop the framework were identified during the research process and are particularly suited to higher education. Theory is applied to the case to reveal how it manifested in its various components of *process*, *product* and *service* innovation. Concomitantly, the innovation components are interpreted to enquire how the case informs theory.

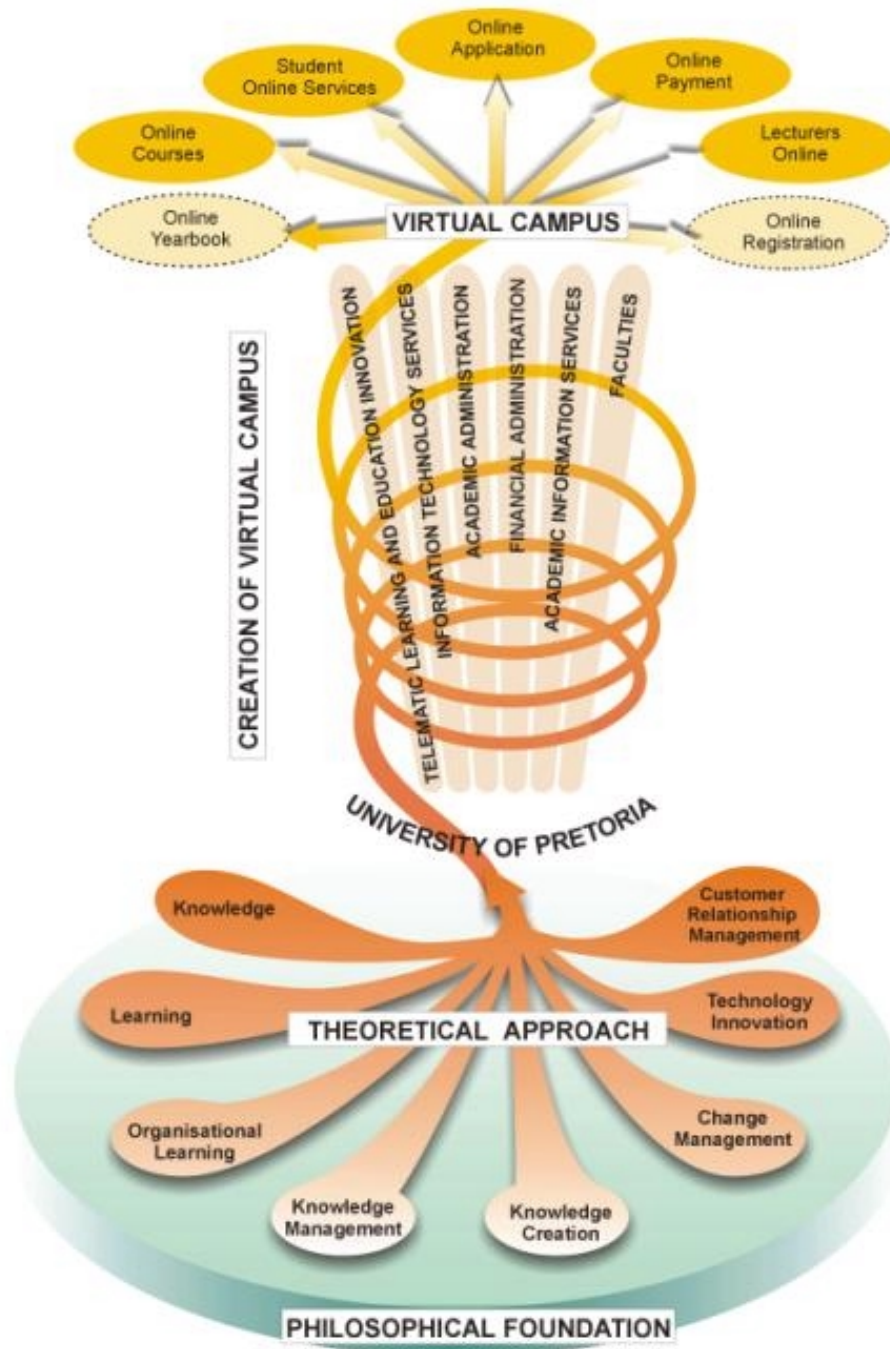


Figure 1.2 Theoretical fields used to describe and interpret the virtual campus

A decision was made to adopt a qualitative approach to explore educational innovation because innovation is too complex to reduce to only quantifiable measures. Statistical data is used as a descriptive measure. Hence a mixed method of research is used.

The structure of the thesis is illustrated in Figure 1.3. Chapter One describes the research problem and research methodology. It gives an overview of the study and explains terminology. Chapter Two is a comprehensive literature review of Learning and Management theories that are applied to the case. Technology innovation is also discussed to explore innovation theory. Chapter Three shows how these different theories manifest in the current higher education landscape. The impact of technology on higher education institutions is emphasised in light of an important focus of this thesis: technology innovation. It explains forces that are shaping the higher education landscape and touches on *process*, *product* and *service* innovation within an educational context. Both international and national perspectives are given. The purpose of Chapter Three is to provide the correct context for the virtual campus as a case. Chapter Four is a case study and describes and interprets the virtual campus from multiple perspectives: learning, management and innovation involved in *process*, *product* and *service* innovation. Chapter Five is the conclusion and makes recommendations for further research.

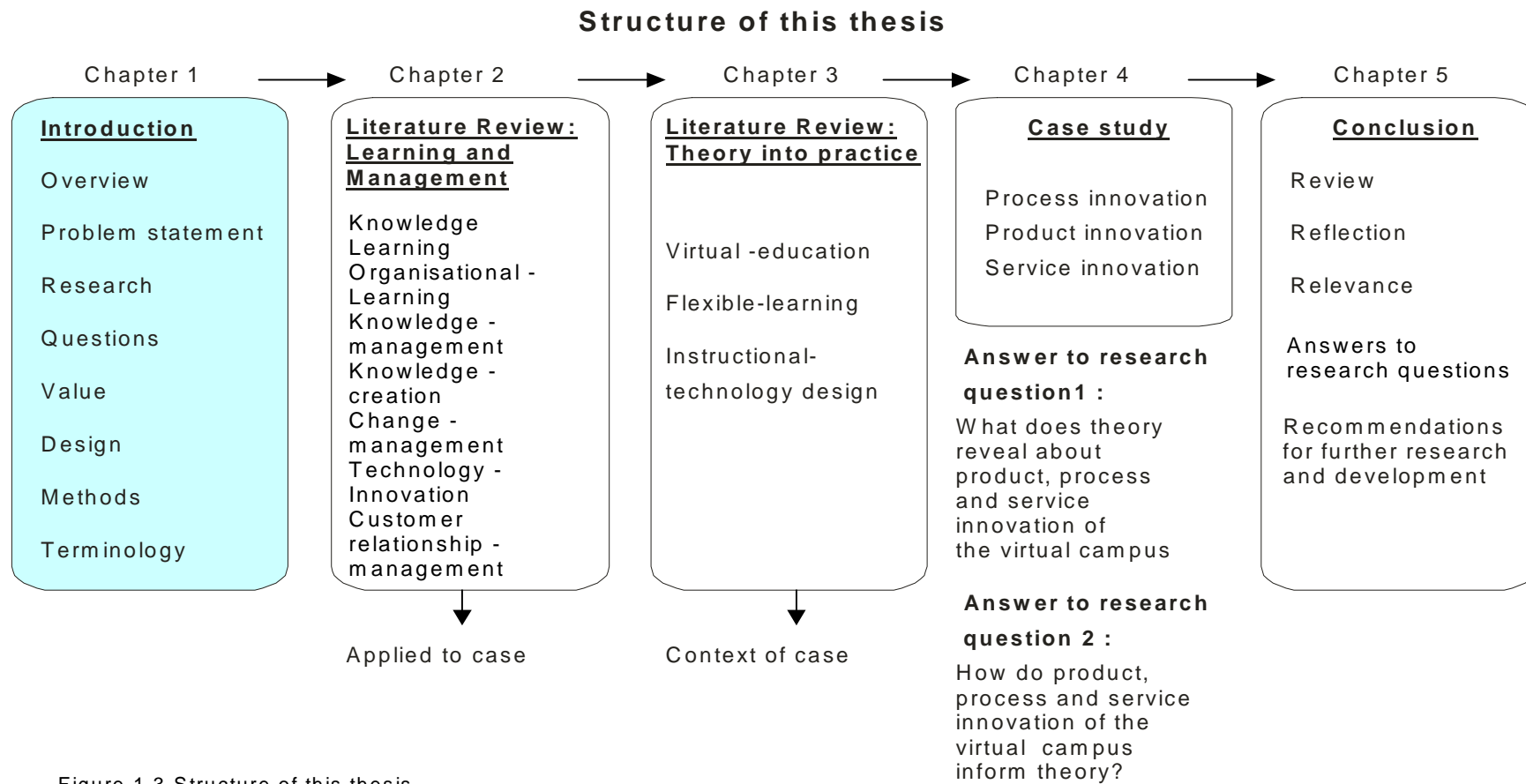


Figure 1.3 Structure of this thesis

The structure of the thesis is explained in Section 1.1.

1.1 Overview

The thesis consists of five chapters, references, annexures and a glossary.

Chapter One (Introduction) is an introduction of this study and explains the research methodology that is used. The reliability of the outcome of the study depends largely on the methods used to reach those conclusions. It should be noted that subjectivity could be considered a threat to valid inferences in qualitative research because the researcher is the key instrument. Although this could confound the validity of the study, it is lessened by empirical components that are used. The research questions, approach, design, data collection methods, sampling and reliability and validity considerations are discussed. The value of the research is highlighted as well as the reasons for the selection of specific theories.

Chapter Two (Literature review: Learning and Management) explores different theories related to Learning and Management. The fields of *knowledge, learning and design theory, organisational learning, knowledge creation, knowledge management, change management, technology innovation and customer relationship management* are discussed. These theories are explored to illustrate the complex nature of educational innovation and the factors inherent in educational innovation. They are applied to the virtual campus as a case of educational innovation in Chapter Four in order to describe and interpret the various components of the virtual campus.

Chapter Three (Literature review: Theory into practice) Global innovation trends in higher education are highlighted to create the appropriate context of the study and particularly of the case of the virtual campus. Best practice is delineated and the concepts of *virtual education, flexible learning and instructional technology design* are explored as a literature review of theory into practice. Certain aspects of theory in practice are applied to the case in Chapter Four.

Chapter Four (Evaluation) is a case on the creation and evolution of the virtual campus of the University of Pretoria. It explores the various innovation processes that were used to create new products and services and the way these were managed over a four-year period. *Product and service* innovation are both

investigated. New processes that support and sustain the new products and services are described. Theory in Chapter Two is applied to *process*, *product* and *service* innovation to reveal what manifested in the case. In turn, these innovations are interpreted as to how they inform theory.

Chapter Five (Conclusion) is a review of the thesis and is a reflection on what the case study reveals about theory and practice. It highlights limitations and benefits of the study. The relevance of the study is discussed and recommendations for further research are made.

The addendum contains documentation, questionnaires, samples of web courses and a glossary.

Section 1.2 presents the problem statement of this study.

1.2 Introduction to research questions

Innovation in higher education is an unexplored field. Increased understanding of innovation should, in turn, lead to competitiveness. There is, therefore, a need for a framework that can be used as a tool to guide innovation management in terms of new *products*, *processes* and *services* in higher education. Organisations are increasingly turning to innovative practices in order to remain competitive. According to Porter *et al.* (1991:5) there is synergy between innovation and competitiveness. This thesis focuses on a case at the University of Pretoria in an attempt to contribute to knowledge about innovation in higher education. Although the findings of this study cannot be generalised to other higher education institutions, the study contributes to knowledge about educational innovation within a higher education context. It also contributes to knowledge about virtual education.

Information and communication technologies (ICT) and the knowledge economy require higher education institutions to change. In order to adapt, many residential higher education institutions have positioned themselves to offer flexible, technology-enhanced education that includes the use of technology in their product and service offering. The creation and evolution of the virtual campus is regarded in this study as an educational innovation and is therefore investigated from both a learning and management perspective, i.e. how were the *process*, *product* and *service* aspects managed; which theoretical constructs manifested and how do these innovations

inform theory. Theory about learning is relevant from a product perspective i.e. how must the new product be designed to foster individual learning in teams and from an organisational perspective, i.e. how do people learn during innovation.

Technology innovation is an established field of study, but limited literature is available on innovation in a higher education context. This prompted the researcher to select relevant theories that are appropriate to address the broader context of educational innovation.

Amidst significant changes and challenges, knowledge of institutional processes and structures required to support virtual education is topical and relevant to higher education institutions globally.

The magnitude of administrative, teaching and learning components present in the virtual campus, makes it a complex and encompassing project. As a result this study covers all aspects of the virtual campus in order to provide a comprehensive and holistic analysis. As stated previously, during the research process it became apparent that technology innovation as a field is not adequate to explain *process*, *product*, and *service* innovation involved in the creation and evolution of the virtual campus. Subsequently there is a range of theories that sheds light on the various aspects of the virtual campus. Thus, a multiple faceted approach is adopted to explore *process*, *product* and *service innovation* in the creation and evolution of the virtual campus.

The selected theories are disciplines in their own right. To the researcher's knowledge these theoretical fields have never been combined to augment technology innovation as a field of study to better inform educational innovation.

Section 1.3 explains the research questions of this study.

1.3 Research questions

The following main research question guided the inquiry:

What are we learning about technology and educational innovation at the University of Pretoria?

This question can be sub-divided into two research questions:

1.3.1 What does theory reveal about process, product and service innovation of the virtual campus? (Addressed in Chapter Four)

1.3.2 How do process, product and service innovation of the virtual campus inform theory? (Addressed in Chapter Four)

The purpose of these questions is to elicit information regarding the connection between various theories and educational innovation.

Each of these questions can be expanded into further sub questions:

1.3.1.1 Having selected theoretical and practical elements to comprise the literature survey in Chapter Two and Chapter Three, in what ways, and to what extent, are they found to be implemented and manifested in the creation and evolution of the virtual campus in terms of *process*, *product*, and *service* innovation and the management thereof?

Specific research questions regarding product innovation

- What is the prevalent educational model that is followed in web-supported courses?
- Do behaviourist or constructivist instructional design principles manifest in the web-supported courses?
- Is the diffusion of *WebCT* as the solution to support web-supported courses successful?
- Does effective learning take place in web-supported courses?

- How does the use of the web in teaching and learning impact the role of the lecturer?

Specific research questions regarding process innovation

- Which processes were used to create new products and services and in what way do the theories of knowledge creation, knowledge management, organisational learning, change management, technology innovation and customer relationship management manifest in these processes?
- Which new processes sustain the new products and services?

Specific research question regarding service innovation

- Is the diffusion of web-based services successful?

General research question regarding the virtual campus

- Do the new products and services of the virtual campus make the University of Pretoria more competitive?

1.3.2.1 How do the findings about *process, product and service innovation* of the virtual campus inform knowledge about the theories discussed in Chapter Two?

Specific research questions regarding product innovation

- How does the prevalent educational model used for web-supported courses inform behaviourist and constructivist instructional design approaches?
- How do the perceptions of learners and lecturers inform the role of the lecturer in a web-supported environment?
- How does the diffusion of the new web-supported courses inform technology innovation theory?

Specific research questions regarding process innovation

- How do the processes that were used to create new products and services inform the theories of *knowledge creation*, *change management* and *technology innovation*?
- How do the processes that have been embedded to support and sustain new products and processes inform virtual education?

Specific research questions regarding service innovation

- How does the diffusion of the new web-based services inform technology innovation theory?

General research question regarding the virtual campus

- Which critical success factors are important to consider in educational innovation?

The value of the research is highlighted in Section 1.4.

1.4 Value of the research

This study will contribute to our understanding of the following aspects:

- 1.4.1 Technology innovation at a (South African) higher education institution.
- 1.4.2 Knowledge creation, knowledge management, organizational learning, change management and customer relationship management at a (South African) higher education institution.
- 1.4.3 Web-supported learning at a (South African) higher education institution.
- 1.4.4 Instructional design and project management involved in web-supported education at a (South African) higher education institution.

1.4.5 Technology architecture required to support a virtual campus.

1.4.6 Educational innovation at a (South African) higher education institution.

Section 1.5 provides an overview of the research methodology used in this study.

1.5 Research plan

Research methodology is explained in terms of the following components:

- Approach
- Design
- Data collection instruments and methods
- Reliability and validity

As indicated in Table 1.2, a qualitative research approach is used in this thesis. A descriptive and interpretive case study is used as the design of the research, with the virtual campus as the case. The reason for selecting this particular design is explained in Section 1.5.4. Data collection methods to answer the research questions include technical and non-technical literature, a sample of three web-supported programmes, interviews and questionnaires.

Approach:	Qualitative
Design:	Descriptive and interpretive case study
Data collection:	Literature review (Technical literature) Non-technical literature (institutional reports & statistics) Sample of web-supported programmes Interviews Questionnaires

Table 1.2 Research plan

Because of the interdisciplinary nature of this study, a systems perspective on research is given in Section 1.5.1.

1.5.1 Research from a systems perspective

According to a systems perspective, objective reality does not exist in the sense that research is a way of finding out about the world through objective and systematic information gathering (Johns, 1996). Rather, research is a way of holistically describing patterns among phenomena of interest that are continually changing (Hanson, 1995).

As mentioned in Section 1.5, the research design is a descriptive and interpretive case study. The case study focuses on the creation and evolution of the virtual campus, and consists of multiple innovations, i.e. *process*, *product* and *service* innovation. It is important to select appropriate research methods to analyse the various innovations that, due to their nature, require different research methods. Yet it should be emphasized that because the context of the study is dynamic and ever changing, the purpose of research, as defined in this study, is not to reveal truth or an absolute reality, but to explore different realities in which the researcher is a participant in the interaction process within the system that is being investigated (Moore, 1997).

In systems thinking no research method is protected from being influenced by the subjectivity and bias of the researcher. This should not be viewed as a constraint. The researcher brings tacit knowledge constructs and insight to the study. Both add value to the research findings. Yet in order to retain credibility it is required of the researcher to make subjectivity in the research process as visible as possible.

From a research design perspective this study interfaces with development research design and excludes program evaluation. The reasons for this exclusion are given in Section 1.5.4.1. Section 1.5.2 describes this research from a time perspective.

1.5.2 Research as a process in time

Hanson (1995) describes research as a process in continuous time where certain patterns emerge as time transpires. Research could also add a dimension of freezing time by taking a snap shot of events at a given time. This study is a combination of a longitudinal analysis over several years and a snapshot of the present.

Table 1.3 establishes the relevance of the selected theories, and explains why they are used as the base from which the case is explored.

Theoretical field	Definition	Motivation
Knowledge (epistemology)	<p>Epistemology is the theory of the method and nature of knowledge. Knowledge Management addresses the issues of organisational adaptation, survival and competence in face of increasingly discontinuous environmental change. It embodies organisational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of people (Malholtra, 2000).</p>	<p>Knowledge forms the foundation of learning and feeds into innovation. One cannot innovate without knowledge. Moreover, knowledge is the core competence of a higher education institution and is therefore the appropriate springboard for this study.</p>
Individual learning	<p>Learning theory deals with the way in which people learn. Learning is generally regarded as the acquiring of knowledge or skill (Brown & Duguid, 2000). There is a close relationship between individual learning and organisational learning (Argyris, 1977).</p>	<p>How a person learns, is important to understand if your innovation <i>product, process</i> or <i>service</i> involves learning. Various learning theories are explored, and later applied to the case.</p>

Theoretical field	Definition	Motivation
Organizational learning	<p>Organisational learning refers to the way in which people in organisations create and share new skills and knowledge that lead to an increased capacity for effective coordinated action (Kim, 1998:41). Nadler and Tushman (1999:96) mention that the most important business development in the twentieth century “is the pursuit of competitive advantage in an uncertain world through new approaches to organisational design”.</p>	<p>How people learn in teams is important to understand in the innovation process. Change impacts on people and innovation often occurs in a team – especially on an enterprise level. Thus, an organization is an epistemological system containing mental models that have to change in an innovation process.</p>
Knowledge creation	<p>Knowledge creation arose because of a perceived lack in knowledge management. It involves the ability to deal with situations, events, information and contexts (Von Krogh <i>et al.</i> (2000:19).</p>	<p>How knowledge is created in an organization is important if one wants to better understand the innovation process, because everyone involved continually builds on the knowledge that exists. Knowledge is tacit and explicit and especially tacit knowledge is important in innovation. Different models of knowledge creation are explored within a context of innovation.</p>

Theoretical field	Definition	Motivation
Change management	<p>Change management is self-explanatory, because it refers to the management of change. Change is a continuous process, which has to be managed. Change management is part of leadership and the learning organisation. According to Nickols (2002) change management refers to the following:</p> <ul style="list-style-type: none"> • systematic and planned management of internal, controlled changes within an organisation, or • responses to changes that lie outside the control of the organisation <p>Hence one type of change management is proactive and the other is reactive.</p>	<p>The magnitude of change involved in an enterprise wide and crosscutting innovation process makes it important to understand the dynamics of change management. Different change management strategies are briefly explored.</p>

Theoretical field	Definition	Motivation
Technology innovation	<p>Innovation is defined by Schumpeter (cited in Janszen, 2000:3) as the commercialisation of all new combinations based upon the application of:</p> <ul style="list-style-type: none"> • new materials and components • the introduction of new processes • the opening of new markets • the introduction of new organisational forms. <p>Hence, innovation is the commercialisation of a new technology or combination of technologies introduced to meet a user or market need (Utterback, 1994). Innovation only takes place when market adoption occurs.</p>	<p>The case of the virtual campus consists of product and service innovation that are both examples of technology innovation. Process innovation relates to the structures, procedures and infrastructure that were created to support the virtual campus and that were used to create new products and processes.</p>
Customer Relationship Management (CRM)	<p>CRM is a business strategy whose outcomes optimise profitability, revenue and customer satisfaction (Gartner, 2001:7)</p>	<p>Innovation requires adoption by the market, or put differently, diffusion. An understanding of CRM can assist diffusion.</p>

Theoretical field	Definition	Motivation
Instructional design and technology	<p>Instructional technology design refers to the design of a learning environment when technology is involved. When learning is designed in a technology-enhanced environment, it firstly requires familiarity and understanding of the underlying models of the specific technology application (Reigeluth, 1999).</p>	<p>How a person learns in a technology-enhanced environment is important to understand if your innovation product is web-supported courses. It is also important to understand best practice on how to design web-based learning environments.</p>

Table 1.3 Description of, and motivation for, selected theories

Driscoll & Dick (1999) point out that educational technology research demands alternative research methodologies.

The following section explains the research methodology used in this study.

1.5.3 Research approach

As mentioned in Section 1.1, the research approach of this study is qualitative.

The characteristics of qualitative research (Bogdan & Biklen, 1992:29-33) are as follows:

- Qualitative research is descriptive.
- Qualitative researchers are concerned with process rather than simply with outcomes and products.
- Qualitative researchers tend to analyse their data inductively.
- "Meaning" is of essential concern to the qualitative approach.
- Qualitative research has the natural setting as the direct source of data and the researcher is the key instrument.

Merriam (1998:6-8, 202) adds the following characteristics of qualitative research:

- Qualitative research can reveal how all the parts work together to form a whole.
- It assumes that reality is holistic, multidimensional, and ever-changing.

1.5.4 Research design

According to Mouton (1996:175) the research design serves to "plan, structure and execute" the research to maximise the "validity of the findings". The specific research design chosen for this study is that of a descriptive and interpretive case study. An interpretive case study can be categorised as qualitative research.

Various definitions for a case study exist. A case is something that is intrinsically bounded (Merriam, 1998:27). Lancy (1993:140) describes it as "the method of

choice for studying interventions or innovations". Thus it fits the educational innovation of creating a virtual campus at the University of Pretoria. Merriam (1988, cited in Bogdan & Biklen, 1992:62), defines a case study as "a detailed examination of one setting, or a single subject, a single depository of documents, or one particular event". This particular case study of the virtual campus of the University of Pretoria therefore falls within the category of a "detailed examination of one setting", although the single setting comprises various sub-components. These sub-components consist of *process*, *product* and *service* innovation.

Yin (1994:13) describes a case study in terms of the research process:

"A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context ..."

Merriam (1998) lists the case study as one type of qualitative research design that is particularly appropriate in the following instances:

- When one wants to advance a field's knowledge base.
- In applied fields such as education, in which the findings can improve upon existing practice.
- In studying educational innovations.

1.5.4.1 Research design in this thesis

The research design is a descriptive and interpretive case study that is analysed through a combination of exploratory, qualitative methods and quantitative methods.

In a descriptive and interpretive case study, the researcher analyses, interprets and theorises about the phenomenon against the backdrop of a theoretical framework. Although the research process in qualitative research is inductive, Merriam (1998:49) notes that most qualitative research inherently moulds or changes existing theory in that:

- Data are analysed and interpreted in light of the concepts of a particular theoretical orientation (Research question 1).
- Findings are usually discussed in relation to existing knowledge (some of which is theory) with the aim of demonstrating how the present study has contributed to expanding the knowledge base (Research question 2).

Qualitative and quantitative data analyses are combined in an attempt to interpret the various innovations in this case.

Figure 1.4 illustrates the research approach and design used in this study.

Qualitative research type: Descriptive and interpretive case study

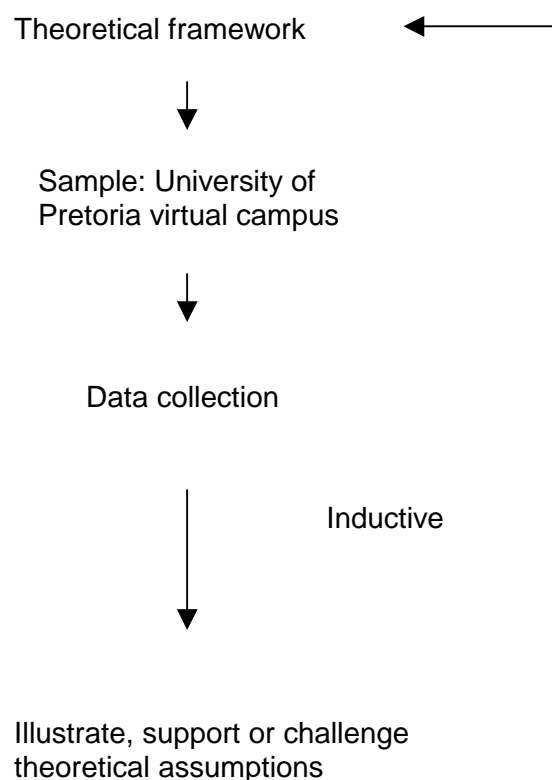


Figure 1.4: Research approach and design

Merriam (1998:11,19) states that qualitative case studies in education are often framed with concepts, models and theories. An inductive method is then used to support or challenge theoretical assumptions.

Section 1.5.5 covers data collection methods used to address the research questions of this thesis. It is imperative that appropriate research methods are selected, which in this instance, are suitable for a case study.

According to Strauss and Corbin (1990:48), technical and non-technical literature is used in tandem with data in qualitative research methodology. They provide the following definitions of technical and non-technical literature respectively:

- "Technical literature: Reports of research studies and theoretical or philosophical papers characteristic of professional and disciplinary writing. These can be used as background materials against which one compares findings from actual data gathered in grounded theory studies" (Strauss & Corbin, 1990:48).
- "Non-technical literature: Biographies, diaries, documents, manuscripts, records, reports, catalogues and other materials that can be used as primary data or to supplement interviews and field observations in grounded theory studies" (Strauss & Corbin, 1990:48).

This study is similar to development research design as articulated by Van den Akker (1999). A significant characteristic of development research, identified by Van den Akker is "complex, innovative tasks for which only very few validated principles are available to structure and support design and development activities" (1999:7). Development research design is appropriate when an intervention or product is implemented to address a need. Theory and hypotheses are then extrapolated in the course of design and development of the product/intervention. It is particularly suitable for research on a micro level, i.e. to, for example, understand the characteristics of the role of a web lecturer. This study does not attempt to identify characteristics and conditions of a single product or intervention, but rather describes and interprets *process*, *product* and *service* innovation in light of various theoretical constructs on a macro level. The study excludes program evaluation design in which certain outcomes and performance goals are evaluated (McNamara, 1998). *Process*, *product* and *service* innovations are interpreted against the backdrop of theory and practice.

Section 1.5.5 explains the data collection methods.

1.5.5 Data collection

The research questions below are addressed through the literature reviews, institutional reports, statistics, questionnaires, interviews and an overview of a sample of web-based courses. Table 1.4 exemplifies how the research questions are addressed through appropriate data collection methods.

<i>Research question 1 (Chapter Four)</i>	
What does theory reveal about process, product and service innovation of the virtual campus?	
<i>Method</i>	
Investigation of the creation and evolution of the virtual campus in terms of theory.	
<i>Goal</i>	<i>Data collection methods</i>
<i>Action</i> (Using theory and practice to investigate the manifestation of its elements in the case study)	<i>Qualitative methods:</i> <ul style="list-style-type: none"> • Application of theory, interpretation of interviews, questionnaires, document analysis of non-technical literature and overview of courses.
	<i>Quantitative methods:</i> Collection of quantitative survey data and descriptive statistical analysis. <ul style="list-style-type: none"> • Adoption rate of services. • Adoption rate of products. • Aspects of web-supported courses.
<i>Research question 2 (Chapter Four)</i>	
How do process, product, and service innovation of the virtual campus inform theory?	
<i>Method</i>	
Building more knowledge about innovation management and theories discussed in Chapter Two.	

<i>Goal</i>	<i>Data collection methods</i>
Development and interpretive	<p><i>Inductive methods and qualitative methods:</i></p> <p>Examination of theories and practice being applied in practice, and induction of ways to implement them.</p> <p>Qualitative inquiry into how the theoretical elements function in different aspects of innovation.</p> <p>Qualitative inquiry of how the findings of the case study contribute to knowledge about innovation in higher education.</p> <p>Motivation: The interpretive design is characterised by subjectivity and the study of individual experience. In this study the theoretical approach is further informed by practice, tending to become grounded theory.</p>

Table 1.4 Research questions and related data collection methods of this thesis

Section 1.5.6 describes the types of sampling used in the case.

1.5.6 Sampling and selection

The virtual campus at the University of Pretoria was selected as the case study. In the study, purposeful sampling is used. Purposeful sampling takes place when the researcher selects a sample from which the most can be learned (Merriam, 1998:31). Section 1.5.7 describes the instruments used in the study.

1.5.7 Instruments

The sources of information or instruments are the following:

- Literature reviews (Technical data)
- Institutional reports and statistics (Non-technical data)
- Web-supported programmes (*WebCT*)
- Individual interviews
- Focus group interview
- Questionnaires (Lecturers and students)

Table 1.5 is a detailed matrix that illustrates which sources are used to explore answers to the research questions about *process*, *product* and *service* innovation.

Product innovation			
Product	Instrument	Sample	Type of sampling
Web-supported courses	Questionnaire (Open ended and rating questions) Focus group interview	Lecturers who have used <i>WebCT</i> frequently for one year and longer	Purposeful
Masters in Engineering Management (MEM), Masters in Project Management (MPM) and Masters in Business Administration (MBA)	Questionnaire (4-point Likert scale and rating questions) Overview of courses in MEM, MPM, MBA	First and second year students: MEM & MPM. First year MBA (modular)	Purposeful
Adoption rate of web-based courses	Virtual Campus server and <i>WebCT</i> Database	All courses – measured over a period of 4 years	Purposeful
Process innovation			
Virtual campus creation: process, infrastructure, services	Interview Non-technical literature (document analysts)	Virtual campus project team.	Purposeful
Instructional design and development model/project management	Non-technical literature	Telematic Learning and Education Innovation	Purposeful
Service innovation			
Adoption rate of services	Virtual Campus server	Student Online Services Online Application Online Payment Lecturers Online	Purposeful

Table 1.5 Overview of research methods used in this study

Section 1.5.8 investigates the reliability and validity of the research.

1.5.8 Reliability and validity

Subjectivity can be considered a threat to valid inferences in qualitative research. Mouton (1996:176) argues “especially in theoretical research this problem emerges as a problem of objectivity”. In this regard, Bogdan & Biklen (1992:46) note “the worth of a study is the degree to which it generates theory, description or understanding”. Thus a good qualitative researcher does not pass judgement, but attempts to add to knowledge. Yet Merriam (1998:199) mentions that a debate is raging because the constructs of reliability and validity are quantitative and positivist and not necessarily that applicable to qualitative research. Although the researcher takes cognisance of this debate, reliability and validity issues are addressed because both quantitative and qualitative research methods are used in the research.

Internal validity deals with the question of how research findings match reality, yet according to the philosophy underlying qualitative research, reality is relative to meaning that people construct within social contexts. Merriam (1998:204) provides the following six strategies to enhance internal validity in qualitative research:

1. Triangulation – using multiple sources of data or methods to confirm emerging findings.
2. Member checks – taking data and tentative interpretations back to the people from whom they were derived and asking them if the results are plausible.
3. Long-term observation.
4. Peer examination.
5. Participatory or collaborative modes of research.
6. Clarifying the researcher’s biases, assumptions, worldview and theoretical orientation at the outset of the study.

The researcher used member checks, long-term observation and clarification of biases as strategies to enhance the internal validity of the findings of this study.

To clarify possible bias it is necessary to mention that the researcher was the project leader of the virtual campus.

Reliability refers to the extent to which research findings can be replicated (Merriam, 1998:205). Reliability is problematic because the culture and context of the creation

and evolution of the virtual campus at the University of Pretoria are unique to this study. Secondly, behaviour is not static, but changes continuously. Hence because there is no single reality, a similar study would most probably not yield the same results. Yet certain principles and patterns could prove to be reliable and some aspects could be replicated. Another factor is that of the researcher, who is conducting the research based on a personal construction of meaning through individual experience. Merriam (1998:206) explains it as follows:

“Because what is being studied in education is assumed to be in flux, multifaceted, and highly contextual, because information gathered is a function of who gives it and how skilled the researcher is at getting it, and because the emergent design of qualitative case study precludes a priori controls, achieving reliability in the traditional sense is not only fanciful but impossible”.

She rather suggests that reliability in this instance should be determined by whether the results are consistent with the data collected. The following techniques are provided to achieve this (Merriam, 1998:206-207):

- Explain the assumptions and theory behind the study.
- Use multiple methods of data collection and analysis (triangulation).
- Explain in detail how data was collected to allow for an audit trail if necessary.

Section 1.6 presents the limitations and delimitations of this study.

1.6 Limitations and delimitations of the study

In light of the reliability techniques set out in Section 1.5.8 it is necessary to set out the researcher's assumptions and various limitations of the study. The Literature reviews in Chapter Two and Chapter Three consist of theories that were generated in other countries. The fact that these theories are applied to a South African context could be considered a limitation of this study. It is important to state that this study is

not an attempt to answer one specific aspect of educational innovation in detail. Rather, it is a broad study and strives to contribute to knowledge about various aspects of educational innovation. Therefore the case of the virtual campus informs about both learning and management aspects of educational innovation. The scope of the study does not allow the researcher to investigate both learning and management aspects in - depth. The findings should be considered as research findings on a macro, and more strategic level. One example of this is that samples of 40 lecturers and 174 students respectively (who participate in web-supported courses) are used. If this study focused on the virtual campus in terms of only product innovation within the context of learning theory, these samples would not have been adequate. It is however, adequate for this study because it is purposeful sampling of three flagship programmes. A possible limitation is that the perceptions of students are recorded in the questionnaire. Their perceptions are not necessarily a representation of reality, but as stated before, a qualitative research approach does not attempt to represent an absolute reality.

The following concepts are addressed to clarify the researcher's assumptions, namely:

- The view in this study of educational innovation.
- The domain of the study and its literature resources.
- An overview of the research perspective.
- The view of technology.

1.6.1 View of educational innovation

Educational innovation in this study uses the field of technology innovation as its base, but also looks to learning and management theories to inform the broader field of educational innovation.

Management of technology innovation refers to the way in which the invention of new technology and its implementation and introduction to the market is managed (Betz, 1998). Innovation in this study deals with *process*, *product*, and *service* innovation.

Girifalco (1991) defines innovation as “the process by which the invention is first brought into use. It involves the improvement or refinement of the invention, the initial design and production of prototypes, pilot plant testing and construction of

production facilities ... diffusion is the process of the spread of the innovation into general use as it is adopted by more and more users”.

According to Pistorius (2000:2-7) “Innovation is the process through which technology can be leveraged to attain the goal of competitiveness”. Further that “innovation is a process that culminates in the implementation and adoption of the idea or innovation” (2000:3-5). Therefore it can be seen as the “creation of new products, processes, services, techniques and their acceptance in the market”. (2000:3-4). Also that “Innovation is a core process concerned with renewing what the organization offers (products and services) and the ways in which it generates and delivers these (processes)” (2000:3-7).

Innovation is as diverse as strategic decision-making and organisational culture. A synthesis of the work of Betz (1998), Utterback (1994), Pistorius (2000) and Tidd *et al.* (1997) indicates that innovation cannot be analysed without considering the market, people involved, strategy and leadership (Chapter Two).

In light of the above the virtual campus is considered to be an example of *process*, *product* and *service* innovation:

- *Process innovation* occurred by successfully implementing institution-wide procedures, structures and infrastructure to support and sustain the virtual campus.
- *Product innovation* occurred by successfully implementing web-supported courses on a significant scale at a residential university and changing to a flexible learning model.
- *Service innovation* occurred by successfully implementing administrative self-services via the web for all students of the university.

Section 1.6.2 explains the domain of the study.

1.6.2 Domain of the study and its literature resources

As explained, this study cannot be generalised to other institutions. Being a case study, certain variables such as the organisational culture, individuals, conditions, resources and market are unique to this case.

An extensive body of literature and practice was consulted in the thesis. Nevertheless, the limitation of this study does not make provision for a complete literature survey, in the sense that important and relevant theories and practice could have been omitted.

An additional limitation is that it does not explore one specific research question in-depth, but rather covers a broad spectrum of research questions on a macro level in order to reach a holistic understanding of the various components of the virtual campus.

Even though the study aims to integrate various theories as a means to better understand educational innovation, its richness in terms of a multiple faceted focus on learning, management and innovation could give an impression of fragmentation and lack of focus.

1.6.3 Research perspective of the study

Research generated in this study does not pretend to be absolute. This pertains to findings of the analysis of the case. It should rather be viewed as a contribution to the fields of educational innovation and particularly virtual education.

1.6.4 Technology in this study

Technology in this study is very prominent because product and service innovation in this study are examples of technology innovation.

1.7 Relevance and significance of the study

This study is particularly relevant to South African higher education institutions. It is also useful for higher education institutions globally that are moving towards flexible, technology-enhanced products and services. Many residential institutions are moving towards becoming hybrid institutions with increasingly prominent traits of a virtual organisation.

The theories that are used to explore the creation of the virtual campus at the University of Pretoria cover a broad range. The range includes learning, management and innovation theory that are interwoven in Chapter Three (Theory into practice). Similarities and differences between literature and the actual experience are explored, and where possible, explained. Significant patterns and possible critical success factors are indicated to provide guidelines to higher education institutions that have embarked on similar routes.

A multiple faceted perspective lends itself to a systemic approach. O'Conner & McDermot (1997) point out that the parts of a system are interconnected and interdependent, with a mutual influence among the parts.

Some systems principles are listed below:

- The focus is on emergent, relational wholes.
- Systems vary in complexity.
- Systems can be open or closed.
- Interaction patterns exist between systems, rather than cause-effect relationships.
- Identification of phenomena is only an attempt to understand relational patterns and interaction between systems.
- There is no predictability of outcomes.
- Processes are dynamic.

(Hanson, 1995; O'Conner & McDermot, 1997)

An organisation such as the University of Pretoria is an open system, i.e. a system in which transformation occurs due to influences from its internal and/or external environment.

Inherent in systems epistemology is the notion of multiple realities, i.e. people construct their own truths based on their frame of reference. In this sense reality is continuously constructed through a creative process. Especially in qualitative research, reality is subjective. In this type of descriptive and interpretive study, patterns can be identified and compared to literature, and observations can be made.

South African research focused on this area, listed below, correlate with some aspects of this study. The estimated correlation is low because these studies

address mostly one aspect of this case. The other possible reason is probably because this type of innovation has only recently been attempted at other South African higher education institutions and most responding studies are in progress. As a result, not many similar studies have been completed.

The following NEXUS and SABINET searches verify the significance of this study:

Table 1.6 shows that the study is (i) relevant, because some of its components concur with some of the listed research studies in terms of the general thrusts of technology in education, innovation and organisational learning and (ii) that it is unique, because it is interdisciplinary and combines the fields of innovation, knowledge management/creation and organisational learning, learning theory and instructional design to better understand *process, product and service innovation*. It is also unique in being a case study of the virtual campus of the University of Pretoria from an *educational innovation* perspective.

Yet absolute truth, reminiscent of positivist research, remains elusive - including inferences made from statistics.

Researcher	Year	Title
Lazenby K	1998	Constructivism and the creation of virtual campuses in higher education.
Van der Merwe, AJ	2000	Modelling strategies to construct virtual distance environments.
Pullen, G	1999	The development of a model to effectively utilize computer mediated communication to support assessment in a virtual learning environment.
Campbell, HM	1999	The impact of asynchronous groupware as knowledge management strategy.
Naidoo, SG	1997	The role of knowledge management in developing competitive advantage.
Kloppers, M	1996	Characteristics of the digital information service.
Marais, NJ	1996	Analysis of the effectiveness of a process of change, with special reference to the establishment of a new set of value in a high-technology organisation.
Vercueil, A	2001	The impact of information technology on the work life of the individual: University of Pretoria
Lehr, RH	2000	Web-based distance learning for power system engineering.
De Villiers, GJ	2000	Evaluation of the web-based information resources to support learning: an exploration
Alberts, P	2001	Instructional design insight and skills required by university lecturers in Advanced Accounting and Finance in order to facilitate Web-based learning
Pistorius, CWI	1996	World competitiveness and the technology
Williams, CB	1998	The evaluation process for technological innovation
Pelser, TG	2001	A strategic management taxonomy of technology and innovation
Van der Merwe, H.J	2001	The use of the Internet as a facet of a multimode educational approach at Technikon Pretoria.
De Villiers, MR	2002	The dynamics of theory and practice in instructional systems design
Steyn, A.B.	2001	evelopment: Creating a learning organisation, using the advantages of information technology.

Table 1.6 Related studies in South Africa

Chapter 2 Literature Review: Learning and management

2.1 Introduction

Chapter One provides a better understanding of the research aspects of this study. Chapter Two attempts to sketch various theories that inform innovation in higher education.

Because this is a descriptive and interpretive qualitative case study, it is necessary to have a theoretical underpinning that feeds into the research questions.

Some of these theoretical fields overlap, making it difficult to separate this review into discrete sections linked to the relevant research questions.

An interdisciplinary approach is required to understand *process, product and service innovation*. It also serves to qualify the research methodology chosen for this study.

Due to the interdisciplinary nature of this study, it is necessary to call attention to systems theory as briefly referred to in Chapter One. The systems perspective emphasises the importance of considering phenomena in their totality. It is therefore a holistic view that values context (Hanson, 1995).

Figure 2.1 illustrates how this Chapter fits into the structure of this thesis. Chapter Two describes theories that are relevant to educational innovation and that are applied to the case of the virtual campus in Chapter Four.

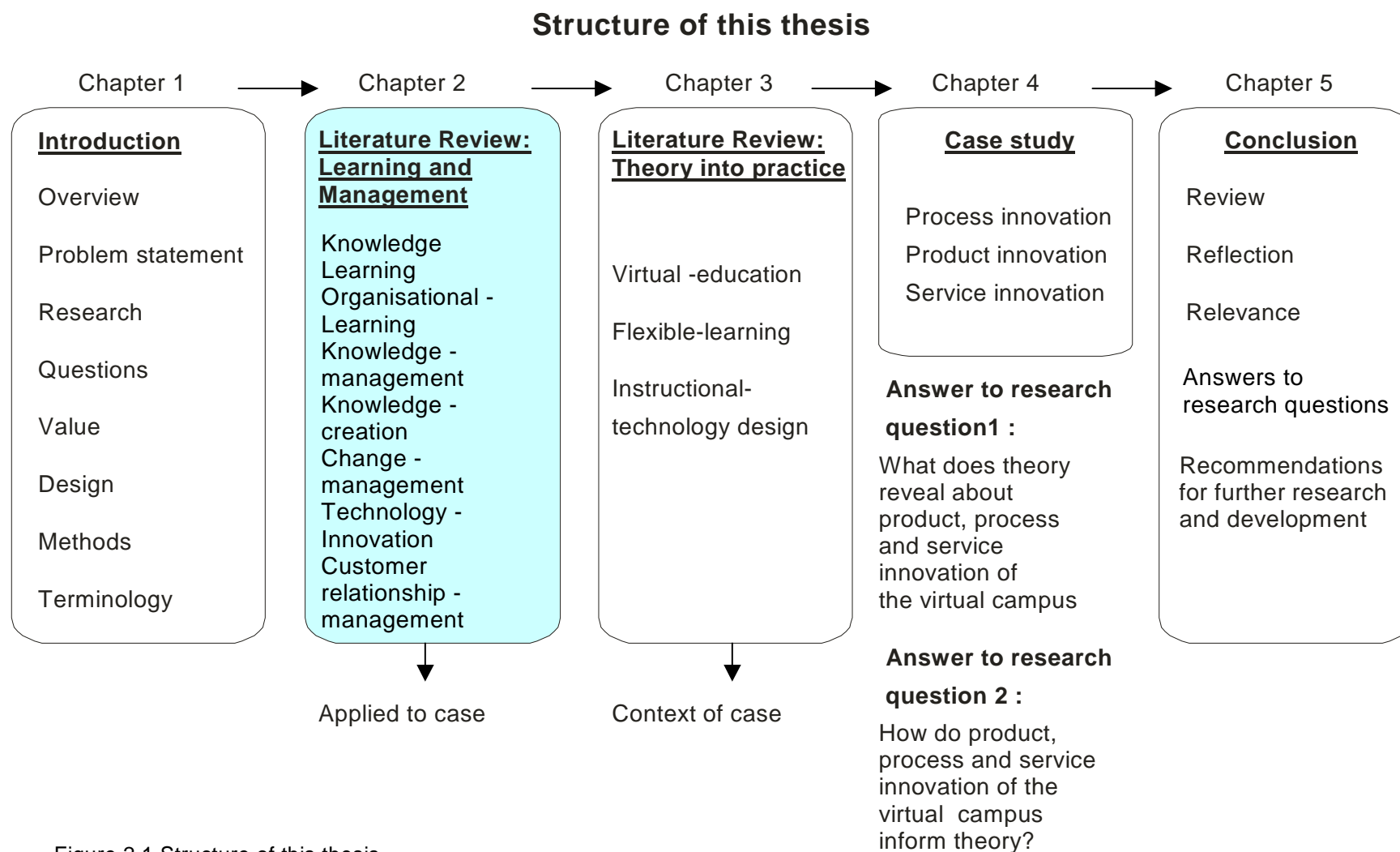


Figure 2.1 Structure of this thesis

The following section starts at the core of this study, i.e. the nature of knowledge, or epistemology.

2.2 Knowledge

The core business of higher education institutions relates to knowledge. Knowledge plays a key role in teaching and learning, in research, in organisational learning and in management and administration. Knowledge in its various permutations therefore forms the basis of the theoretical approaches that are used in this study.

A philosophical explanation of knowledge is required, since Western philosophy shaped what is considered to be knowledge in the disciplines of, amongst others, management, learning and organisational theory. Concomitantly it is important to also explain knowledge in the context of Japanese philosophy. Taking Japanese philosophy into account provides a holistic understanding of knowledge and brings a different approach altogether to Western philosophy. It also strengthens the notion of an organisation as a synergistic system. Both Western and Eastern (or Japanese) philosophies are therefore explored in this chapter and are later returned to in the case study of the creation and evolution of the virtual campus in Chapter Four. The researcher chose to include Japanese epistemology and knowledge creation theory due to its relevance to this study. The Japanese view of knowledge resonates with constructivism – a learning theory that will be discussed in Section 2.3.5 on knowledge creation by Nonaka, Takeuchi, Von Krogh and Ichijo (1995, 2000) mirror innovation processes. African epistemology is excluded in this study due to its limited scope.

2.2.1 Western philosophy

The philosophical inquiry of knowledge is known as epistemology. The dominant Western epistemologies are rationalism and empiricism (Russell, 1991:101-584).

- Rationalism essentially says that knowledge can be obtained deductively by reasoning, whereas
- empiricism holds that knowledge can be attained inductively from sensory experiences.

Plato laid the foundation of rationalism by claiming the existence of a perfect world of ideas that cannot be known through sensory experience. He therefore believed in absolute truth that cannot be known by man and that man attempts to know the absolute truth through his senses and that senses simply lead to an imperfect world, reminiscent of the ideal world. Aristotle stressed the importance of observation and the verification of individual sensory perception. Thus Western philosophy is based on a dualistic split between mind and body.

Two mainstreams in epistemology emerged, namely:

- Continental rationalism and
- British empiricism.

A well-known Continental rationalist, Descartes, coined the famous phrase *Cogito, ergo sum* (I think, therefore I am) and posed that humans possess a-priori mental structures that contain innate ideas and concepts. He was opposed by Locke, who argued that only experience provide the mind with ideas (Venter, 1990:3-49). Both Descartes and Locke built on the basic ideas of Plato and Aristotle respectively, but it is beyond the scope of this study to explore their theories in depth.

Towards the eighteenth-century Kant and Hegel attempted to synthesise the two streams of rationalism and empiricism. Philosophers such as Husserl, Heidegger, Sartre, Merleau-Ponty, Wittgenstein, James and Dewey continued it in the twentieth-century. During this period knowledge became associated with action and the separation between theory and practice gradually fell away (Russell, 1991:651-783). This synthesis has important implications for this study and will be explained later in this chapter.

2.2.2 Japanese philosophy

Nonaka and Takeuchi (1995:27) make it clear that no distinct Japanese philosophy exists, but that the Japanese have a very definite approach to knowledge. They list these distinctions of intellectual tradition as follows:

- Oneness of humanity and nature.

- Oneness of mind and body.
- Oneness of self and other.

A Japanese approach to knowledge is holistic and has always been that way. On the other hand the Western approach was initially dualistic and grew to become more holistic.

The Japanese live very closely with their environment, which is evident in their language. Their language is not arbitrary symbols as in the case of Western languages, but consists of concrete images of objects that are contextualised when used. It is echoed through their art in that they don't have a fixed perspective of time and space, but rather see it as being in constant flux and transition – hence more circular. As a result Japanese drawings do not fix the artist's viewpoint and therefore there is no need to draw shadows (Nonaka & Takeuchi, 1995:28). They also have a holistic view of the human, i.e. the concept of the oneness of mind and body found in Zen Buddhism. In Zen Buddhism, "true knowledge cannot be obtained by theoretical thinking but only through one's total mind and body" (Nonaka & Takeuchi, 1995:30). Finally, oneness of self and other is expressed by the collective, intuitive and organic worldview of the Japanese. Everything and everyone is interrelated. The implication is that for the Japanese, to work for others means to work for oneself (Nonaka & Takeuchi, 1995:31).

The implication for epistemology is that Japanese philosophy integrates what is referred to in Western philosophy as *rationalism* and *empiricism*. Hence knowledge is acquired from experience and generated from the mind. Mind and body is one. Furthermore, the oneness of self and other implies a social element of knowledge. The relevant question is what Western and Japanese epistemology holds for knowledge in various theoretical fields.

The following theories will be explored in this study:

- Learning and design theory
- Organisational learning
- Knowledge creation
- Knowledge management
- Change management
- Technology innovation and management
- Customer Relationship Management (CRM)

The basis of these theories is epistemology – the science of knowledge/knowing.

2.2.3 Epistemology in education (learning and teaching)

A distinction is made between endogenic and exogenic epistemological traditions of knowledge (Gergen, 1995:18). The former could be described as ‘mind centred’ and the latter as ‘world centred’. Brought into context of the Western distinction between rationalism and empiricism, the similarity can be illustrated as follows:

Knowledge constructed from within	Knowledge experienced from without
Rationalism	Empiricism
Endogenic epistemology	Exogenic epistemology

Table 2.1 Rationalism versus empiricism

- Endogenic thought separates the mind and the world, but holds that the mind as a reasoning capability, attributes certain elements to the external world.
- Exogenic thought believes in an external world, which is considered to be the truth, and divides that reality from the psychological world, whose task it is to know the external world. The arrangement of environmental inputs builds internal representation.

In an educational context, an exogenic view of a learner would be an empty slate that should be filled with the essential features of the world. Clearly, this is an outside-in approach with the Aristotelian understanding that knowledge is a commodity that can be transferred from the knowledgeable to the novice. It is also situated in a logical positivist tradition, which emphasises the importance of being able to measure and prove concepts. Under this view, *knowing* is based on a structured collection of connections among basic mental and behavioural elements, i.e. stimulus and response (Greeno, Collins & Resnick, 1996). The following are practical examples of an exogenic epistemological approach in an educational context that are provided by Gergen (1995:18):

- Enrichment of experience takes place through, for example, the collection of species or specimens, participant observation, laboratory experiments and field trips.

- Examinations are favoured to assess individual knowledge acquisition and exposure to books.
- Lectures are complementary to direct information, providing amounts of information not otherwise available.
- Reliable, objective testing is favoured. Multiple-choice questions, test standardisation, and statistical normalisation all help determine "to what degree the slate has been filled".

Conversely, the endogenic perspective in education places emphasis on the rational capacities of an individual's thought processes – it is not so much the quantity of information in one's mind, but the way the mind processes and deliberates about it that is important. According to this view *knowing* is based on internal mental representations (Inhelder & Piaget, 1958). Gergen (1995:18) gives the following practical examples of an endogenic epistemological approach in an educational context:

- Subjects such as philosophy, mathematics and foreign languages best facilitate quality and clarity of thought.
- Co-operative social learning environments are favoured above lectures, because it is through active engagement that cognitive skills are optimised.
- Essay exams and term papers, which are more subjective means of assessment, are preferred.
- Language and social context are the vehicle through which meaning is constructed, thus external and internal knowledge are continually constructed within specific real-life contexts.

If one weighs the exogenic and endogenic views explained previously, one is once again caught up in a dualistic way of thinking, either believing in an empty slate that is filled through experience, or believing in *a priori* (inborn) mental ability or preliminary scaffolding of concepts that determines any particular configuration of conceptual categories. Exogenic thought cannot explain exactly how transfer of knowledge from the external world to the empty mind takes place and endogenic thought cannot explain how new concepts are integrated in an *a priori* set of categories to locate and incorporate uncategorisable events.

Section 2.3 discusses the relationship between knowledge and learning.

2.3 What is learning?

The concise Oxford dictionary definition of learning is “the acquiring of knowledge or skill” (1989:571). Brody (1997:11A) states that “Knowledge is content that is assimilated, collated and interpreted to provide a unique perspective that helps us perform a task, solve a problem, or stimulate our intellect”. In order to understand knowledge it is important to understand learning. Thus learning entails the acquisition of skill or know-how, and the acquisition of know-why, which means the ability of, *informed action*. If we return to the synthesis achieved in Western epistemology in the twentieth century, it is clear that ‘informed action’ denotes an integration of theory and practice – hence the separation between theory and practice has disappeared. It is also a reflection of the Japanese philosophy of oneness of mind and body. Building on the synthesis, Kim (1998:43) defines learning as “increasing one’s capacity to take effective action”. Kolb (1984:21) defines it as “the process whereby knowledge is created through the transformation of experience”. Brown and Duguid (2000:124) argue that it is learning that makes intellectual property, capital, and assets usable. To understand learning it is helpful to revisit the earlier point that synergy eventually formed between theory and practice, knowledge and action (i.e. mind and body). Pragmatically speaking, talk without action is worthless. The age-old adage of the difference between ‘knows that’ and ‘knows how’ comes into play.

This is emphasised by Senge *et al.* (1999:24) who define learning as enhancing capacity through experience. They state “learning always occurs over time and in ‘real life’ contexts, not in classrooms or training sessions”.

The phenomenon of human learning has been studied for centuries and it is generally agreed that two main streams exist in learning research, namely:

- Learning as behaviour and
- learning as cognition.

Section 2.3.1 explains the theoretical underpinning of *behaviourism*, which emphasises overt behaviour, versus *cognitivism*, which emphasises mental operations.

Both schools are relevant and should be viewed on a continuum, where, in any given learning environment, the appropriate strategy is chosen depending on the expected

learning outcome. Once again if it is brought into context of epistemology it can be illustrated as follows:

Knowledge constructed from within	Knowledge experienced from without
Rationalism	Empiricism
Endogenic epistemology	Exogenic epistemology
Cognitivism	Behaviourism

Table 2.2 Cognitivism versus Behaviourism

2.3.1 Behaviourism

Behaviourism is based on a stimulus-response approach in which contiguity, reinforcement and practice are imperative, whereas *cognitivism* holds that learning is a set of processes with the function of information processing (Gagné & Glaser, 1987:51-56). Behaviourist theory was prevalent in the first half of the twentieth century and led to the practice of rote-learning and content-driven instruction, which is still prevalent in educational systems. Skinner (1938) is regarded as the creator of this theory.

Behavioural theorists posit that learning takes place through reinforcement, in other words – practice makes perfect. In a learning environment this would translate into a question and response, where a right answer is rewarded and a wrong answer is not reinforced. Hence learning is regarded as a set of stimulus-response associations, induced by repetition and reinforcement. To return to epistemology, this paradigm states that knowledge is experienced from without. Very little, if anything, is said about how the learner constructs and processes the associations. Rather, the emphasis is on representation through repetition.

A related theory, *Objectivism*, holds that learning consists of assimilating an objective reality that exists apart from learners. Jonassen (1991a:28) describes it as follows: "Objectivists believe in the existence of reliable knowledge about the world. As learners, the goal is to gain this knowledge; as educators, to transmit it...the role of educators is to help students learn about the real world. The goal of instructional designers or teachers is to interpret events for them. Learners are told about the world and are expected to replicate its content

and structure in their thinking". *Objectivism* is applicable to relatively fixed knowledge constructs such as Anatomy. Like *behaviourism* it focuses on replication.

Behaviourism and *Objectivism* fall into the empirical philosophy which believes that learners must be instructed to replicate an objective reality that does not make provision for the learner's prior experience, understanding, beliefs and interpretation. Learning is measured by testing the accuracy of the representation by the learner of the objective reality/knowledge.

Although the scope of this study does not allow for a deeper exploration of *behaviourism*, it is necessary to briefly mention *Instructionism* and *Reductionism*. Both schools of instruction fall in an empirical category. Instructionist theorists posit that knowledge and skill requirements can be articulated and measured. Further, a pragmatic stance is taken in the sense that information and skills should be presented on a need-to-know basis (Hannafin *et al.*, 1997, Jonassen, Campbell & Davidson, 1994, Schoenfeld, 1993). *Reductionism* attempts to simplify complex phenomena on behalf of the learner by means of linear models.

Commonalities of behavioural approaches to learning are as follows:

- The learner takes on a predominantly passive and reactive role.
- Instruction is structured and systematic.
- Instructional processes are aimed at learners in general and not on the individual learner.
- Learning can be measured.
- It assumes that a well-planned instructional intervention can result in a desired learning outcome.

It is important to note that this view of learning lies on a continuum and is suitable for certain learning environments.

Section 2.3.2 covers cognitive learning theory, which became prevalent in the late 1960s.

2.3.2 Cognitivism

From a cognitive perspective, learning takes place when a person integrates new knowledge into an existing mental model. Cognitivists encourage the development of metacognitive skills in learners. Cognitive science theories view learning as the execution of internal cognitive processes, such as *remembering*, *thinking*, *conceptualisation*, *application* and *problem solving* (Reigeluth, 1999 & Moore, 1999).

It further views learning as a reorganisation of internal knowledge structures, in other words the creation of *mental models* (such as *mind maps*) and *schemata* and the way in which information is retrieved from these structures.

Psychological research makes a distinction between learning and memory. Kim (1998:44) notes that learning relates more to acquisition and memory to retention. However the two are interconnected because what we retain in our memory has an effect on what we learn and what we learn affects our memory. A cognitive paradigm focuses on the use of critical thinking skills, conceptualization and problem solving.

Problem solving gained attention when Newell and Simon (1972) postulated that problem solving takes place through information processing – similar to a computer. A distinction is made between short-term memory and long-term memory. The process of cognition consists of the following series of operations:

- Sensation from a stimulus,
- perception,
- encoding in short term memory,
- association,
- encoding in long term memory, and
- retrieval.

The researcher interprets cognitivism as an extension of *behaviourism* and *objectivism*. It retains the construct that an external reality is represented, but focuses more on how external information is processed and stored. It brings us closer to an integrated epistemology, but does not explain how knowledge translates into action.

Bloom's (1956) *Taxonomy of Educational Objectives* ranks types of learning from lowest to highest:

Knowledge – according to Bloom the lowest learning type and he views it as the ability to remember previously learned material.

Comprehension – understanding the meaning of constructs.

Application – using knowledge in real life situations.

Analysis – breaking down constructs into smaller components to understand its structure.

Synthesis – creativity is required to group components to form new wholes.

Evaluation – value judgments are involved and according to Bloom this is the highest learning type on the cognitive hierarchy.

The researcher does not agree with Bloom's view of knowledge, because its definition relates to memory. As was discussed in Section 2.3, knowledge is more than memory. Section 2.5 will show that knowledge is actually on a high level of cognition.

Henri (1992) provides an analytical model of information processing:

Surface processing	In-depth processing
Repeating the information contained in the statement of the problem without making inferences or offering an interpretation.	Linking facts, ideas and notions in order to interpret, infer, propose and judge.
Repeating what has been said without adding any new elements.	Offering new elements of information.
Stating that one shares the idea or opinions stated, without taking these further or adding any personal comments.	Generating new data from information collected by the use of hypotheses and inferences.
Proposing solutions without offering explanations.	Proposing one or more solutions with short-, medium or long-term justification.
Making judgments without offering justification.	Setting out the advantages and disadvantages of a situation or solution.
Asking questions which invite information not relevant to the problem or not adding to the understanding of it.	Providing proof or supporting examples. Making judgments supported by justification.
Offering several solutions without suggesting which is most appropriate.	Perceiving a problem within a larger perspective.
Perceiving the situation in a fragmentary or short-term manner.	Developing intervention strategies within a wider framework.

Table 2.3 Surface processing versus deep processing (Henri, 1992:73)

From this view of learning, *component display theory* arose (Merrill, 1983; 1987) in which relationships between content to be taught and performance are categorised. Four types of content are identified, i.e. *fact*, *concept*, *procedure*, and *principle*. These define the different types of knowledge that comprise a domain to be learned. The three performance levels are: *remember*, *use* and *find*.

This theory incorporates both behavioural (reinforcement) and cognitive (analogies) strategies and supports a more integrated approach of *learning as informed action*, but neglects the social dimension of learning. It therefore holds that each learning outcome is attached to a corresponding condition to achieve the required outcome.

Sometimes, information processing is done incorrectly, leaving gaps in the understanding of a concept. Metacognition is viewed as a means to address these gaps. Moore (1995) states that metacognitive knowledge is characterised by three interrelated components:

- Awareness of one's own cognition and the degree to which one's own cognitive efforts are successful.
- Knowledge about the different cognitive demands of different learning tasks.
- Procedural knowledge of strategies to employ when the status quo is not successful.

Metacognition (thinking about thinking) is the ability of learners to plan, monitor, and control their own cognitive processes and performance, and to select learning strategies for themselves (Winn, 1990).

An important construct that emerged from cognitivism is that of mental models, which is discussed in Section 2.3.3.

2.3.3 Mental models

The concept of mental models is an important element in trying to understand learning. Jensen (1995:33) affirms this by stating "we never really understand something until we can create a model or metaphor derived from our unique personal world". This statement is contrary to the objectivist attempt to create a model on behalf of the learner. In both approaches, though, a model promotes a better understanding of phenomena. Cognitive

instructional strategies, for example, include the use of concept maps, metaphors and analogies and chunking. Nonaka and Takeuchi (1995:60) define mental models as “working models of the world by making and manipulating analogies in [their] minds”. Mental models “represent a person’s view of the world, including explicit and implicit understanding” (Kim, 1998:45). People use mental models such as paradigms, perspectives, beliefs and schemata to interpret their world (Merrill, Li and Jones, 1990). Mental models provide the context in which to view and interpret new material, and they determine how stored information is relevant to a given situation. There is therefore an individual or personal element inherent in cognitivism and in mental models, i.e. that an individual constructs mental models based on memory and relevant to a given situation.

Section 2.3.4 describes constructivism and constructionism and arrives at a praxis in which knowledge is informed action in a social context – reminiscent of knowledge creation theory that is discussed in Section 2.5.2.

2.3.4 Constructivism and constructionism

Learners may neglect to use related prior knowledge to integrate new knowledge, or worse, they draw on incomplete or inaccurate prior knowledge. For this reason dialogue and/or interaction is critical because negotiation of meaning leads the learner to discover inaccuracies and/or gaps in his or her mental model. It could be reasoned, however, that this view embraces a behavioural assumption that there is one objective reality or knowledge.

Wittgenstein (1958) stated that knowledge is in the eye of the beholder, and that you give meaning to the concept through the way you use it. A generation later than the cognitive science and philosophy, the “constructivist perspective” emerged. It holds that cognition is a creative act of construction or creation. *Constructivism* places emphasis on the mental processes involved in establishing meaning. Moving away from representation of external constructs. Cognitive constructivists regard knowledge as internally represented in the mind of the learner, built in interaction with the surrounding environment (Bonk & Wisner, 2000:7). It requires self-regulation and the building of conceptual structures through reflection and abstraction and is known as *cognitive constructivism* (Dick, 1991:41).

Constructionism is a theory that locates meaning in language and the implied socio-cultural context and is also referred to as *social constructivism* (Steffe & Gale, 1995). Both theories

are learner-centred and endorse problem-based experiential learning to promote critical thinking. *Constructionism* is the concept that it is through language, communication and social constructs that meaning is derived. It emphasizes the social aspects of learning and cognition such as collaboration, negotiation and dialogue. In short, if people privately determined what words meant, communication would become very difficult, because we rely heavily on words, whether it be written or spoken, to establish meaning within specific contexts. It is largely through language that transmission of knowledge has traditionally taken place in education. Whether it is through a lecture, courseware, experiments or discussion, the lecturer can never construct meaning on behalf of the learner. This will be explained in more detail.

Slabbert (1996:63) explains this concept as follows: "The learner establishes a relationship with objects in terms of nature and events, or with subjects in terms of him/herself or others. From this relationship meaning is constructed by the same learner".

The social aspect of constructive learning is important because of the fact that collaborative methods of learning are purported to develop critical thinking through directing learners towards discussion, clarification of their own ideas and evaluation of others' ideas (Pulkkinen & Ruotsalainen, 1997).

The basic idea of constructive learning is that learners must construct knowledge and skills through their own experiences. This takes place best in situations and learning environments arranged for the purpose, putting an emphasis on the process goals and ensuring that support and guidance are available.

Piaget formulated the concept of constructionism because of his dissatisfaction with the theories of knowledge in Western philosophy (Steffe & Gale, 1995). He concedes that the lecture and textbook are still the most commonly used way of presenting a large array of material rapidly and efficiently. Furthermore that rote learning and drill-and-practice which are both strongly based on short-term memory; are valuable in transforming understanding into automated skill, making the information and procedures available without conscious effort. The disadvantage of rote learning and drill-and-practice is that both are weak in motivation (engagement) and in providing conceptual aids to understanding.

According to Cennamo *et al.* (1996) learning environments should take into account the following important characteristics of adult learning.

- Learners often have plenty of experiences of the things to be learned, especially in adult education.
- Learners can concentrate on different types of tasks in their studies.
- Learning is a process.
- Learning is a social event.

The following is a synthesis by Bonk & Wisner (2000:6) of the characteristics of constructivist learning:

- Learning is constructed from the experience of the learner and builds on the learner's prior knowledge in order to make it relevant and meaningful.
- Interpretation is personal.
- Meta skills to manage one's learning are reflected upon to address misconceptions in thinking.
- Learning is an active process whereby experience is converted into knowledge and skills.
- Learning is collaborative and social, thus allowing for multiple perspectives.
- Knowledge is situated in real-life, which is ideally where learning should take place.
- Assessment should be integrated with the task.

The value of a constructionist approach to learning and knowledge is illustrated by research that indicates that children learn vocabulary fast and successful by everyday immersion, whereas "learning words from abstract definitions and sentences from dictionaries is far slower and less successful" (Brown & Duguid, 2000:130). Making it relevant for the work environment, the authors use the example of the eager young intern with all the right information but none of the practical knowledge that makes the job doable.

From an instructional point of view, constructivist-learning environments are open in the sense that it allows the learner freedom to engage with a variety of resources and build on prior knowledge and experience to solve a problem or do a project. The researcher is of the opinion that learners do this intuitively, i.e. they improvise in any given learning situation and involve mental schemata, experience, intuition, other people and a variety of resources to solve problems. This does not apply, of course to memorizing information or solving textbook problems, where the answers can often be constructed from sections in the textbook. It refers to solving unstructured problems.

Winn (1990) refers to *situated cognition*, meaning that learning should take place in real world environments as opposed to isolating instruction in artificial educational contexts. *Cognitive apprenticeship* relies heavily on the lecturer in the role of guide and mentor, i.e. not designing the learning environment on behalf of the learner, but giving problems situated in real life (like case studies) and scaffolding/guiding the learner in the process of solving the problem (if necessary) (Jonassen, 1991b).

Applied to instruction the concept of open endedness relates to the ability of the learner to manipulate the learning environment.

In the following section motivation in adults is briefly explored to understand what elements are important when adults learn.

2.3.5 Motivation in adult learners

It is generally agreed that motivation can make more of a difference between success and failure in learning successfully than any other factor (Wlodkowski, 1999).

Intrinsic motivation is closely linked to emotions, and in turn, our emotions are governed by many factors. General intrinsic motivational principles are provided by Fleming & Levie, (1993:6):

- variation
- curiosity
- relevance (need stimulation)
- challenge and
- control

Variation in the learning environment relates to different modes of instruction (e.g. multimedia, web and face-to-face) and incorporating a variety of appropriate learning strategies into the learning environment. It is further explained under instructional technology design.

Curiosity relates to **problem-based** assignments or tasks that stimulate the learner's need to solve a problem. It is inherently creative.

Relevance plays a major role in adult motivation. Especially adults need to identify with what they learn in the sense that what they learn must make them feel more competent.

Challenge is important in order to stretch a learner. If solving a problem falls below a learner's competence, no learning takes place. On the other hand, the challenge must not exceed the learner's capacity too much. Land & Greene (2000:46) warn that novice learners approach complex tasks in superficial ways and unless they are guided, may not respond to the complex tasks with increased use of learning strategies.

Control relates to choice – choice or control over how, what, where and when a person learns. For their motivation to be sustained, adults must experience choice or willingness in the learning activity. Generally, adulthood is associated with responsibility. In this sense responsibility is also key to adult motivation in learning and it is difficult to feel responsible unless one has a choice to hold oneself accountable for.

In this regard Wlodkowski (1999:12) adds the following factors that contribute to motivation:

- success
- value and
- enjoyment

2.3.6 Adult learning

Success is an important motivational factor, because success is associated with competence. Success also feeds back into the loop of motivation – once a person is successful, it fosters motivation once again.

Tapscott (1996:204) notes that research at the MIT media lab is finding that the best learning comes from passion.

According to Duke (1996) the largest growing continuing education sector is that of employed adults who want to upgrade their skills and knowledge in order to equip them better for their jobs. This trend is endorsed by Merriam and Cafarella (1991) who note that the vast majority of adults choose vocational and practical education that leads to knowledge about how to do

something. This is significant as a return to epistemology in which *learning is informed action*.

It is important to note that the concept of adulthood is culturally and historically relative. Wlodkowski (1999:10) explains that some cultures regard puberty as entry into adulthood, whereas others use legal codes to permit adult behaviour.

According to Knowles (1989:83-84):

- Adults are self-directed
- Adults prefer to learn things that help them cope with real-life situations

These assumptions reflect a largely individualist and pragmatic culture. Contrary to the idea that adults are self-directed, Triandis (1995) points out that people from collectivist cultures may experience difficulty with self-directed learning, because they value assistance from others and focus more on harmonious relationships within the group. This concept is reminiscent of Japanese philosophy in which oneness of self and others are one of the fundamental principles. Similarly, Merriam (1998:56) notes that data-based studies of adult learners have revealed that some adults do not want responsibility or do not want to take responsibility for their own learning.

Because of the difference culture brings to the learning situation, Wlodkowski (1999:11) recommends that self-directed learning strategies in teaching should be negotiated with learners and not simply mandated.

Interaction should involve complex activities by learners, such as engaging and reflecting, annotating, questioning, answering, pacing, elaborating, discussing, enquiring, problem-solving, linking, constructing, analysing, evaluating, and synthesizing. Pea & Gomez (1992:5) argue that the lecturer and learner engage in a learning conversation “in which both parties clarify messages, test for understanding, compare and contrast with previous understandings and are both transformed by the experience”.

Tennant and Pogson (1995:42) talk of practical intelligence, which they describe as

“practice as opposed to theory, direct usefulness as opposed to declarative knowledge, and commonplace, everyday action or thought with immediate, visible consequences”.

Intelligence is therefore multidimensional, and not fixed. Although it definitely plays a role in learning, this study does not provide for an in-depth exploration of the correlation between intelligence, types of intelligence and successful learning.

Experiential learning is relevant to discuss in Chapter Two, because it combines aspects of constructivism and learner centred approaches to learning.

2.3.7 Experiential learning

Experiential learning is a way of learning that is facilitated by the practice of co-operative education. Qualifications are awarded upon successful completion of practical experience in particular industries, as well as theoretical components, either through full-time study or through distance education. Experiential learning recognises three different epistemologies or ways of knowing things:

- Propositional knowledge: Learning that which is purely based on the philosophy of positivism.
- Practical knowledge: This is based purely on the utility point of view.
- *Experiential knowledge: This is based on the philosophy of constructivism.*

Hence experiential learning combines an endogenic and an exogenic epistemology of knowledge and reflects the synthesis that emerged in the twentieth century when the separation between theory and action fell away.

Teaching methodologies within this system include:

- Self-regulated and peer-assisted learning,
- experiential and real-world learning,
- resource based and problem-based learning, and
- reflective practice and critical self-awareness (Kannaiyan, 1997:26).

In the experiential learning system, workshops, group meetings and discussions, co-operative learning and the use of appropriate technology-applications are considered innovative methods to facilitate effective learning.

The basic issues of true **experiential learning** can be described through such keywords as **constructivism, learner-centred, and problem-based**. Essentially the main idea is that people learn best when engrossed in the topic and motivated to seek out new knowledge and skills because they need them in order to solve the problem at hand (Kannaiyan, 1997:27). The major theme is one of focusing education around a set of realistic, intrinsically motivating problems (Cunningham, 1991:13-17). Learners work to solve these problems, often in groups, often in overextended periods of time. Problems should be structured carefully so that in the course of finding a solution, learners naturally pass through and acquire all topics of relevance. The learners might not even notice they are undergoing instruction and learning, for the education occurs naturally in the course of activity.

The following are features of learner-centred learning (Brown & Duguid, 1996:10).

- Learners discover knowledge rather than faculty simply transferring information.
- Continuous learner and course assessment, not just learner achievement, is used as tools to analyse teaching.
- Learning includes learner-driven episodes, not just scheduled lectures.
- Learner performance is observed by others versus only private assessment by instructor.
- Learners help define the questions rather than instructors simply handing out facts.
- Learners take active and proactive roles in learning versus being a passive audience or just listening to lectures.
- Learners learn collaboratively versus being rewarded for individual, competitive performance.

Because of the fact that co-operative learning is such an important component of constructivism, it is further explored.

2.3.8 Collaborative and cooperative learning

Collaborative learning in a problem-based context emphasises interaction among group members to solve a problem as a group. This type of learning can be facilitated by a virtual learning environment, as will be illustrated later. Blumenfeld *et al.* (1991) note that not only problem-specific learning goals, but also cognitive and social goals, are involved in a collaborative learning environment.

Co-operative learning has a very specific meaning in the field of education. Slavin (1983) describes it as a method in which small groups of students incorporate a co-operative task structure, a co-operative incentive structure and a co-operative motive to produce co-operative behaviour. Thus a small group of learners has a joint problem to solve or a task to perform, and every person in the group is responsible for contributing to the outcome. Empirical research indicates that co-operative learning promotes higher achievement than do competitive and individualistic learning (Johnson & Johnson, 1985:112). The characteristics of true co-operative learning environments are:

- positive interdependence,
- individual accountability,
- heterogeneous grouping,
- shared leadership,
- shared responsibility for others and for self,
- task and maintenance emphasised,
- social skills directly taught,
- lecturer observes and intervenes, and
- groups process their effectiveness.

The other very important component of constructivism is that knowledge is situated in real-life. In this light ill-structured knowledge domains are discussed.

2.3.9 Ill-structured knowledge domains

Ill-structured knowledge domains are prevalent in advanced concepts and their complexity arise from the fact that they closely resemble real-life. Constructivism is appropriate for learning in ill-structured domains where there is room for personal interpretation. However, in knowledge domains where concepts are well defined (for example linguistics and mathematics) the objective reality is absolute reality.

Spiro *et al.* (1995:92) note that “Various forms of conceptual complexity and case-to-case irregularity in knowledge domains (referred to collectively as ill-structuredness) pose serious problems for traditional theories of learning and instruction”. The authors continue to elaborate on the two properties found in ill-structured knowledge domains, namely:

- “each case or example of knowledge application typically involves the simultaneous interactive involvement of multiple, wide-application conceptual structures (multiple schemas, perspectives, organisational principles, etc.) each of which is individually complex; and
- the pattern of conceptual incidence and interaction varies substantially across cases nominally of the same type (i.e. the domain involves across-case irregularity)” (Spiro *et al.*, 1995:93).

An important implication is that ill-structured knowledge domains cannot be facilitated in a logically structured linear way. The implication for learning facilitation is to find a way to present the same concepts or knowledge constructs in different ways and at different times, in rearranged contexts and for different purposes, since different conceptual perspectives and multiple, adaptive and flexible interpretations are essential for attaining advanced knowledge acquisition.

This type of learning facilitation requires considerable planning and time from a lecturer.

The importance of interaction and feedback in learning is discussed below.

2.3.10 Interaction and feedback

Interaction means that the environment changes when the learner manipulates it, and the feedback the learner receives continues the negotiation process. This rich learning environment is found especially in artificial intelligence programs and intelligent expert systems, which provide cognitive scaffolding and diagnostic feedback. Diagnostic feedback is based on an adaptive learning process and means that the complexity of tasks can be adjusted according to the individual learner's knowledge level, his/her personal abilities and history of learning in the subject. It consequently provides for a flexible and adaptive learning environment (Baniulus & Tamulynas, 1997). Within the South African context few, if any, institutions can afford the development of such sophisticated software. Sponsorship by industry and sourcing from institutions abroad are better options.

Interaction is a dominant factor in effective learning, because it leads the learner to be active in the learning process and encourages him/her to make decisions and question acquired

knowledge. Interaction with people often offers the same or even better benefits than artificial intelligence programs.

Yacci (2000:6) lists the following four major attributes to the concept of interactivity:

- Interactivity is a message loop.
- Instructional interactivity occurs from the learner's point of view and does not occur until a message loop from and back to the student has been completed.
- Instructional interactivity has two distinct classes of outputs: content learning and affective benefits.
- Messages in an interaction must be mutually coherent.

Cronjé (1997) gives the following explanation of interactivity: "Interactivity has to do with simulating the interchange between two people who are communicating meaningfully. When this interactivity is mediated by technology, two factors come into play. The first is the level or intensity of the interaction, which might be measured in terms of the interdependence of the participants. The second is the mode in which the interactivity takes place, that is the number of participants, the time frame and the level of technological sophistication".

Oliver and Macloughlin (1996) recognize five different kinds of interactions:

- Social interaction.
- Procedural interaction – dialogue between learner and lecturer.
- Expository interaction – answering questions.
- Explanatory interaction – using the learner's reactions to explain new information.
- Cognitive interaction – giving a constructive answer to learners so that they reconsider their own ideas.

This is based on early work by Vygotsky (1978) who posits that social interaction and discourse foster cognitive development and higher order thinking.

Recent literature typifies three categories of interaction:

- Learner-content interaction.
- Learner-instructor interaction.
- Learner-learner interaction.

From a socio-cultural point of view, interactions like articulating, exploring, testing and refining and debating ideas augment critical thinking and cognitive and metacognitive understanding.

Knowledge construction is therefore facilitated by using interactions to achieve the following outcomes listed by Wagner (1997), cited in Bonk and Wisner (2000:22):

- To increase learning.
- To increase participation.
- To develop communication.
- To receive feedback.
- To enhance elaboration and retention.
- To support learner/self-regulation.
- To increase motivation.
- For negotiation of understanding.
- For teambuilding.
- For discovery.
- For exploration.
- For clarification of understanding.
- For closure.

Wlodkowski (1999:244-249) provides the following characteristics of effective feedback:

Effective feedback

- is informational rather than controlling,
- provides evidence of the learner's effect relative to the learner's intent,
- is specific and constructive,
- can be quantitative,
- is prompt, frequent and positive,
- is related to impact criteria,
- is usually personal and differential.

Some studies indicate that online discussions remain on a level of information sharing and comparing, instead of rising to knowledge negotiation, construction (new knowledge), testing and application (Kanuka & Anderson, 1998; Bonk & Wisner, 2000).

Creativity in the learning environment relates to motivational aspects such as engaging the learner and exceeding the learner's expectations. It includes a focus on the client's needs.

2.3.11 Synthesis

If one views this exposition of learning theory from an epistemological perspective, it is clear that both rationalism and empiricism underlie the continuum of learning theories and paradigms. Ideally, an integrated and holistic view of learning combines knowledge constructed from within and experienced from without and goes a step further toward social interaction and action, as is the case with constructivism.

It is the contention of the researcher that behavioural learning strategies are suitable for basic and relatively fixed knowledge domains; that cognitive learning strategies are suitable for deep information processing, long-term memory and more complex knowledge domains; and that constructivist learning strategies are complementary to complex knowledge domains and problem-based educational models. It is also possible to combine these strategies within a given learning environment, as proposed by Cronjé (2000:4).

If we understand individual learning, it is easier to understand group learning. In the words of Tapscott (1996:47), "in the race to the finish line, lifelong organisational learning becomes the only sustainable competitive advantage".

From this perspective the researcher deemed it necessary to investigate organisational learning.

In this light Teece (1998:55) notes that economic historians have long emphasised the role of the **learning organisation** and **technological innovation** in economic development.

2.4 Organisational learning

A movement called 'scientific management' which was founded by Frederick W. Taylor; attempted to increase efficiency in production by prescribing scientific methods and procedures to organise and operate work (Nonaka & Takeuchi, 1995:35). In response, a group of management scholars at Harvard University, headed by George Mayo, created a theory on human relations in which they emphasised the importance of human factors in management (Nonaka & Takeuchi, 1995:36). Subsequently, Chester, I Barnard tried to synthesise the mechanistic and humane management models and contended that

knowledge consists not only of logical, linguistic content, but also of behavioural, nonlinguistic content. Hence leaders should create values, beliefs and ideas in order to maintain the soundness of knowledge systems within the organisation.

According to Nonaka and Takeuchi (1995:37) the Barnardian attempt laid the foundation of organisation theory.

Some definitions of organisational learning are as follows:

- Organisational learning means the process of improving actions through better knowledge and understanding (Fiol & Lyles, 1985).
- An entity learns if, through its processing of information, the range of its potential behaviours is changed (Huber, 1991).
- Organisations are seen as learning by encoding inferences from history into routines that guide behaviour (Levitt & March, 1988).
- Organisational learning is a process of detecting and correcting error (Argyris, 1977).
- Organisational learning occurs through shared insights, knowledge and mental models ... [and] builds on past knowledge and experience – that is, on memory (Stata, 1989).

Studies of organisational culture have been able to illuminate the organisation as an epistemological system.

Drucker (1985) was one of the earliest to realise that knowledge would become the corner stone of the new economy. He argued that an organisation should be prepared to abandon knowledge that has become obsolete and to **create new things** through:

- Continuing improvement of every activity.
- Development of new applications from its own successes.
- Continuous innovation as an organised process.

It is clear from this description that organisational learning and innovation have the creation of new knowledge in common.

In organisation learning theory, it is generally accepted that learning consists of two types of activity. These two types of learning have been termed 'single-loop' and 'double-loop' learning (Argyris, 1977). The former is obtaining knowledge in order to solve specific

problems based upon existing premises and the latter is establishing new premises (i.e. schemata, mental models, paradigms or perspectives) to override the existing ones. Kim (1998:60) states “I believe that the process of surfacing individual mental models and making them explicit can accelerate individual learning. As mental models are made explicit and actively shared, the base of shared meaning in an organisation expands, and the organisation's capacity for effective coordinated action increases”.

Now that we have a better understanding of organisational learning, the following section focuses on knowledge management and knowledge creation. These fields have emerged from organisational learning.

2.5 Knowledge management

The new era of dynamic and discontinuous change requires continual reassessment of organisational routines to ensure that organisational decision-making processes, as well as underlying assumptions, keep pace with the dynamically changing business environment.

(Malhotra, 2000:3)

Duderstadt (2000:14) contends that there is an increasingly strong correlation between the level of one's education and personal prosperity and quality of life.

Extending this to an organisational context, Tapscott (1996:43) notes “the new economy is all about competing for the future, the capacity to create new products or services, and the ability to transform businesses into new entities that yesterday couldn't be imagined and that the day after tomorrow may be obsolete”.

Towards the end of the twentieth century, economists started to focus on knowledge as a contributor to economic wealth. Hayek was one of the first to emphasise the importance of implicit, context-specific knowledge (Nonaka & Takeuchi, 1995:33). He did not, however, succeed in defining a model that could make implicit knowledge explicit, but simply argued for the efficient utilisation of existing knowledge.

Schumpeter (cited in Pisano, 1997) emphasised the combining of explicit knowledge to create new products and services. Both were pioneers in terms of knowledge creation, as will be explored later in this chapter. Inherent in the shift towards the role of knowledge was a shift from mechanistic economic approaches to more human-centred approaches.

McGregor (1991) makes the point that when the primary asset of an organisation is stored in people rather than physical assets, the executives who guide the overall strategy of an organisation must include personnel factors in their decisions.

Von Krogh *et al.* (2000:31) argue that both the constructionist and cognitivist perspectives on knowledge have influenced management theory and practice.

They are particularly excited about the fact that constructionist studies focus on tacit aspects of knowledge in addition to its explicit forms.

Leonard and Sensiper (1998:113) note that:

“In the business context, we define knowledge as information that is relevant, actionable, and based at least partially on experience. Knowledge is a subset of information; it is subjective; it is linked to meaningful behaviour; and it has tacit elements born of experience”. Therefore knowledge is more closely related to learning than information.

Knowledge is not quite the same as information. Nonaka and Takeuchi (1995:57) illuminate this point by arguing that knowledge, unlike information, is about **beliefs, commitment and action**. Yet knowledge, like information, is about meaning – it is context-specific and relational.

Brown and Duguid (2000:119) make the following distinctions:

- Knowledge entails a knower, i.e. knowledge is usually associated with a person.
- Knowledge seems harder to detach than information – information is viewed as more self-contained than knowledge.
- Knowledge is digested rather than held and entails the knower’s understanding and commitment.

The first point is endorsed by Tapscott (1996:44) who notes that human beings create knowledge and that it implies an inherent shift to knowledge work.

The thought-provoking point is made that “while one person often has conflicting information, he or she will not usually have conflicting knowledge” (Brown & Duguid, 2000:120).

Von Krogh *et al.* (2000:6) delineate the different faces of knowledge as follows:

- Knowledge is justified true belief – personal beliefs are justified based on individualised observations of the world.
- Knowledge is both explicit and tacit.
- Knowledge is contextual – it depends on the situation and people involved rather than on absolute facts and hard data.

The authors continue to argue that effective knowledge creation depends on enabling contexts, i.e. “a shared space that fosters emerging relationships” (Von Krogh *et al.*, 2000:7).

In this light what becomes most important is an institution’s ability to attract, retain, and continually grow the capabilities of knowledge workers and provide the environment for innovation and creativity (Tapscott, 1996:47). Knowledge workers require motivation and trust in team relationships to be effective (Tapscott, 1996:47).

The most valuable asset of a 21st- century institution will be its knowledge workers and their productivity (Drucker, 1999:41).

Tissen *et al.*, 2000:3 add, “For in the knowledge economy it will be essential to act with the utmost speed to respond to unexpected and unusual market demands, while at the same time having to juggle the conflicting interests of increasingly irreconcilable parties”.

Quinn (1992:181) point out that “A corporation’s success today lies more in its intellectual and systems capabilities than in its physical assets. Managing human intellect – and converting it into useful products and services – is fast becoming the critical executive skill of the age”.

Brown and Duguid (2000:121) provide the following definitions:

“Knowledge management is the use of technology to make information relevant and accessible wherever that information may reside. To do this effectively requires the appropriate application of the appropriate technology for the appropriate situation”.

“Knowledge management incorporates systematic processes of finding, selecting, organising, and presenting information in a way that improves an employee’s comprehension and use of business assets”.

This notion is echoed by Malhotra (2000) who exposes two myths about knowledge management technologies:

Myth 1: Knowledge management technologies deliver the right information to the right person at the right time.

Myth 2: Knowledge management technologies can store human intelligence and experience.

Although the abovementioned statements are regarded as myths, some extent of the first statement could be achieved through, for example information portals, which will be discussed in Chapter Four.

The researcher believes that knowledge management is also a mechanism to improve customer satisfaction and therefore it has internal and external value added qualities.

Brown and Duguid (2000:123) note: "...investors see the value in people and their know-how – people with the ability to envisage and execute adventurous new business plans and to keep reenvisioning these to stay ahead of competition".

The world has entered into the knowledge economy by the increase in the availability of information. The problems of the future will be open-ended, complex, global and adaptive in nature (Gibbons, 1998). As a result, *knowledge management* has emerged as a critical field of study and as an important strategy in organisations. The growth of information technology has also amplified the importance of intellectual property and consequently intellectual property laws and systems. Unfortunately the scope of this study does not allow for an investigation of intellectual capital.

Economic prosperity rests upon knowledge and its useful application. The reason is the obvious: intellectual capital in the information age is directly linked to an increase in returns. Intellectual capital comes in two basic forms i.e. human capital and structural capital:

" Human capital includes all individual capabilities – that is, the talents, knowledge, and experience of the company's employees and managers. Structural capital consists of everything that remains when the employees go home – that is, the infrastructure that supports the company's human capital, including the information technology and physical systems used to transmit intellectual capital" (Von Krogh *et al.*, 2000:92).

The combined knowledge and intellectual capacity of employees are directly related to productivity and competitive advantage, making society dependent on knowledge workers. Universities with the most intellectual capital will have a new and powerful source of competitive advantage. Concomitantly the provision of relevant knowledge to workers, the retooling of people for new careers and catering to the need for mental stimulation are becoming economically viable markets (Blustain *et al*, 1999:51).

In a service organisation such as a university, the provision of relevant information and knowledge to customers is an equally strong competitive advantage.

As mentioned in Section 2.5, knowledge is tacit and explicit. This concept is further explored in Section 2.5.1.

2.5.1 Tacit and explicit knowledge

To better understand knowledge creation, it is necessary to provide a clearer explanation of the difference between *tacit* and *explicit* knowledge. As noted, knowledge can be tacit rather than explicit. "Tacit knowledge is that which is difficult to articulate in a way that is meaningful and complete" (Teece, 1998:63). Tacit knowledge involves physical skills and perception skills (Von Krogh, 1998:134). According to Teece (1998:63) this is the reason why it is hard to codify tacit knowledge – what we can do, think and know are more than what is easily put into words. Leonard and Sensiper (1998:121) contend, "Collective tacit knowledge is developed communally, over time, in interactions among individuals in the group. ...The more that tacit knowledge about operations is diffused and shared, the harder is imitation". Hence it is a competitive advantage when an organisation innovates because it will be hard for competitors to copy the innovation. Contrary to this view is the fact that it could also jeopardise the organisation if too little tacit knowledge is made explicit. The reason is that it poses a risk of being too dependent on individuals in the organisation.

This fact is illuminated by the theory of Jacques Lacan (cited in Johnson, 1989:321) in that language is inadequate to express what a person truly feels, thinks, knows and experiences. This means no one can ever speak the whole truth. Leonard and Sensiper (1998:113) echo this by stating: "Semiconscious or unconscious tacit knowledge produces insight, intuition, and decisions based on 'gut feel'. The common element in such knowing is the inability of the knower to totally articulate all that he or she knows". A statement such as this drives home the essence of innovation and creativity. Life is too complex to contain it. Innovative practice

means there is no model or recipe to follow. Insight and intuition often lead decision-making and planning.

Furthermore, whenever a person uses language by speaking or writing the listener or reader enacts with that which is spoken or written by contextualising the information in his or her own framework as was explained in Section 2.3.2. Hence added meaning, diversions and lacunae emerge which are almost impossible to capture and make visible. This factor is a constraint when implementing something completely new in an organisation. First of all most people resist change because of fear, and as explained earlier, motivation is an important factor to promote effective learning. If there is too much fear it could freeze any receptivity towards the change and could even lead to undermining change. This reaction is explored in Section 2.6. The direct link between learning and organisational change is explored again in Section 2.5.2.

A new concept is harder to fit it into a person's frame of reference and because of the complexity of meaning, it is difficult to gauge when a person has truly adopted a new concept. Wilson (1996:35) notes that tacit knowledge is "personal knowledge consisting of highly subjective insights, intuitions and hunches, rooted more in action than in reflection". Leonard and Sensiper (1998:118) enforce this by saying that "When a group of diverse individuals addresses a common challenge, each skilled person frames the problem and its solution by applying mental schemata and patterns he or she understands best. The result is a cacophony of perspectives. In a well-managed development process, these varying perspectives foster creative abrasion, intellectual conflict between diverse viewpoints producing energy that is channelled into new ideas and products".

Teece (1998:63) notes that there is a direct relationship between codification of knowledge and the cost of its transfer. An example is provided by Nonaka and Takeuchi (1995:96-113). In 1987 the Matsushita Electric Industrial Co., Ltd. developed a bread-making machine that is remarkable in that it embodies the skills of a master baker. The process of development started as early as 1984 when a team of experts was established, represented by the R&D lab, a mechanical designer and software developer whom were all familiar with bread making. After several mishaps they realised that they were overlooking an important factor. The idea that originated was to capture the tacit knowledge of a master baker in order to develop a winning bread making machine. In order to do this the entire team trained with the head baker for a year and in 1985 the team succeeded in developing a machine that could make tasty bread! This example illustrates that it could be a costly exercise to codify tacit knowledge, but in the longer term the return on investment is worth the initial investment.

Brown and Duguid (2000:123) warn against laying off or downsizing too easily, because an organisation's competitive advantage lies in its knowledge (i.e. people) and not in its information: "the sort of blind downsizing produced by business process reengineering has caused organisations to lose collective memory". Mistaking knowledge and its sources for information and its sources is therefore costly to an organisation. Adding to this, Tapscott (1996:28) emphasises that business process re-engineering (BPR) is inadequate without a changed, technology-enabled business model.

Organisations have always been oriented toward accumulating and applying knowledge to create economic value and competitive advantage. From the beginning of the 20th century, knowledge has become increasingly important as contributor to a country and individual organisation's success in industrial competition. The shift from an industrial economy to the processing of information and the creation, application and transfer of new knowledge has placed a new emphasis on knowledge and knowledge management.

It has been noted that knowledge creation is a critical success factor of the new economy. Nonaka and Takeuchi (1995:61) contend that tacit knowledge and explicit knowledge are mutually complementary entities. They call this interaction knowledge conversion. In any organisation there is a continuous and dynamic knowledge creation process of interaction between tacit and explicit knowledge. Table 2.4 shows their four modes of knowledge conversion.

	Tacit knowledge	To	Explicit Knowledge
Tacit knowledge	Socialisation		Externalisation
From			
Explicit knowledge	Internalisation		Combination

Table 2.4: Four models of knowledge conversion (Nonaka & Takeuchi, 1995:62).

- *Socialisation* is the knowledge conversion model of tacit to tacit – experiences are shared and tacit knowledge such as shared mental models and technical skills are thereby created. The point is made that an individual can acquire tacit knowledge

directly from others without externalising it through, for example language or writing it down. This field facilitates the sharing of experiences and mental models.

- *Externalisation* is the knowledge conversion model from tacit to explicit and is a process of articulating tacit knowledge into explicit concepts, e.g. conceptualising an image and expressing it through language. This field is prompted by meaningful dialogue or collective reflection.
- *Combination* is the knowledge conversion model from explicit to explicit and is a process of systemising concepts into a knowledge system, i.e. combining different forms of explicit knowledge such as creating a database of existing data. The networking of new knowledge and existing knowledge that results in a new product, system or service triggers this field.
- *Internalisation* is the knowledge conversion model from explicit to tacit and is a process of embodying explicit knowledge into tacit knowledge, i.e. learning by doing. Learning by doing triggers internalisation.

2.5.2 Organisational knowledge creation

Nonaka & Takeuchi (1995:84) list five main steps that are involved in organisational knowledge creation:

- Sharing tacit knowledge (socialisation).
- Creating concepts (externalisation).
- Justifying concepts (externalisation).
- Building a prototype (combination).
- Cross-levelling knowledge (internalisation).

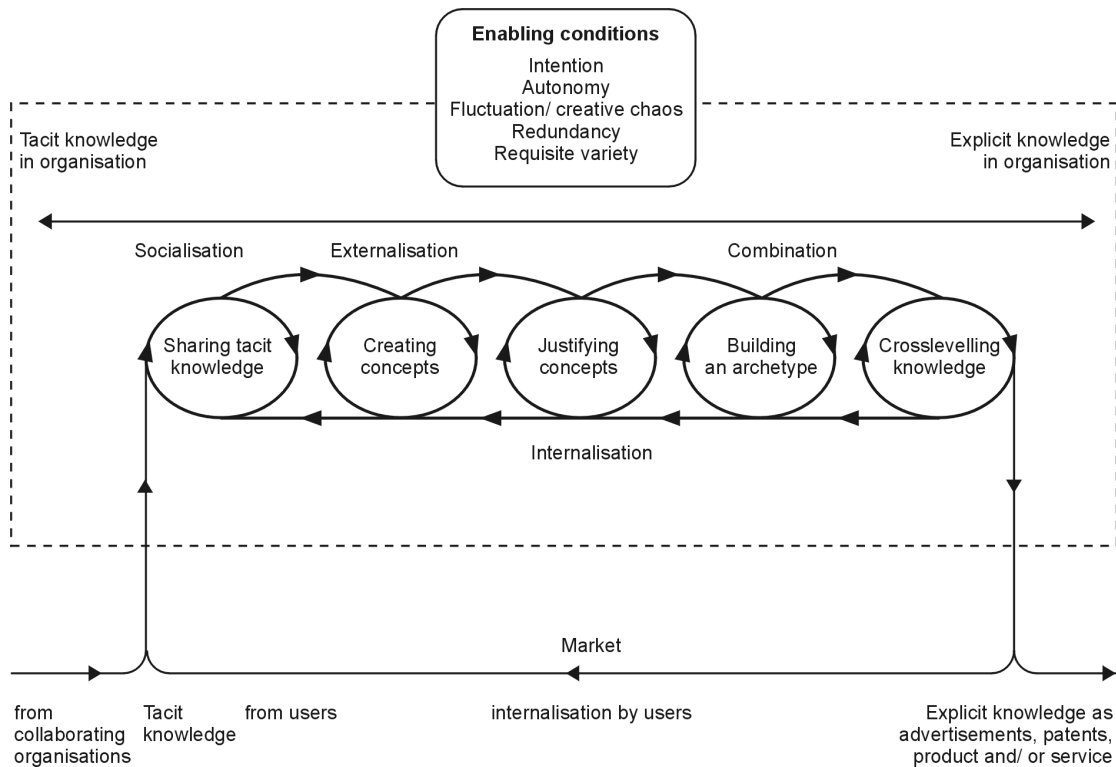


Figure 2.2: Five-phase model of the organisational knowledge-creation process (Nonaka & Takeuchi, 1995:84)

In other words if, for example, a new product needs to be created, team members come together and share their insights and experience. Part of this process is a negotiation of meaning and results in a new, or adapted concept. The best concepts need to emerge through individuals' arguments that their beliefs are more appropriate. It often requires justification, explanation and persuasion and requires delicate facilitation.

Dede (1997:4) sheds more light on the process by stating:

“Learning is social as well as intellectual. Individual, isolated attempts to make sense of complex data can easily fail unless the learner is encouraged by some larger group that is constructing shared knowledge. In addition, institutional evolution is a communal enterprise; educational innovators need emotional and intellectual support from others who have similar challenges in their lives”.

The next step is to develop a prototype based on the winning concept. It need not be a product, but could be a new marketing strategy for the organisation. Upon completion, the team takes the responsibility to share their new knowledge within the organisation.

Researchers stimulating implicit learning found, in fact, that forcing individuals to describe what they thought they understood about implicitly learned processes often resulted in poorer performance than if individuals were allowed to utilise their tacit knowledge without explicit explanation (Leonard and Sensiper, 1998:114). This is a catch 22 situation. In most cases, mission-critical knowledge should be codified as a risk management measure.

According to Von Krogh (1998:133-136) the company's overall performance depends on the extent to which managers can mobilise all of the knowledge resources held by individuals and teams and turn these resources into value-creating activities. Value creation can take place through creation of new knowledge comprising a least the following five phases:

- the initial sharing of knowledge, experience, and practices among team members;
- the effective creation of new service and product concepts based on this shared knowledge;
- the justification of these concepts deeply rooted in, for example, market studies, trend studies, focus interviews, benchmarking, or company strategy;
- the building of a prototype product or initial service offering;
- and the global leveraging of knowledge, concepts, prototypes, and offerings throughout the company.

These knowledge creation phases closely resemble innovation processes – as will be illustrated in Section 2.7.

Because knowledge resides in our bodies and is closely tied to our senses and previous experience, we will come to create the world in ways that are unique to ourselves. Thus knowledge is not universal and the constructionist does not pay much attention to comparing various representations. For the constructionist, the fragility of knowledge creation presents a major managerial challenge. Particularly where organisation-wide innovation is concerned, knowledge creation is a critical success factor.

Figure 2.3 illustrates the model of organisational knowledge creation (Nonaka and Takeuchi, 1995:73).

Theory of Organisational Knowledge Creation

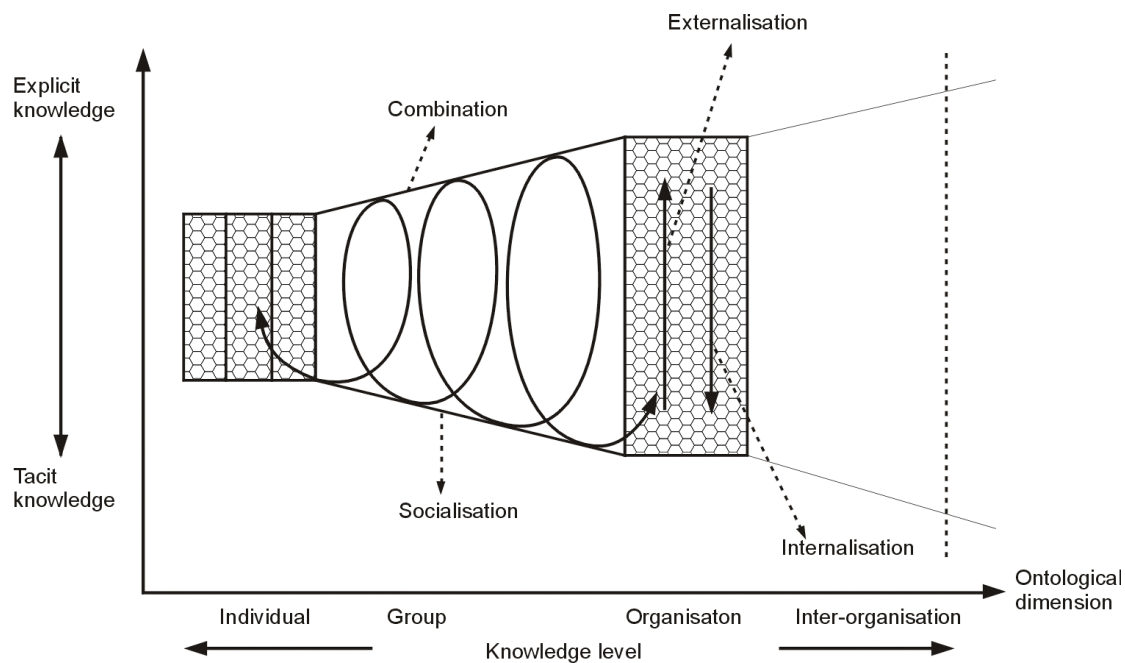


Figure 2.3: Spiral of organisational knowledge creation (Nonaka & Takeuchi, 1995:73)

Section 2.5.3 focuses on how knowledge is created in organisations.

2.5.3 Enabling knowledge creation

Nonaka and Takeuchi (1995:74-83) indicate the following conditions for enabling knowledge creation:

- intention,
- autonomy,
- fluctuation and creative chaos,
- redundancy,
- requisite variety.

- **Intention** can be defined as an organisation's efforts through various strategies to achieve its goals.
- The next condition is **autonomy** – individuals should be given sufficient autonomy as far as circumstances allowed within their working environments.
- **Fluctuation** is described as a breakdown of routines, habits or cognitive frameworks due to external forces and is believed to foster the creation of new concepts.
- **Chaos** results from crises, either real or evoked by intention.
- **Redundancy**, as the fourth condition, means that there is intentional overlap of information about business activities, management responsibilities, and the company as a whole because it helps build unusual communication channels and brings about learning by intrusion.

A different set of enablers is provided by Von Krogh *et al.* (2000). Discussing each enabler by chapter, the authors distinguish the following knowledge enablers:

- Instill a vision.
- Manage conversations.
- Mobilise activists.
- Create the right context.
- Globalise local knowledge.

Managing conversations, though is emphasised by Von Krogh *et al.* (2000:129) as an essential enabler because it connects with every step of knowledge creation:

“A creative conversation allows individuals to bring in their own ideas and insights through multiple reasoning methods like induction, deduction, and abduction. Abduction, which refers to the use of metaphors, analogies, and language games, is particularly important during this phase; it will provide the group with new terms, key words, descriptions, and meanings for the concepts they begin to define together”.

Good conversations require openness, patience, the ability to listen, experimentation with new words and concepts, politeness, the formation of a persuasive argument and courage (Von Krogh *et al.*, 2000:226). The leader of conversations should act almost like conductor of an orchestra – knowing when and how to encourage active participation.

Knowledge activists have six purposes:

- Initiating and focussing knowledge creation.
- Reducing the time and cost necessary for knowledge creation.
- Leveraging knowledge-creation initiatives throughout the organisation.
- Improving the condition of those engaged in knowledge-creation by relating their activities to the organisation's bigger picture.
- Preparing participants in knowledge creation for new tasks in which their knowledge is needed.
- Including the perspective of micro-communities in the larger debate on organisational transformation.

(Von Krogh *et al.*, 2000:148).

The authors single out middle managers as the most appropriate and powerful knowledge activists, because they work closely with the teams who have the knowledge, and also live close enough to top management to maintain the bigger picture and ensure a flow through the organisation.

In this regard, Nonaka and Takeuchi (1995:127) talk about the 'middle-up-down' management model. They purport it to be more effective than either the 'top-down' or 'bottom-up' management model, because it best describes the iterative process by which knowledge is created: "Simply put, knowledge is created by middle managers, who are often leaders of a team or task force, through a spiral conversion process involving both the top and the front-line employees (i.e. bottom). The process puts middle managers at the very centre of knowledge management, positioning them at the intersection of the vertical and horizontal flows of information within the company" (Nonaka & Takeuchi, 1995:127). They believe middle managers to be "the key to continuous innovation".

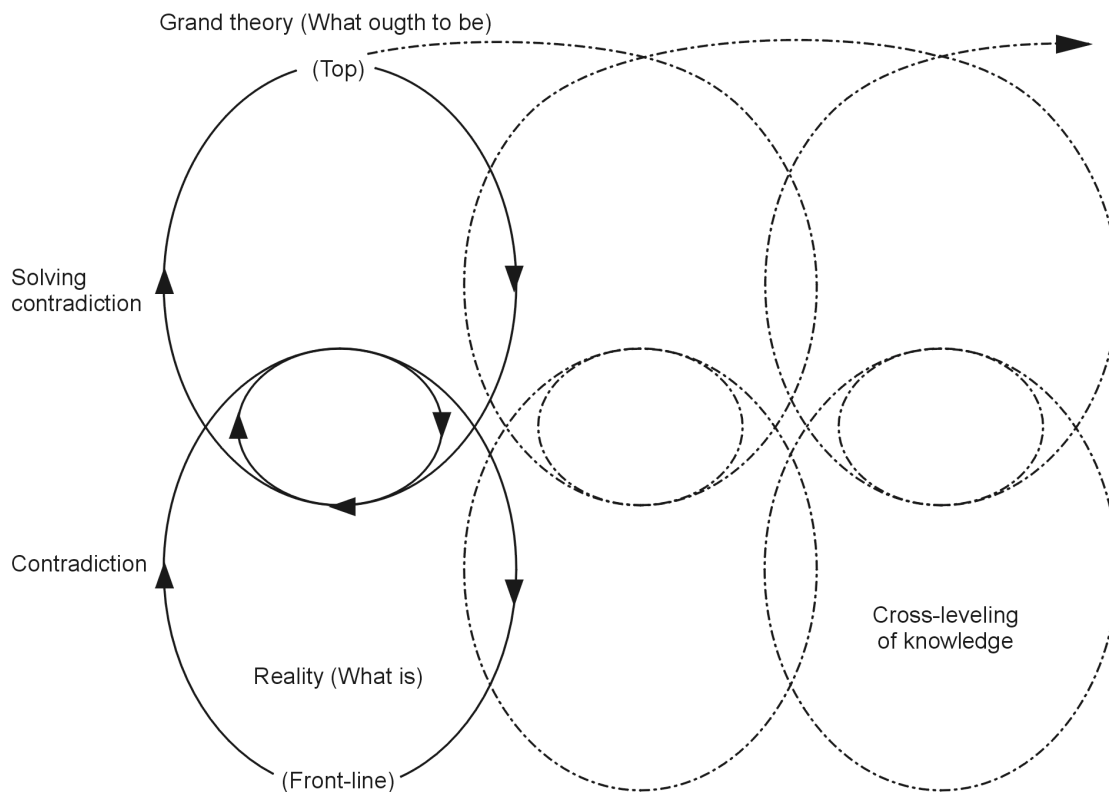


Figure 2.4: Middle-up-down knowledge creation process (Nonaka & Takeuchi, 1995:129)

The fourth enabler, *create the right context*, involves **organisational structures** that foster solid relationships and effective collaboration. They point out: "In fact, the whole process of knowledge creation depends on sensitive and aware managers who encourage a social setting in which knowledge continues to grow"(Von Krogh *et al.*, 2000:176). On this point, it is relevant to include the Japanese approach to knowledge creation. They refer to the enabling context as *ba*, which roughly translates as place (Von Krogh *et al.*, 2000:49) and has come to constitute the enabling context or place in which knowledge is shared, created and used. It does not necessarily mean physical space, but include virtual and mental space.

Ba refers to the right context (Von Krogh *et al.*, 2000:178) – one that promotes emerging relationships within microcommunities, across group boundaries, throughout an organisation. The authors suggest four ways of creating *ba*:

- *Originating interaction* (how individuals share feelings, emotions and experiences).
- *Conversing* (allows a group to share mental models and skills of individual members).
- *Documenting* (collective and virtual – involves the combination of existing explicit knowledge).

- *Internalising* (both individual and virtual)– individuals internalise knowledge that is communicated throughout the organisation via manuals, e-mail, videos or other media.

Figure 2.5 shows a comparison of Japanese-style versus Western-style knowledge creation. It is applied in Chapter Four.

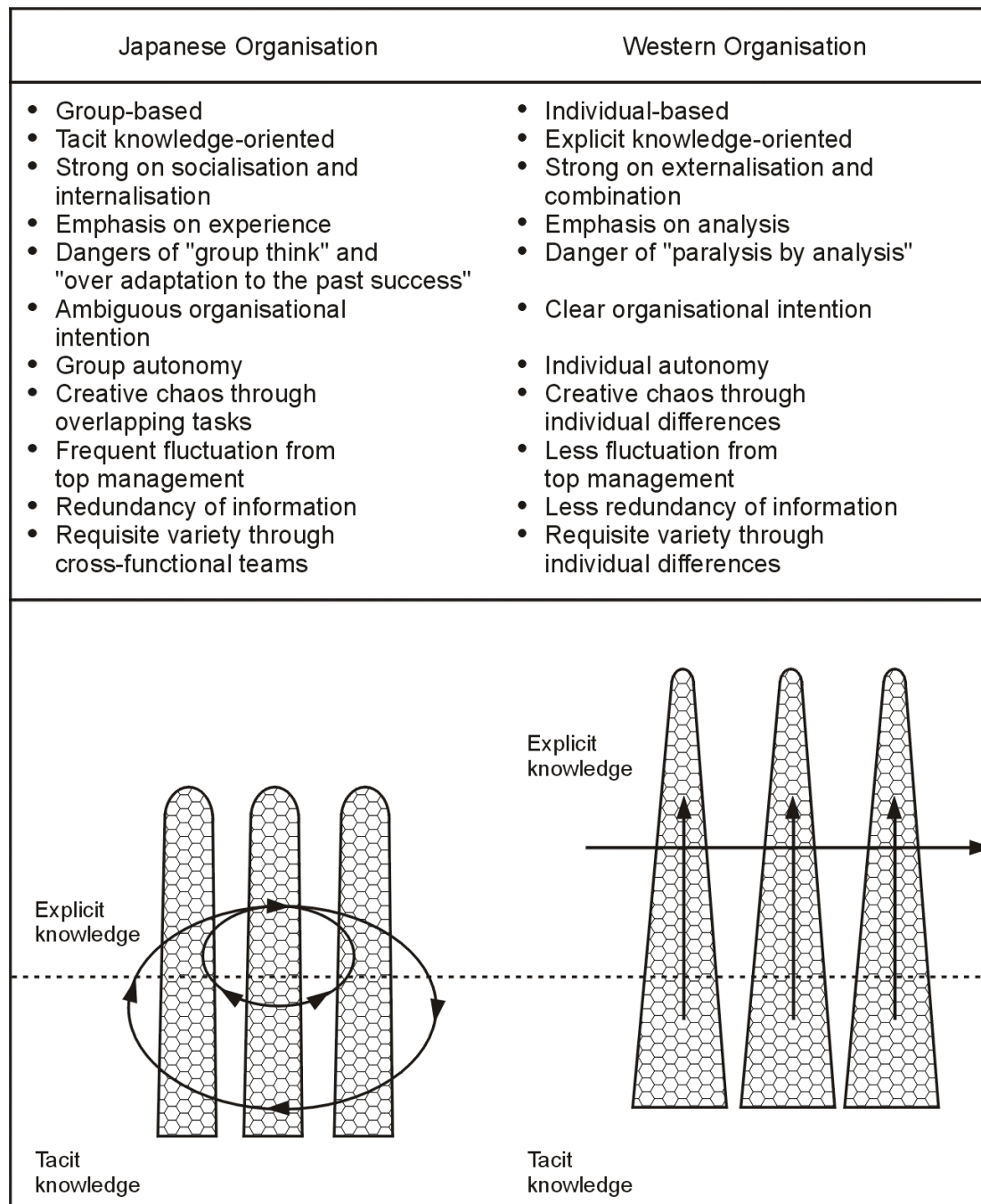


Figure 2.5: Comparison of Japanese-style versus Western-style organisational knowledge creation (Nonaka & Takeuchi, 1995:199)

Finally, *globalise local knowledge* means that “those who have created knowledge must come to the attention of those who seek knowledge creation, and vice versa”(Von Krogh *et al.*, 2000:224). Managers need to decide on what knowledge needs to be packaged and distributed. On a truly global level, knowledge exchange and competition should be typified as “Think globally and locally; act appropriately” (Von Krogh *et al.*, 2000:233).

2.5.4 Connection between knowledge enablers and knowledge creation

Von Krogh *et al.* (2000:129) give the following useful matrix in which the connection between knowledge enablers and knowledge-creation steps is indicated.

Knowledge-creation steps					
Knowledge enablers	Sharing tacit knowledge	Creating a concept	Justifying a concept	Building a prototype	Cross-leveling knowledge
Instill a vision		✓	✓✓	✓	✓✓
Manage conversations	✓✓	✓✓	✓✓	✓✓	✓✓
Mobilise activists		✓	✓	✓	✓✓
Create the right context	✓	✓	✓✓	✓	✓✓
Globalise local knowledge					✓✓

Table 2.5: The 5x5 Grid: Conversations affect all five knowledge-creation steps (Von Krogh, *et al.*, 2000:209).

Section 2.6 explores Change Management – focussing more on managerial aspects that are important during knowledge construction and change.

2.6 Change management

One of the greatest challenges for universities is to learn to encourage more people to participate in the high-risk, unpredictable, but ultimately very productive confrontations of stagnant paradigms. We must jar as many people as possible out of their comfortable ruts of conventional wisdom, fostering experiments, recruiting restive faculty, turning people loose to 'cause trouble', and simply making conventionality more trouble than unconventionality.

(Duderstadt, 2000:268)

The period of large-scale change started in the mid-1980's, driven by increasing global competition. Hambrick *et al.* (1998:5) provide the following forces that gave rise to massive change in organisations:

- The emergence of global competition.
- New technology.
- Public policy and socio-economic changes.

These changes can affect organisations adversely if no steps are taken to counteract them. As a result the field of change management emerged.

Conner (1998:100) states that change management deals with the human aspects of implementing major corporate initiatives such as **business process reengineering and the introduction of new technology** – especially on an enterprise scale. This definition shows the interface with innovation. Business process reengineering (BPR) and the introduction of new technology are closely related to technology innovation.

Nadler and Tushman (1995) postulate that in various stages of an organisation, there is relative equilibrium among the multitude of factors that shape that particular organisation. Periodically, however, organisations experience destabilising events that cause upheaval and disequilibrium. The authors suggest that these periods of disequilibrium involve discontinuous change. Discontinuous change is marked by three components or challenges that top management have to adhere to:

- Early recognition of changing forces that are likely to create disequilibrium.
- Making appropriate strategic choices to reposition the organisation as a strong competitor in the context of the disequilibrium reshaping the industry.
- Re-architecting the organisation.

If one examines recent global trends in higher education the following can be listed (Collis & Moonen, 2001:30):

- Virtualisation
- Lifelong learning
- Personalisation for the individual client
- Globalisation and internationalisation

To these one can add a shift from offering everything to market differentiation and from a one-stop service to enablement (providing access to resources rather than buying the resources). An example of the latter would be to give learners access to research databases abroad in which instance the said databases do not belong to the particular institution.

Faced with disruptive change, a change management plan is required, which spells out the following aspects (Senge *et al.*, 1999):

- A broad statement of purpose that articulates the organisation's ultimate goals and portrays what kind of organisation the change is intended to create.
- A description of core values that the organisation considers most important, such as *quality, innovation and service*.
- A statement of the core strategies, including a definition of businesses, markets, and offerings and a determination of particular bases for competition.
- A general explanation of the structures and processes used to coordinate management at the enterprise level (Governance).
- A broad framework for the architecture of the enterprise – the structures, processes, and systems that will enable people to perform the work required by the strategy and vision (Organisation).
- The patterns of behaviour required of people within the organisation over time, for example *customer focussed, responsive and empowering* (Operating environment).

- The actions that will be taken to improve the effectiveness of the core operations, including process redesign, quality, cost reduction and service and product innovation (Operational performance).
- A plan for upgrading the organisation's talent pool (Talent).

The authors caution against inadequate participation and poor implementation as the two most common reasons why organisations fail to redesign themselves successfully. Other reasons include complexity and capacity of people to absorb disruption – not only in terms of time available, but also personal traits such as resilience. Volume and momentum (speed) also have considerable impact. When the demands of change on people are too high they demonstrate dysfunctional behaviour, which leads to a loss in productivity. Conner (1998:15) points out that when change continues despite indications of dysfunctional behaviour the results are three-fold:

- Morale deteriorates.
- The initiatives that are attempted result in only short-term, superficial application of the intended goals.
- People stop listening to leaders and could attempt to undermine the process.

Common symptoms associated with distressing change include confusion, anxiety, fear, defensiveness and withdrawal (Conner, 1998:29). People need to feel in control or at least need to have indirect control – for example knowing what is going to happen although they cannot influence what will happen.

Kotter (1995:61) provides eight steps to organisational transformation:

- Establishing a sense of urgency (examine market and competitive realities).
- Forming a powerful guiding coalition (assembling a group with enough power to lead the change effort).
- Creating a vision.
- Communicating the vision.
- Empowering others to act on the vision.
- Planning for and creating short term wins.
- Consolidating improvements and producing still more change.
- Institutionalising new approaches.

Kotter's steps to organisational change have similarities with knowledge enabling steps (Von Krogh *et al.*, 2000, Nonaka & Takeuchi, 1995). A synthesis can be made as indicated in Table 2.6.

Nonaka & Takeuchi	Von Krogh	Kotter
Fluctuation		Establishing a sense of urgency
Intention	Instill a vision	Creating a vision
	Manage conversations	Communicating the vision
Autonomy	Mobilise activists	Empowering others to act on the vision
	Create the right context	Forming a powerful guiding coalition; Planning and creating short term wins
	Globalise local knowledge	Institutionalising new approaches.
		Consolidating improvements and producing still more change
Redundancy		
Requisite variety		

Table 2.6 Synthesis of knowledge creation and change management enablers

According to Senge (*et al.*, 1999:5) the majority of change initiatives fail. They add that deep changes in how people perceive the world and how they think are difficult to bring about.

Deep changes touch on values, and values cannot be enforced.

Crego and Schiffrin (1995:56-85) argue that most people are never encouraged to change and that individuals, like nature, have an innate mechanism that resists change in order to maintain what is referred to as *homeostasis* – a relatively stable state of equilibrium. Some individuals, on the other hand, naturally embrace change or continually strive to upset the equilibrium in order to grow. The authors (1995:59) mention that change in organisations threaten individuals on the following levels:

- Loss of status.
- Loss of job.
- Loss of security.
- Loss of structure.
- Social disruption.
- Group transformation.

Whereas the first three threats are self-explanatory, *loss of structure* refers to the chaos that ensues with change and innovation. It threatens the order and comfort zones of individuals. *Social disruption* refers to the fact that a social hierarchy exists in most organisations that is often linked to authority. A change can alter the social order and cause what the authors refer to as “disassociation” pain in those who are affected. The researcher is of the opinion that this factor is more prevalent in males, because they attach more value to power bases. *Group transformation* pertains to groups that are tightly knit and who have probably worked together for many years. These groups will resist change more than individuals or more loosely structured groups.

These threats could cause groups or individuals to consciously sabotage or undermine innovation and change.

The authors warn against a silo-based culture (1995:69) because it works actively against change “In the real world, in many organisations, each silo contains missiles pointed not at the enemy – the competitors – but at the other silos within the company”. The first corporate maxim is “Be true to your silo”. The second is “Protect your silo at all costs”. Another great barrier to change is bureaucracy - entrenched policies, procedures and unofficial rules that often no longer serve the institution and are not necessarily focussed on the needs of customers, but have been shaped around the needs of individuals or departments.

In this light, Conner (1998:207) adds the following:

“Organisational renewal demands a re-examination and, if necessary, a significant modification to the basic assumptions, beliefs and behaviours serving as the cultural infrastructure for the enterprise. Without this type of cultural context to reinforce the innovations emerging from a learning environment, important changes tend to be initiated but not sustained”.

Senge *et al.* (1999:43) list the following qualities of important change initiatives:

- They are connected with real work goals and processes.
- They are connected with improving performance.
- They involve people who have the power to take action regarding these goals.
- They seek to balance action and reflection, connecting inquiry and experimentation.
- They afford people an increased amount of 'white space': opportunities for people to think and reflect without pressure to make decisions.
- They are intended to increase people's capacity, individually and collectively.
- They focus on learning about learning, in settings that matter.

Conner (1998:207) recommends human due diligence, by which is meant that it is necessary to conduct a rigorous analysis to establish organisational readiness for change.

Typical questions are as follows:

- How much resilience do people have available to help them absorb change, and how do we develop this trait if it is too low?
- How knowledgeable are people about the human dynamics that unfold during change (e.g., why people resist and how they become committed), and how can we encourage more learning about the people side of change?
- How likely is it that important initiatives will be poorly implemented because of insufficient diagnosis, planning, and execution skills, and how do we enhance these skills if they are insufficient?

On the execution side the following questions are critical:

- How close to future shock overload are people before the change is engaged?
- How much additional change-load demand will it generate for them, and how can the demands from other changes be reduced or people's adaptation capacity be increased?
- How strong is management's commitment to this change, and how can it be heightened if it is insufficient?
- How strong is the employee resistance to this change, and how can it be reduced or, at least, managed?

To once again consider systems theory: it is important to consider the impact a particular change initiative has on the various systems in and around which it occurs.

Crego and Schiffrin (1995:71) contend that a change management plan should be designed to ensure effective leadership, appropriate organisational alignment and adequate individual involvement.

One of the difficulties with commitment is that it is easy for people to fake commitment. This contention is emphasised by Conner (1998:117). The author states that the most reliable predictor of commitment is “the price people believe they will pay if they fail to achieve their change”.

Crego and Schiffrin (1995:78-85) point out that a shift has taken place from *business process reengineering* to *customer process reengineering*. The reason is that the latter focuses on organisational and cultural change as well as on business redesign. This is necessary for sustainable change because it addresses the human factor. They provide the *Seven C's* as critical success factors in change management:

- Closeness - to all customers, internal, external and stakeholders.
- Clarity – of vision and strategy.
- Courage – to make the difficult decisions and to act.
- Creativity – to think outside of the box.
- Competencies – which are distinctive, differentiating, and continually developing.
- Commitment – the will to persevere.
- Consistency – in words and deeds.

Senge *et al.* (1999:26-27) list the following challenges that occur when change develops:

- Time (we don't have time for this stuff) – people involved in change initiatives need enough flexibility to devote time to reflection and practice.
- Personal mastery: Learning to cultivate the tension between vision and reality.
- Mental models: Developing awareness of the attitudes and perceptions that influence thought and interaction.
- Shared vision: Establishing a focus on a mutual purpose.
- Team learning: Through dialogue and skilful discussion, teams transform their collective thinking.
- Systems thinking: Understand interdependency and change.

Duderstadt contends that transformations “are frequently launched by a few remarkable people with unusual ability” (2000:267). He continues to explain that those who innovate new paradigms and who destabilise, are often very young or new in their field and disregard current disciplinary rules. They are often mostly involved in the early, flatter, and less productive portion of the ‘S’-curve, where the broad outlines of the new business is hammered out. The ‘S’-curve is discussed in Section 2.7.1.

Sections 2.1 – 2.6 have explored theoretical fields that feed into innovation in a higher education context, as will be illustrated in Chapters three and four.

Section 2.7 deals with innovation.

2.7 Innovation

As mentioned before, innovation relates to market acceptance and adoption of a new concept. The way in which the market adopts a new product or service is called diffusion. *Diffusions of innovations theory* describe the factors that influence people’s thoughts and actions and the process of adopting a new technology or idea. Bryce Ryan and Neil Gross (Ryan & Gross, 1943) pioneered the model in 1943.

Diffusion consists of several aspects:

- Spatial
- Temporal (time)
 - Rate of adoption
 - Stages of adoption
 - Categories of adopters

Rogers (1995:281) describes the process that people experience when they embrace new ideas and innovations. It is described in Section 2.7.2.

2.7.1 Rate of adoption

The 'S'-curve empirical prediction cycle is a well-known indicator used in the technology and innovation environment. Technology diffusion into a market generally follows the 'S'-curve path (see Figure 2.6). According to Christensen (1997:41) 'S'-curves are only useful with sustaining technologies and that disruptive technologies cannot be plotted on the 'S' - curve because it is completely different in nature.

The Basic 'S' - Curve

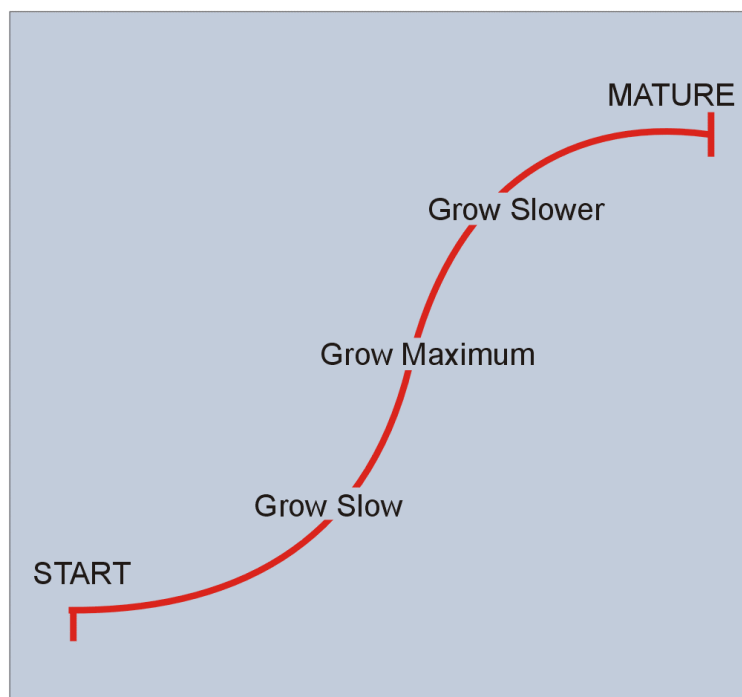


Figure 2.6 The basic 'S'-curve (Porter *et al.*, 1991)

Evolution normally takes place in predictable patterns of growth described as the 'S'-curve (Hambrick *et al.*, 1998:6). The pattern traces innovation in organisations from its beginning, with a variety of competing designs and technologies, to the emergence of dominant designs and a weeding out of competitors, and finally to the mature phase, when product innovation becomes secondary to process innovation. It forms the nucleus of technology strategy and posits that in the early stages of a technology, the rate of progress in performance will be

relatively slow. As people become familiar with the technology, it is diffused more rapidly throughout the organisation and the rate of technological improvement accelerates (see Figure 2.7). It is often used to predict whether an emerging technology is likely to supplant an established one. The stages of adoption and categories of adopters (Moore, 1999) are briefly discussed in Section 2.7.2.

2.7.2 Stages of adoption and categories of adopters

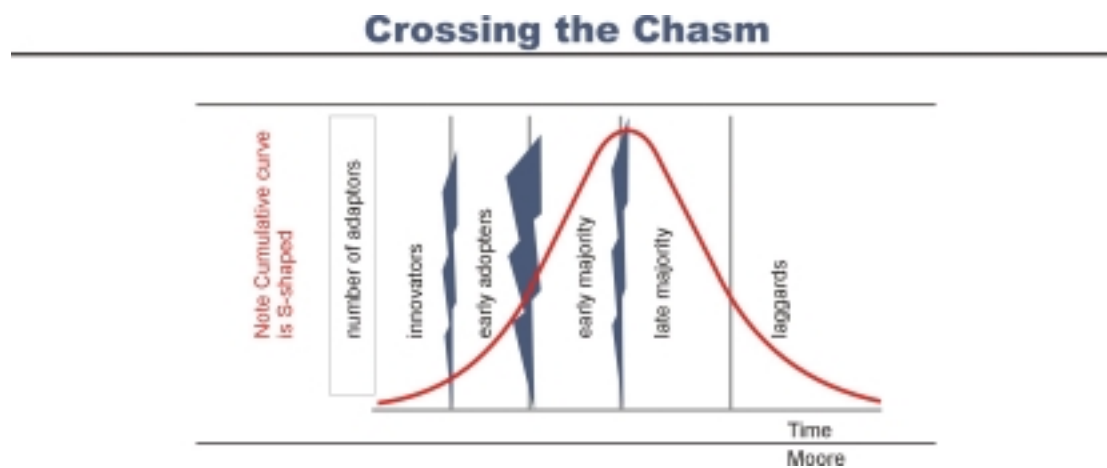


Figure 2.7 Crossing the Chasm (Moore, 1999)

The categories of adopters described are briefly discussed below (Rogers, 1995, Pistorius, 2000:4-16).

- *Innovators* take a keen interest in technology and like to experiment with new technology. They pursue innovation passionately because of their interest in new and advanced technology.
- *Early adopters* take a business interest in technology and are the greatest influence in opinion leadership. They adopt new technology because they can envisage its benefits without the need for well-established references. Opinion leaders are people who have the ability to informally influence other individuals' attitudes or overt behaviour with relative frequency (Rogers, 1995:281).
- The *early majority* usually adopt new technology once sufficient support and a track record of success are in place. They are driven by practicality.

- The *late majority* usually adopt because they have to. They are uncomfortable with technology.
- *Laggards* are the last to adopt, or they may never adopt.

Rogers (1995:369) emphasises the importance of change agents in the diffusion of innovation and argues that change agents have strong expertise regarding the innovative idea being diffused. Critical success factors in ensuring that an innovation is adopted is dependent on the extent to which change agents are:

- client oriented,
- accessible to clients
- empathetic
- perceived as credible
- able to foster a client's ability to evaluate innovations.

Rogers (1995) emphasises that adoption of technology is a communication process. He describes the process of diffusion in five stages:

- *Knowledge* is the stage where the potential adopter becomes aware of the innovation and gains understanding of it.
- *Persuasion* is the stage where a favourable or unfavourable attitude towards an innovation is formed.
- *Decision* is the stage where an innovation is put to use.
- *Confirmation* is the stage of reinforcement of a favourable adoption decision.

Rogers goes further to investigate the attributes of the innovation itself that could possibly influence its rate of adoption. These attributes are:

- *Relative advantage* - the degree to which an innovation is perceived to be better than the idea it supersedes.
- *Compatibility* – The degree to which an innovation is perceived to be consistent with existing values, beliefs, experience and needs.
- *Complexity* – the degree to which an innovation is perceived to be difficult to understand.

- *Triability* - the degree to which an innovation may be experimented with on a limited basis.
- *Observability* – the degree to which the results of an innovation are visible.

The chasms in Figure 2.7 show critical points in the adoption curve. Each gap poses a threat to successful diffusion of a particular innovation. The biggest risk is situated between the early adopters and early majority. Consequently, if there is too little momentum during the *early adopter* phase, market diffusion does not take place. Similarly, a gap between the early majority and late majority could mean that diffusion stops before it reaches the majority of the market. This does not imply market failure though. The researcher is of the opinion that complete diffusion is not always necessary and will depend on the business strategy of the organisation.

The Technological Acceptance Model (TAM) is a widely used research model to predict IT adoption and was developed by Davis in 1983 (Davis, 1989). It identifies two perceptions by users of technology that have an impact on their adoption of technology:

- Perceived usefulness.
- Perceived ease of use.

Perceived usefulness relates to the degree that people believe that using particular technology would enhance their job performance. It also pertains the extrinsic characteristics of the technology, such as efficiency and effectiveness.

Perceived ease of use pertains to intrinsic characteristics of the technology. It relates to the degree to which a person believes using the technology will be free of effort, i.e. to ease of use, ease of learning and flexibility.

Section 2.7.3 provides a broader outline of innovation and discusses Intrapreneurship as an important aspect of Innovation.

2.7.3 Describing innovation

Innovation refers to any concept or invention; a product, service or process; which is adopted by a market (Utterback & Abernathy, 1975; Roberts, 1988, Girifalco, 1991; Betz, 1998).

Thus innovation contains an element of something new – either a completely new idea (invention) or a concept, which is improved - and an element of market acceptance. It is important to point out that *innovation* is not the same as *invention*, because a market does not necessarily adopt an invention. Furthermore, even if a concept is borrowed and not created; adapted, implemented and adopted by a new market; it is still an innovation.

Innovation is therefore not necessarily concerned with technology and could take on any form. Yet because of the dynamic nature of technology and its significant impact on organisations, innovation has moved to the forefront of management theory - primarily focused on technology innovation. Figure 2.8 illustrates the researcher's view of the dynamics of innovation within the context of this study.

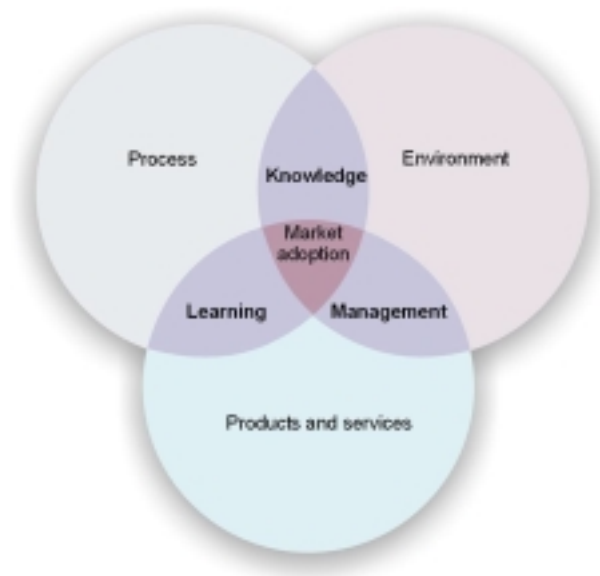


Figure 2.8 Dynamics of innovation

2.7.4 Intrapreneurship

Pinchot (1985:3) notes, “In this time of rapid economic and technological change, the entrepreneurial spirit can be a unique and important advantage, but only if we learn to use it”. He continues to make noteworthy statements about innovation that should be heeded by large organisations:

- Innovation seldom succeeds without a champion.

- Continuous innovation is required just to stay where we are.
- Innovation requires flexibility and freedom to act (no red tape and hierarchy).

Importantly, he coins the term *intrapreneur* – a person who is an entrepreneur within a large organisation.

He describes the following characteristics of intrapreneurs:

- The intrapreneur is the general manager of a new business that does not yet exist.
- The intrapreneur has the ability to visualise the steps from creating the idea to actualisation.
- The intrapreneur can create order out of chaos.
- Intrapreneurs cross-organisational boundaries and must cross the barriers that divide the organisation into functions.
- They have vision, imagination, courage and resilience.
- They are naturally action oriented and pragmatic.
- They are unwilling to accept no for an answer.
- They could be too task-oriented (putting objectives before people).
- They have well developed intuition, take initiative and are creative.
- They are often natural strategists.

Conner (1998:190) picks up on resilience as a key success factor for change. The authors identify five personal characteristics that define resilient behaviour:

- Positive – identify opportunities and have the self-confidence to know they will succeed.
- Focused – have a clear vision of what they want to achieve.
- Flexible – draw on a wide range of internal and external resources to develop creative, pliable strategies for responding to change.
- Organised – use structured approaches to managing ambiguity, planning, and coordinating effectively in implementing their strategies.
- Proactive - engage action in the face of uncertainty, taking calibrated risks rather than seeking comfort.

Owing to the complex nature of large organisations, such as universities, Duderstadt (2000:273) points out that universities become encrusted with policies, procedures,

committees, and organisational layers that discourage risk taking and creativity. This could become a serious impediment to successful change. Ironically, it is the creative anarchy of academic culture that sometimes resists change. Because an intrapreneur works outside the normal governance of an organisation, high-level sponsorship is required, as indicated in table 2.7.

Inventor	Intrapreneur	Sponsor	Protector
Understands the new product or service, but not how to make a business of it.	Attention is on business realities; may occasionally forget realities of corporate politics.	Attention is primarily on removing organisational barriers and giving advice to the intrapreneur.	Very high-level sponsor who approves and protects, but only occasionally meets with the intrapreneur.

Table 2.7: Sponsorship spectrum (Pinchot, 1985:149)

Threats to intrapreneurs include the following (Pinchot, 1985:154):

- *Jealousy* – when one person or one group in an organisation is singled out to innovate, the others feel slighted and cheated.
- *Danger of success* – success becomes a threat to other groups and individuals because their resources could be drawn away; their reaction could cause isolation of the intrapreneur.
- *The spotlight* – the lack of mature profit centres with which to hide development costs make it hard to defend expenditures and demands for return on investment.

These reactions, or ‘antibodies’ could result in many attempts to undermine innovation. Comparing it to a Darwinian process Duderstadt (2000:273) notes that when successful innovations, or “islands of entrepreneurship” are supported with the necessary resources and incentives; they draw away resources from existing activities resistant to change. The benefit is that these initiatives will attract staff and students into the new activities. It could also mean that the successful new initiatives destroy older, obsolete efforts. On the other hand, unsuccessful initiatives are unable to compete with ongoing activities capable of sustaining their relevance during a period of rapid change.

Conner draws on organisational learning as a solution for successful change. The author terms it nimbleness, i.e.: “the ability for an organisation to consistently succeed in unpredictable, contested environments by implementing important changes more efficiently and effectively than its competitors”(1998:39).

The characteristics of a nimble organisation are as follows:

- Repeatedly succeed in erratic, competitive environments through fast and effective modifications of their operations.
- Demonstrate a superior capacity to deal with unanticipated problems and opportunities.
- Rapidly redefine and redeploy their human, physical, and financial resources following a disruptive change.
- Orchestrate multiple, even simultaneous reconfigurations of their various corporate structures.
- Employ associates who accept frequent reassignment of their duties and perpetual reordering of their priorities as the norm.
- Help their people view a continuous flow of unplanned activities as simply the inevitable price to be paid for competing in volatile markets.

A very useful continuum is provided, which indicates that nimbleness is also about flexibility of decision, based on the context:

- Individual effort ...Team work.
- Improvisation...Discipline.
- Defined structure...Fuzzy boundaries.
- Diversity of ideas...Shared perspective.
- Continuous improvement...Exploit what works as long as possible.
- Trust logic...Rely on intuition.
- Zero defects...Learn from mistakes.
- Near-term results...Long-term vision.
- Tactful feedback...Frank dialogue.
- Patience...Urgency.
- Pride in accomplishments...Humility for what is left undone.
- Forgiveness for being human...Insistence on accomplishing important tasks, no matter what.
- Leading the whole...Managing the segments.

- Attract unorthodox thinking...Eject destructive conflict.

2.7.5 Change management strategies for innovation

Duderstadt (2000:268) recommends the following actions that a university must take in times of great change:

- Commitment at the top.
- Seeking institution - wide involvement.
- Igniting the sparks of transformation (identify key individuals at different levels who will buy into the transformation process and become active agents to drive it).
- Controlling and focusing the transformation agenda (focus different members and groups of the university on the aspects of transformation that are relevant to them).
- Staying the course (don't let resistance to change and an attitude of 'we'll wait them out' or 'this, too, shall pass' wear you down).

Speaking from a Northern American perspective, Duderstadt (2000:37) mentions that some universities have attempted to restructure, reengineer, and reinvent their administrative services and core academic activities in response to global changes. Yet society is becoming impatient with reluctance of universities to truly face up to the challenge of change. He laments the fact that the major resistance concerns changes in curricula and pedagogy; and that technology has largely bypassed the classroom.

Revisiting the exposition on knowledge and learning; it is finally important to note that Conner (1998:24) stresses the importance of organisations to acquire new and explicit knowledge about change. He terms this 'generic knowledge', which unlike systemic and specific knowledge deals specifically with knowledge about change. Only if new learning is associated with change, does it result in generic knowledge, which he deems represents the strongest competitive advantage.

2.7.6 Types of innovation

Porter *et al.* (1991:5) state “International competitiveness in technology-based industries is the new metric of national economic achievement. A nation’s competitiveness depends on the capacity of its industry to innovate”.

Table 2.8 is an overview of the types of innovation.

Type of innovation	Author/s	Definition	Example
Radical/ Revolutionary/	Marquis, 1969 Henderson & Clark, 1990,	Establishes a new dominant design, which is embodied in components that are linked together in a new architecture of which no increase in scale, efficiency or design can make what it impacts upon competitive with the new. Impacts organisation-wide and often provide competitive advantage. Is accompanied by a high degree of change in human behaviour and paradigms.	Desk top computers
Incremental/ Evolutionary/	Marquis, 1969 Henderson & Clark, 1990	Refines and extends an established design, but underlying concepts, and the links between them, remain the same. Continuous improvement of products, processes and services	
Disruptive	Christensen, 1997	Results in worse product performance in the beginning – have attributes that (generally new) customers value	
Sustaining	Christensen, 1997	Improved performance of established products – could be radical or incremental.	
System	Marquis, 1969	Ideas that require several resources and many labour-years to accomplish.	Communications networks
Architectural	Henderson & Clark, 1990	Existing knowledge or hardware in a product is arranged differently, resulting in a different product and possibly a new market. Often small changes that lead to significant competitive advantage.	Ceiling mounted fans.
Modular	Henderson & Clark, 1990	Usually represents a radical innovation of a certain part of a total product and often takes place in complex products or processes with many sub units and functions.	Tone and pulse phones

Type of innovation	Author/s	Definition	Example
Process/ Procedure	Utterback & Abernathy, 1975	Improving current procedures and processes used in the production of products.	Any improvement to current manufacturing, delivery, packaging, marketing, project management.
Product/ Service	Utterback & Abernathy, 1975	Often associated with new product development. In a service organisation the product is supplying a service to the client.	Digital watch, self service
Market pull	Noori, 1990	Innovation starting with an identified customer or market need.	Velcro
Market push	Noori, 1990	Innovation based on new technology or bright idea.	Photocopier

Table 2.8 Types of innovation

2.7.7 Conditions for successful innovation

Drucker (1985) discriminates between the fundamental conditions under which new ideas become successful and enduring innovations in any field.

- Ideas that become successful innovations represent a solution that is clearly definable, is simple, and includes a complete system for implementation and dissemination.
- Successful innovations start small and try to do one specific thing.
- Knowledge-based innovations are least likely to succeed and can succeed only if all the needed knowledge is available.

Collis *et al.* (2000) propose the 4-E model to implement technological innovation in an educational setting.

According to the model, an individual's likelihood of making use of a technological innovation for a learning-related purpose is a function of four groups of factors:

- Environment (institutional culture)
- Educational effectiveness (perceived or expected)
- Ease of use
- Engagement (the individual's personal response to technology and to change)

An important component of institutional culture is support, i.e. to what extent does the institution provide support in terms of online library services, technological infrastructure and training. Other elements include management style and vision of leaders and the institution's previous experiences with technology-related change.

2.7.8 Innovation management

Tidd *et al.* (1997:36) provide the following table to indicate how such a process of innovation can be managed:

Basic ability	Contributing routines
Recognising	Searching the environment for technical and economic clues to trigger the process of change.
Aligning	Ensuring a good fit between the overall business strategy and the proposed change – not innovating because it is fashionable or a knee-jerk response to a competitor.
Acquiring	Recognising the limitations of the company's own technology base and being able to connect to external sources of knowledge, information, equipment, etc. Transferring knowledge from various outside sources and connecting it to the relevant internal points in the organisation.
Generating	Having the ability to create some aspects of technology in-house, e.g. through R&D, engineering groups.
Choosing	Exploring and selecting the most suitable response to the environmental triggers, which fit the strategy and the internal resource base/external technology network.
Executing	Managing development projects for new products or processes from initial idea through to final launch. Monitoring and controlling such projects.
Implementing	Managing the introduction of change – technical and otherwise – in the organisation to ensure acceptance and effective use of innovation.
Learning	Having the ability to evaluate and reflect upon the innovation process and identify lessons for improvement in the management routines.
Developing the organisation	Embedding effective routines in place – in structures, processes, underlying behaviours, etc.

Table 2.9: Innovation management process (Tidd, *et al.*, 1997:36)

Maddox, Anthony and Wheatly (1987, cited in Porter *et al.*, 1991:40), on the other hand, provide the following framework.

- Forecast the technology.
- Analyse and forecast the environment.
- Analyse and forecast the market/user.
- Analyse the organisation.

- Develop the mission.
- Design organisational actions.
- Put the plan into action.

The value network (the context within which a firm identifies and responds to customers' needs, solves problems, procures input, reacts to competitors, and strives for profit) shape how an organisation perceives possible rewards from sustaining and disruptive innovations (Christensen, 1997:32).

Christensen (*ibid.*) claims that these expected rewards determine the allocation of resources towards sustaining innovations and away from disruptive ones. In other words, established organisations portray consistent leadership where sustaining innovation is concerned, but not where disruptive innovation is concerned. Because of this disruptive technologies are usually developed with very little resources and mostly within established organisations. Furthermore, they are seldom initiated by senior management and they often employ off-the-shelf components (Christensen, 1997:43).

Christensen (1997:99) adds that the following principles and management thereof, lead to successful innovation where disruptive technologies were concerned:

Principle	How successful managers harnessed these principles
1. Resource dependence: Customers effectively control the patterns of resource allocation in well-run companies.	1. Embed projects to develop and commercialise disruptive technologies within an organisation whose customers need them. When managers align a disruptive innovation with the right customers, customer demand increases the probability that the innovation will get the resources it needs.
2. Small markets don't solve the growth needs of large companies.	2. Place projects to develop disruptive technologies in organisations that are small enough to get excited about small wins.

3. The ultimate uses or applications for disruptive technologies are not known in advance. Failure is an intrinsic step towards success.	3. Plan to fail early and cheaply in search of a market for a disruptive technology – hence through an iterative trial and error process.
4. Technology supply may not equal market demand. The attributes that make disruptive technologies unattractive in established markets often are the ones that constitute their greatest value in emerging markets.	4. Develop new markets when commercialising disruptive technologies, rather than search for a technological breakthrough so that the disruptive product can compete as a sustaining technology in mainstream markets.

Table 2.10: Management of principles of disruptive technologies that lead to successful innovation (Christensen, 1997:99).

Pogrow (1996) makes a few thought-provoking statements concerning broad-scale reforms.

Myth	Reality
(i) You can change instruction via advocacy, in-service, and training.	Large-scale reform requires highly specific, systematic, and structural methodologies with supporting materials of tremendously high quality.
(ii) You can reform education by disseminating knowledge and leaving it up to practitioners to apply that knowledge.	Reform requires technology, methodology, structure, dosages, and materials. It is far more difficult to figure out how to implement theory than it is to generate it.
(iii) The most important change involves radical reformulation of existing practice, i.e., new paradigms.	The most important changes are incremental ones. While paradigm shifts are important in the evolution of knowledge, they are extremely rare.

(iv) The best way to achieve reform is through institution wide change/restructuring.	Institution wide change, while a nice idea, has never worked on a large scale and is probably not necessary.
(v) You can understand large-scale change by understanding what happens on a very small scale.	Large-scale change reflects properties that are often diametrically opposed to those in effect in small-scale research.

Table 2.11: Myths and realities about educational reform (Pogrow, 1996)

Consequences of the myths, according to Pogrow (1996), are “massive waste of resources on staff development and dissemination. In the absence of a valid technology and a body of experience for carrying out a proposed reform on a large scale, in-service training and dissemination strategies are largely ritualistic shams that waste time. Staff development gets everyone excited, but little happens. Still, despite its woeful track record, we keep on pushing staff development with religious fervour as the key to improving education”.

Section 2.7.9 provides technology innovation strategies.

2.7.9 Technology innovation strategies

Tidd *et al.* (1997:58-63) mention the long-standing debate between ‘rationalist’ and ‘incrementalist’ strategies for innovation.

A rationalist strategy entails the following linear steps.

- Describe, understand and analyse the environment.
- Determine a course of action in the light of the analysis.
- Carry out the decided course of action.

An incrementalist strategy entails the following iterative steps.

- Make deliberate steps (or changes) towards the stated objective.
- Measure and evaluate the effects of the steps (changes).
- Adjust (if necessary) the objective and decide on the next step (change).

The authors contend that real-life management is too complex to be prescriptive about using certain strategies and that managers often shift between both strategies, depending on the particular environment at the time. Laurillard (1996:1) provides the following useful critical success factors that should be borne in mind with technology innovation within an educational context:

- A pro-active process that ensures synergy among all units and that can maintain a proportion of new methods.
- A course production-presentation process that can be responsive to curriculum development and flexibility in its team building, project management and creative collaboration processes.
- A staff development programme that supports academic and production staff in their exploration of ways of utilising technology for teaching and learning.
- Resource planning and activity costing procedures that enable all units to use new technology resources effectively.
- A technical infrastructure that will support all learners and staff.
- Quality assurance mechanisms.
- Collaborative partnerships.

Section 2.7.10 explores the relationship between innovation and competitiveness.

2.7.10 Competitiveness

As indicated, there exists a link between economic competitiveness, and technology innovation. This is emphasized in the World Competitiveness Rating (World Economic Forum, 2000): “In 2000 the world ‘on-line’ meets the world ‘off-line’. The winning nations for competitiveness are those, which create the best environment for the interaction between the enterprises of the ‘new economy’ and those of the ‘brick and mortar’ world. Massive investment in technological infrastructure is now paying off ...” Duderstadt (2000:15) notes that there has been a shift in emphasis within the university away from simply distributing and analyzing knowledge, e.g. ‘teaching’ and ‘scholarship’, to creating knowledge, to activities such as ‘innovation’ and ‘creativity’.

An increase in returns is linked to four factors related to technology innovation. These factors are briefly described by Teece (1998:58).

- The first pertains to *standards*. If, for example a company like Microsoft develops an operating system protocol, which is proprietary, and the protocol gains acceptance, the better the chance the standard has of becoming the dominant operating system and thus yielding significant rents.
- The second to *customer lock-in*. Investment in high technology products amplify switching costs, hence many suppliers focus their energy on initial sale because follow-up sales will be easier. An example would be selling a network infrastructure to a University. Once the University has bought into that network infrastructure, the costs of switching to another network will be high.
- The third relates to *up-front costs* required to develop a product. A typical example is the enormous initial investment to develop new software. Hence the first copy literally costs millions, but the second zero.
- The fourth deals with the *cost of producer learning*. Producers often become more efficient as they gain experience, but if the knowledge is tacit and difficult to transfer to other producers, competitors with less experience are at a competitive disadvantage. In this sense process technology is easier to protect than product technology: a laser printer can be bought and imitated through reverse engineering, but a manufacturing process in a biological factory is hard to imitate by looking at the end product. The point made, though, is that high technology does not give a competitive advantage if it is not supported by cognitive and managerial skills to discern the correct strategies in time. Moreover, imitation is often hindered because few routines are stand-alone and imitating only a part of what a competitor does may not achieve the required result.

The fact that innovation depends on market adoption renders interaction with the market very important. Customer relationships have become important for any business or organisation. It is the contention of the researcher that Customer Relationship Management (CRM) should be a strategy in an organisation's change management plan. Its relevance to the field of innovation is discussed in Section 2.8.

2.8 Customer Relationship Management

It is essential to explore Customer Relationship Management (CRM) to understand how important organisational change in higher education institutions have become. In light of lifelong learning trends and wider choice, institutions need to become increasingly customer/consumer centric. As was pointed out in Section 2.5, *knowledge management* is a useful strategy to attain consumer satisfaction by giving consumers access to topical and relevant information according to their needs.

CRM goes a step further, i.e. beyond information and knowledge provision. It posits that a relationship with the customer is necessary for sustainable growth.

Gartner (2001:7) define CRM as “a business strategy whose outcomes optimise profitability, revenue and customer satisfaction by organising around customer segments, fostering customer-satisfying behaviours and implementing customer-centric processes”.

Characteristics of a customer driven organisation are as follows (Prinsloo, 2001):

- They spend time meeting customers and listening to their problems.
- They benchmark competitor's products and seek 'best of class' solutions.
- They continuously improve and refine service offerings according to market feedback.
- They meet customer requirements for customisation where it can be done profitably.
- They study customer needs and wants in well-defined market segments.
- They measure company image and customer satisfaction continuously.
- They influence all employees in the organisation to be customer-centred.

A look at Figure 2.9 shows the similarities of a CRM model and aspects of change management, knowledge management and creation, and the innovation process.

It focuses more on measurement (metrics) and on the customer, whereas *knowledge management, knowledge creation, organisational learning, change management* and *innovation management* focus predominantly on internal organisational dynamics and processes.

Hence CRM is complementary to the above theoretical fields by providing strategies to establish sustainable relationships with the external market.

CRM Implementation : Yin and Yang

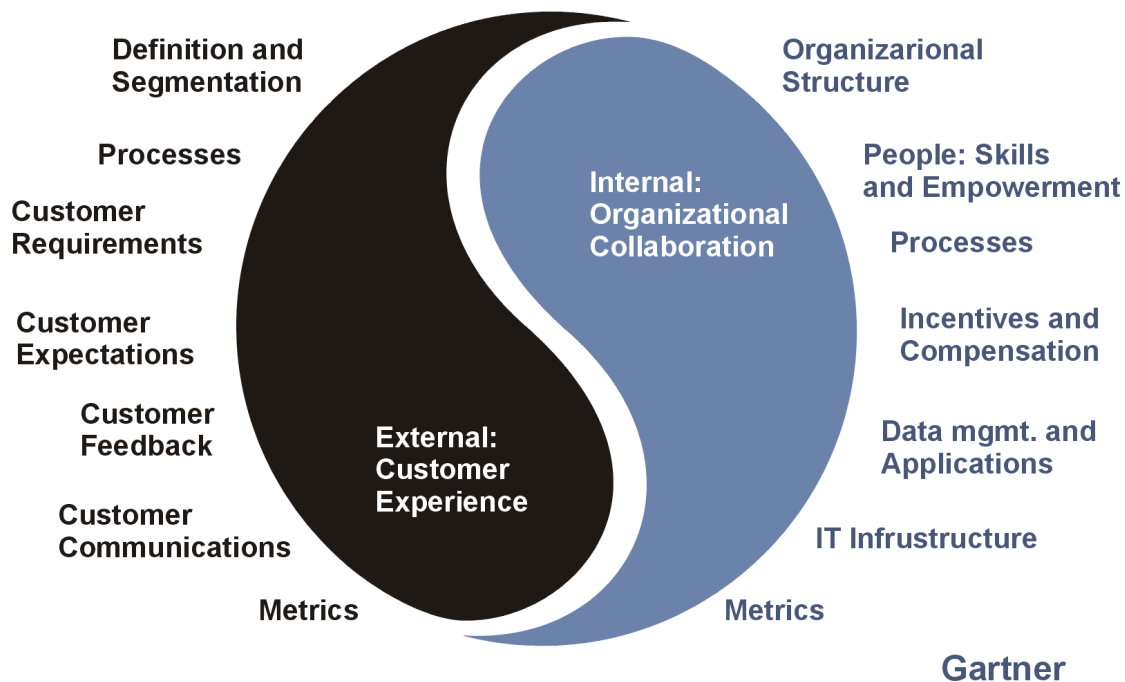


Figure 2.9 CRM Implementation: Yin and Yang (Gartner, 2001:11)

According to Radcliffe (2001:1-4) there are eight building blocks of CRM:

- Vision
- Strategy
- Valued customer experience (understand requirements, monitor expectations, collaboration and feedback)
- Organisational collaboration
- Processes (customer lifecycle, knowledge management)
- Information (data, one view across channels, analysis)
- Technology (applications, architecture, infrastructure)
- Metrics (value, retention, satisfaction, loyalty, cost to serve)

Figure 2.10 illustrates the levels of Customer Satisfaction.

Customer Satisfaction Model

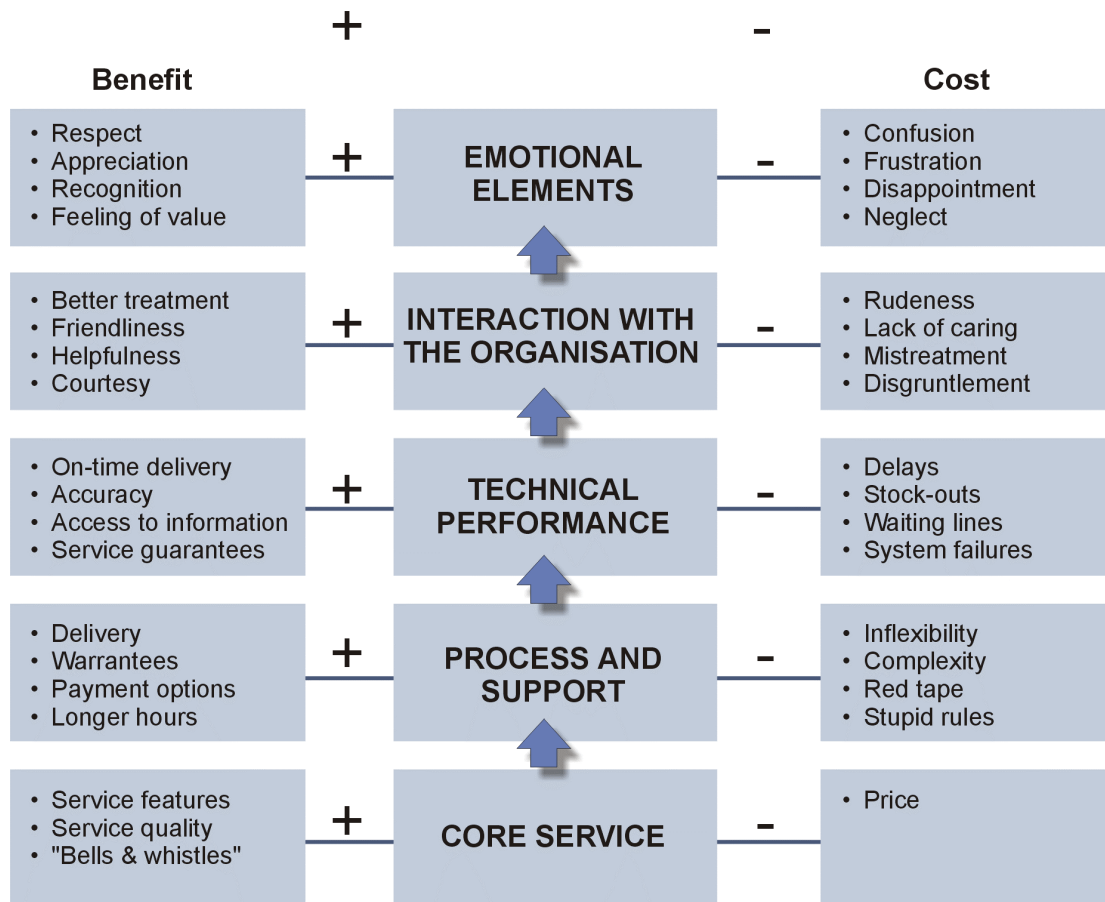


Figure 2.10 Customer Satisfaction model (Adapted from Barnes, 2001:32-64)

If one has service failure on the top level, i.e. the emotional level, the customer usually goes to another service provider. In the case of the university, students who experience lack of caring, rudeness and neglect are likely to cancel their studies. The virtual campus that is described in Chapter Four addresses the first three levels of customer satisfaction.

Very few universities actually monitor why students cancel their studies. If the student has established a good relationship with staff at the University, the chances of this happening decrease.

2.9 Conclusion

Chapter Two explored the concept of *knowledge* and continued to weave a tapestry of various theoretical fields that build on *knowledge* and *learning*. These theories provide a scientific base for the analysis of the virtual campus case study in Chapter Four that deals with *process*, *product* and *service* innovation at the University of Pretoria. It demonstrates the synthesis reached in epistemology of learning as informed action and how *constructivism* has created praxis in learning theory in stressing the importance of social interaction in real life environments. It is constructivism which has transferred to the field of *knowledge creation*. Theorists discovered that knowledge management is not limited to systems but inherently deals with knowledge creation through interaction with people. In organisations, knowledge creation goes hand in hand with change.

The reason is that new knowledge signifies change, especially if it occurs on a wide scale. *Change Management* is a field that focuses on how to bring about transformation and organizational change. *Innovation* is when new concepts are implemented and accepted in the market. It implies change on a relatively large scale. The importance of the market has led to a new business strategy of *Customer Relationship Management* (CRM), that emphasises the need to create relationships with clients in order to sustain profit and return on investment. However, CRM is not based on business alone, but on values. Customers should be treated in terms of the value system of an organisation. Ultimately, customers make decisions driven by emotional drivers.

Chapter Three provides an overview of theory in practice, describing how technology impacts upon the higher education landscape.

3 Literature review: Theory into practice

3.1 Introduction

Chapter Two provides an adequate description of various theories that are relevant to use in the investigation of *process*, *product* and *service* innovation of the virtual campus. This Chapter serves the purpose of contextualising the case in Chapter Four. It also serves the purpose of demonstrating best practice. All theories in Chapter Two manifest in the current higher education landscape that is described in this Chapter. Figure 3.1 illustrates how Chapter Three fits into the structure of this thesis.

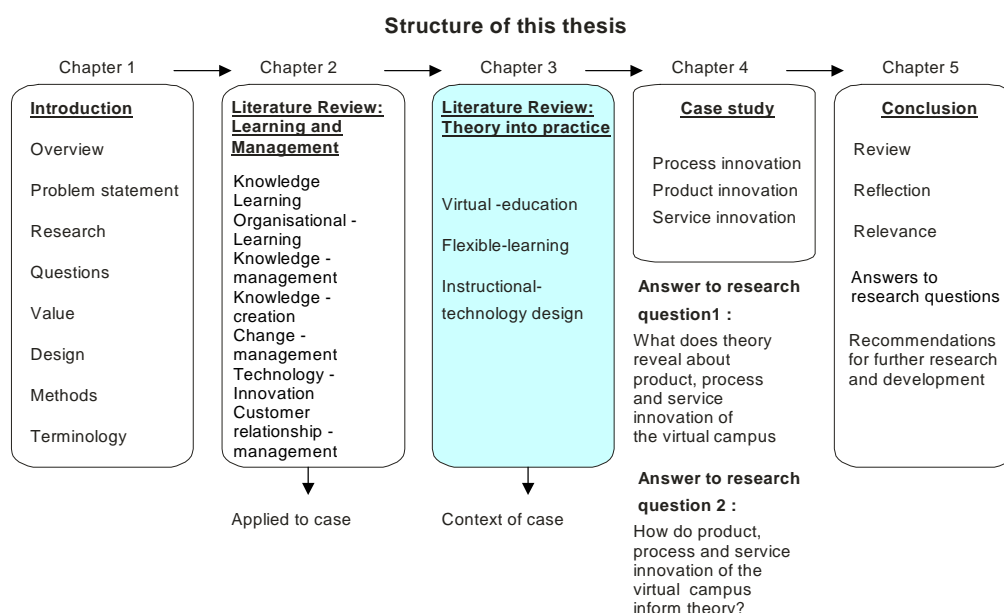


Figure 3.1 Structure of this thesis

Some theorists postulate that the innovative kinds of teaching and learning empowered by emerging technologies could transform distance education into distributed learning. They further claim that high-performance computing and communications will make knowledge utilities, virtual communities, shared synthetic environments and sensory immersion commonplace (Drucker, 1985, Dede, 1997).

Traditionally in the business of information transfer and knowledge creation, many higher education institutions are no longer competing with one another. One reason is that the market has changed from school leavers to adults. Businesses and large corporations are competing for students by offering in-service training and short

courses. Drucker's (1985) prediction that "the growth industry in this country [USA] and the world will soon be continuing education of adults" is coming to pass. The forecast is that higher education will become market driven as it deregulates. In the USA it is predicted to be as big as a \$300 billion industry in the next decade, featuring 30 million learners of which 50% will be adult learners who are active in the work force (Duderstadt, 1999:11). Svetcov (2000:50) mentions a forecast by Thomas Weisel Partners (a merchant bank in San Francisco) of \$21 billion in the next three years. The analysts estimate a \$10 billion virtual higher education market and a \$11 billion corporate-learning market. Although no similar data exists for South Africa, it is an important trend to take note of.

Business, more than government, is instituting the changes in education that are required for the emerging knowledge-based economy. The reason is provided by Cairncross (1997:118), who states "the Internet has become the most powerful driver for innovation that the world has ever seen. Because of its open, flexible protocol, thousands of small companies, founded by the best-educated group of entrepreneurs ever to blitz a business, are making (or, periodically, losing) huge sums of money developing new ways of using the Internet". Especially public providers of education are lagging behind the transformation in learning that is evolving outside them (Ives & Jarvenpaa, 1996, Gates, 1996, Violino, 1997:70). According to these authors, over the next few decades the private sector could eclipse the public sector as the predominant educational institution. Businesses are moving into the educational market, especially in commerce and information technology by offering life-long in-service training to employees, thereby capturing a market segment previously held by higher education institutions. In addition, massification of education and the shift in education and training to lifelong learning demand different approaches to teaching and learning from what is found in traditional universities. In-house programs provide tailored instruction at times and places convenient to the customer. Businesses have adopted customer-oriented strategies whereas educational institutions do not yet regard students as customers or clients.

Subsequently, the challenge posed to educational institutions is to manage technology and knowledge in such a way that their strategic goals are achieved but that they satisfy the customer at the same time.

In a survey on Desktop Computing and Information Technology in American Higher Education, Green (2000:2) identifies instructional integration as a core concern facing

American colleges and universities. Green remarks that the results confirm the transition of information technology from the unique to the ubiquitous and that increasingly there will be a demand for technology innovation in American higher education. Due to the global impact of technology on society as a whole, the same could be said of all higher education institutions around the world.

Section 3.2 explores the emerging field of virtual education.

3.2 Virtual education

Over the past five years the term 'virtual' has proliferated to describe the range of technologies applied in higher education institutions. It is used interchangeably with other labels such as 'open and distance learning', 'resource-based learning', 'distributed learning', 'distance education' and 'flexible learning'. Currently, the term most used is 'electronic' as is evident in the concepts of e-education, e-commerce, e-business and e-governance. Similarly the term 'digital' is increasingly popular in this context.

Collis and Moonen (2001:32-33) have a specific view of the term 'virtual':

- "Virtual as a vision that anyone, anywhere, can experience the services and products of the university, while remaining at home or at work".
- "Virtual as a way of describing how the traditional university can gradually move to be more flexible in the options it offers to students in terms of how, when and where they complete certain course requirements".
- "Virtual as a way of describing how the resources and experiences available within the traditional university are being broadened for those within the university".
- "Virtual as a way to describe consortia".
- "Virtual in terms of a specific informational environment, such as portals, by which learners interact in a virtual learning environment".

Duderstadt notes that the increasingly sophisticated labour market of a knowledge-driven economy is driving new needs for advanced education and training (2000:14).

It could safely be assumed that hundreds of virtual universities have emerged and that these numbers continue to grow.

Section 3.2.1 describes the reasons why new services and products are required in the higher education sector.

3.2.1 Product innovation

In the borderless competitive environment that is discussed in the introduction, the attainment of a competitive advantage will be appropriated through *price, quality* and *access of services and products* (Duderstadt, 1999:12). Consequently, new rules are set for the way we do business. It is fundamentally changing many of the rules of competitiveness. Organisations that are positioned to rapidly act and respond to changes will have the competitive advantage. This is endorsed by Nadler and Tushman (1999:97) in their contention that “the organisation’s capacity to understand its environment and to make the right kinds of strategic changes at the appropriate point in the cycle will determine its competitive strength”.

Leadbeater (2000:112) claims “In some respects universities are models for the new economy, particularly the way they encourage research, experimentation and knowledge-creation by autonomous, self-managing researchers and knowledge workers”. He warns though that universities lack entrepreneurial spirit and are “too slow-moving and resistant to change”. Slow to change, universities have revolved around a model born in the Middle Ages and solidified by the German research university concept at the turn of the century (Hitch, 2000:21).

With the emergence of a commodity market, virtual universities will unbundle marketing and delivery of services and customised products to users. The most common applications of ICT are found in administration, support services and materials development and distribution (Farrell, 1999:3).

The move to digital technologies has given rise to new learning enterprises. Barone and Luker (2000:10) note that familiar business models in universities will no longer apply as the roles of producer and consumer shift and evolve. Especially the private sector is capitalising on the technology revolution. An example is the company-

owned British Aerospace Virtual University, which has 47 000 students (employees) who access courses offered by the University (Gibbons, 1998:49).

However, the crucial role of universities remains that of the interface with learners in the learning process. Although universities are becoming more like businesses, they are not simply selling products, but have to be the leaders in learning facilitation.

Traditional structures, processes, teaching and research methodologies, financial formulas and subsidies at universities have been moulded by paper for centuries. Digital technology has vastly different properties that do not fit into the status quo (Battin & Hawkins, 1998). These properties include availability on-demand and customisable, borderless and ubiquitous information that are contrary to the stability of print-on-paper technology. The geographical distribution of information around the world is being shifted in response to demand for access and the Internet is powerful enough to serve teaching, research and administration needs (Barone & Luker, 2000:6).

Especially telephone and Internet technologies have grown exponentially and are impacting on higher education. Projections were made that the global Internet user population will exceed 140 million by 2001 (McNee, 1999:3).

Dede (1990:247) makes the point that "Given the rapidly evolving implementation of information technologies, all students will need skills in online interaction and collaboration". Twigg & Oblinger (1996:3) support this by stating that proficiency in using technology is a required competency in the work place. The implication is that higher education institutions need to equip their learners with computer skills because they need these to be competitive in the market place.

A poignant statement is made by Norman and Spohrer (1996:24):

"A revolution is taking place in education, one that deals with the philosophy of how one teaches, of the relationship between teacher and student, of the way in which a classroom is structured, and the nature of the curriculum. At the heart is a powerful pedagogy, one that's been developing over the past 100 years. It embraces social issues, the culture of the classroom, lifelong learning concerns, and technology".

This trend suggests a shift in the primary location of higher education on campus to more flexible, learner-selected options such as home and the work place. A way to accomplish this is through product innovation, i.e. to redesign courses and use technology.

According to Green (2001:36) “the most significant technology challenges ahead for higher education involve questions about the instructional mission – across all sectors of the academic enterprise”. In other words, universities have to consider how they need to change their product offering in order to remain competitive.

The response of learners to these changes should be accounted for. They are accustomed to a passive role in which lecturers are paid to teach. In reaction to the use of digital technology in the learning environment, Barone and Luker (2000:10) remark that “students wonder if faculty are really teaching them if most of their learning appears to take place independently, from learningware accessed via the network”. The concern about this statement is the tendency to provide syllabi and content online without an accompanying strategy to facilitate learning.

With the use of computer communication systems for educational delivery and interaction, web-based education is growing rapidly as a field of practice. Driscoll (1998:9) warns that web-based instruction is not simply a new format for instructor-led or self-paced instruction and that merely ‘changing the format’ tends to result in passive programmes that frustrate learners.

A critical challenge to universities will be to identify their role in disintermediation – information technology sometimes replaces the ‘middle man’ – and to identify “those ‘transactions’ where humans are ‘in the middle’ as opposed to those in which they add value” (Oblinger, 1999:24). This is reminiscent of the factor of **cost of producer learning** mentioned earlier. In an educational context it means that lecturers would need to add value to the learning process and not simply act as yet another source of knowledge or information. The way in which they facilitate the learning process, doing so increasingly via various technologies; will aid competitiveness. As a consequence of the impact of technology, the new role of the lecturer has become a concern.

Leadbeater (2000:113) contends that universities and academics will become increasingly segmented. The elite will be involved in the ‘knowledge- creation’

business of research and experimentation; the mass will be involved in the 'knowledge management' business of delivering degree modules. He does not indicate the way in which this will be accomplished. As technology has become a primary means of delivery, it implies that the latter segment of lecturers would have to be skilled in the use of various technologies to facilitate learning. It could be debated whether these roles would be simply value-adding transactions or whether the lecturer-student interaction could be considered as that of being 'in the middle'. Duderstadt (1999:9) indicates that an emerging trend is that of three roles of what was previously packaged into one: that of the lecturer. These roles are *content providers*, *celebrities* and *learning facilitators*. He argues that constraints will make it impossible for one person to fulfil all these roles and remain competent in other responsibilities such as research and administration. Oblinger (1999:24) speaks of the 'unbundling' of traditional tasks. A lecturer might choose which functions to perform, based on aptitude or on those functions in highest demand by the university. Hence she postulates that the current value chain of content generation, courseware production, assessment and research could be dispersed among various individuals or even companies or different institutions. Although it seems to be a feasible solution, successful orchestration of the value chain across functional providers would pose the highest risk. If coordination is not adequate, the learner will experience a fragmented service offering.

Section 3.2.2 investigates service innovation in higher education.

3.2.2 Service innovation

Disintermediation has a profound impact on existing structures. Distant learners assume that payment and registration can occur online and that online digital library privileges exist. There are many examples of universities that have web-enabled student administration systems to deal with student enquiries. Some higher education institutions are finding that almost sixty percent of student enquiries related to student services can be handled without human intervention (Twigg & Oblinger, 1996:4). Most universities have not redesigned their business processes to suit the needs of students. Unfortunately administrative functions such as admissions, financial aid, and registration processes are mostly set up for the convenience of the institution, with minimal regard for the needs of the consumer (Twigg & Oblinger, 1996:4).

With the advent of Enterprise Resource Planning (*ERP*) systems in the 1990's some higher education institutions have shifted to integration of business processes. Since 2000, *ERP* systems have become increasingly Internet-based – thereby enabling a more customer-focused strategy by giving students and staff access to enterprise information via the web. These systems include modules such as student administration (admissions, recruiting, student financial aid, student records and payment), human resources and supply chain management. *ERP* systems could be regarded as *service* innovation, because it is an example of technology innovation where the institutional service offering is integrated on a large scale in such a manner that it also benefits the customer, i.e. the student. The shift towards web-enablement and subsequently self-service is consumer centred and a positive step towards a competitive business model.

Two of the *ERP* market leaders, namely Systems and Computer Technologies Corp. (*SCT*) and *Peoplesoft* have been adopted by 1300 and 610 campuses in the U.S.A. respectively (Yanosky, *et al.*, 2002a & 2002b: 1-4). Figure 3.2 gives an overview of the various *ERP* systems in higher education in the U.S.A.

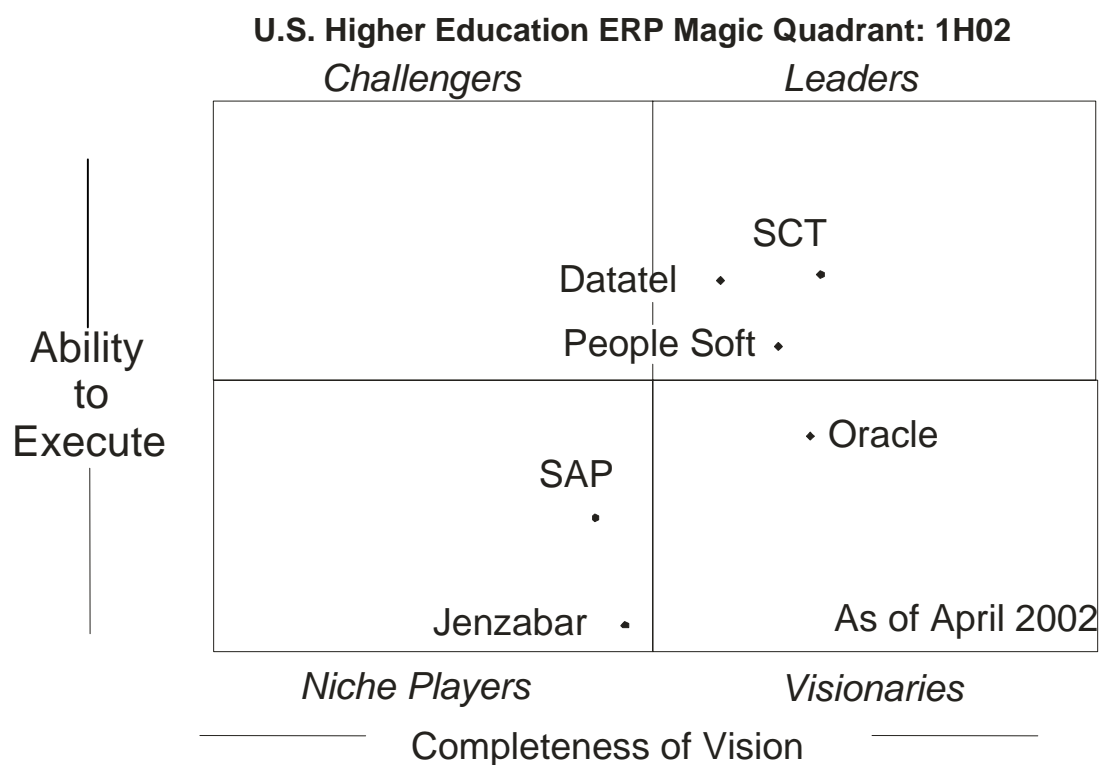


Figure 3.2 U.S. Higher education *ERP* magic quadrant (Yanosky *et al.*, 2002c:1)

ERP systems are costly and have not yet penetrated the South African higher education market.

Similar to *ERP* systems that integrate and make information accessible to more users, virtual libraries are imperative to act, in a certain sense, like brokers of relevant information sources that form a critical part of knowledge – particularly regarding research.

Section 3.2.3 discusses the need for a new business model in higher education.

3.2.3 A new management model: Process innovation

As a result of rapid changes in technology and the explosion of information and knowledge, employees require re-skilling more often. According to Twigg and Oblinger (1996:3) the average worker can have up to seven careers. Consequently, lifelong learners make greater demands in terms of educational access and flexibility. Most cannot afford to leave their jobs for lengthy periods in order to further their qualifications. Moreover, school leavers increasingly opt to find work first and then further their qualifications whilst working. Many underestimate the rise in expectations that working students bring with them. As paying clients they are no longer in awe of professors or of rigid structures and processes that do not provide excellent service. They expect quality products and services. Policy makers are concerned whether the salaries spent on duplicative administrative and student services add value to the educational experience (Twigg & Oblinger, 1996:8). Hence higher education institutions need to adapt their processes to support and sustain new products and services.

Adults are exposed to a rapidly changing and complex work environment in which they have to be re-skilled continuously. Without the time available to study full-time at a residential university, flexible learning opportunities have become non-negotiable. Increasing costs, decreasing public funding and a growing population, half of which are adults from diverse socio-economic backgrounds, are causing an increasing market niche for just-in time and just for you (non degree continuing education) instructional offerings. Yet students continue to attach value to formal programme offerings, such as three-year degrees. Perceptions of status and quality

associated with degree programmes could be the reason why many still consider short courses to be of less value.

Duderstadt (1999:4) states “Adult learners look for access, customised curricula, flexible delivery and responsiveness to needs”. The growing demand for flexible education and training cannot be met by existing management models. Johnson (1997) poses that traditional universities will continue to cater for highly motivated, academic learners, with emphasis on advanced research. Alternative institutions, on the other hand, will focus on non-university, corporate and continuing forms of higher education. Yet, even if this is the case, traditional universities cannot afford to ignore the impact of the knowledge economy, digital technology and the needs of their learners. Teaching and learning models of the future assume universal access to the network (Internet) and will require a new pedagogy (Barone and Luker, 2000:6). New business processes will be required to enable and support this.

Education and advances in technology have become at least as important as capital in contributing to economic growth (Cole, 1998:16). The nature and degree of exposure of employees to lifelong learning and education has led to the term ‘knowledge workers’. Academic institutions have essential roles to play in the knowledge economy to serve as sources of knowledge creation and as training ground for knowledge workers (Cohen, 1998:37). Graduates are viewed as the most important asset of universities and concomitantly, a research environment that retains faculty is essential.

Questions about accreditation, standards, intellectual property and articulation have remained mostly unanswered to date and need to be answered to adapt to the new environment. Stallings (2000:3) paints a scenario called ‘Dystopian’ in which this confusion leads to a quagmire of courses and courses without human presence in which, in the absence of standards and leadership, a dominant model emerges from a body of accredited learning corporations. The researcher is of the opinion that continued regulation of higher education institutions will prevent this scenario from materialising. It will be more difficult to prescribe standards to private providers. The South African Qualifications Authority (SAQA) is an example of a regulating body that attempts to regulate all providers of education and training. The ‘Utopian’ scenario, similar to the Edujazz scenario by Page-Shipp *et al.* (2000) sees a growth industry of “performance-enhanced software [that] energises a generation of virtual educators and trainers who become globally recognised... Computer-based instruction

increasingly applies artificial intelligence techniques, driving the quality of instructor-mediated courses higher”.

According to Twigg and Oblinger (1996:9) a scenario for higher education institutions in 2007 could be characterised by the following:

- Fewer institutions.
- Flexible learning opportunities.
- More for-profit educational enterprises.
- Greater global institutional competition.
- Provision of credit banks and credentialing services by public learning agencies (accreditation bodies).
- Institutions positioned as either content providers or learning brokers.

They state that many companies in the States are dissatisfied with the level of competence of the nation's graduates and that “they are becoming less interested in degrees and more interested in certification of competencies” (Twigg & Oblinger, 1996:10).

In the debate about how higher education must position itself to respond to the needs of 21st century learners, two distinct points dominate:

Pro-traditional higher education

This side argues that there is more to education than providing job-related skills. Unlike training providers, universities also provide guidance, structure and organisation for those students who are uncertain about what they need. This view is contentious, as technical and college institutions could claim to do the same.

Non-traditional higher education

Others contend that education rooted in tradition has become less relevant. External forces, including student needs, market demands and the advancement of communications technologies have decreased the 18-22 year old residential student market. Just-in-time education will become sought after.

Duderstadt (2000:17) points out that only 17 percent of students enrolled in American colleges are in the 18-22 year old group.

Yet Zastrocky (2000) warns against inflated perceptions of the benefit of virtual education, or as he calls it, *distributed learning*. He makes a forecast of the evolution of the Internet's path to maturity in higher education that is depicted in Figure 3.3.

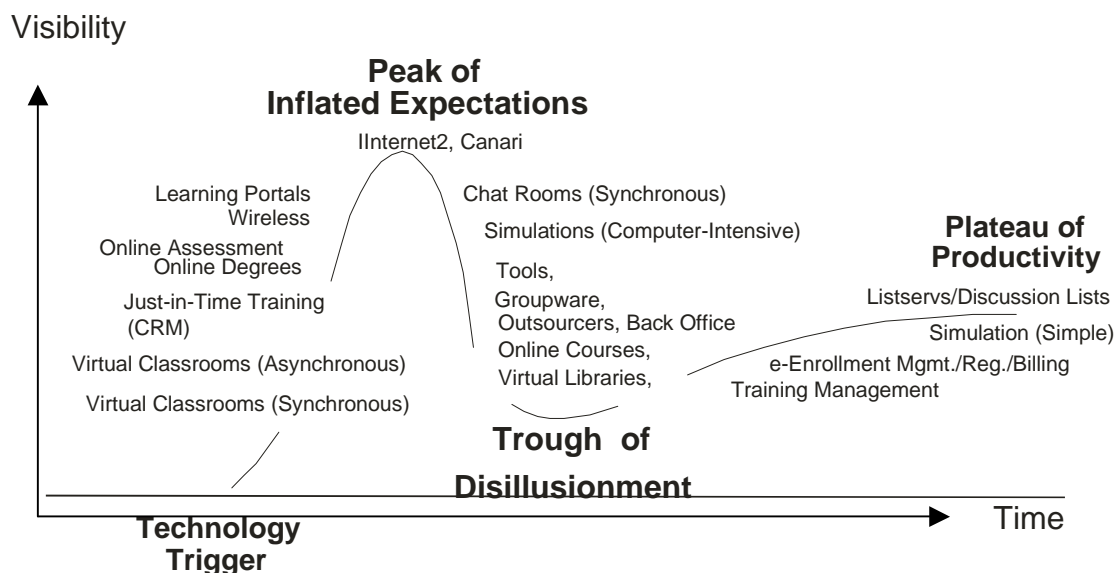


Figure 3.3 Distributed learning hype cycle for higher education (Zastrocky, 2000:3)

What is clear from Figure 3.3 is that the Internet will remain relevant to higher education despite inflated expectations.

In Section 3.3 the concept of *flexible learning* is discussed.

3.3 Flexible learning: process, product and service innovation

The use of technology in education has been prevalent since the sixties and has been utilised in especially distance education for decades.

Taylor, as cited by McLendon & Cronk (1999:1-2), outlines four generations of distance education delivery, as indicated in Table 3.1.

Generation	Associated delivery technology
I. Correspondence model	Print
II. Multimedia model	Print, audiotape, videotape, computer-based learning, interactive video.
III. Telelearning model	Audio teleconferencing, videoconferencing, audiographic communication, broadcast TV/radio and audio teleconferencing.
IV. Flexible learning model	Interactive multimedia, Internet-based access to <i>WWW</i> resources, computer mediated communication.

Table 3.1: Four generations of distance education delivery (McLendon & Cronk, 1999:2)

Distance education is a greatly misunderstood area in the field of education (Roy, 1997:12). If distance learning is a concept so widely misconstrued, how much more so the concept of open learning or, for that matter, flexible learning. Distance education is often thought of as correspondence education. In many countries the terms are used interchangeably, i.e. distributed learning, blended learning, flexible learning, e-learning, online learning and distance learning. Distance education has been described as teaching and learning through the print or electronic communications media, in a place or time different from that of the facilitator/lecturer (Moore & Kearsley, 1996). This would therefore dispel the myth that distance education is education by correspondence per se. A brief review of its growth shows that distance education has evolved through a number of different stages, or generations and could be considered to be an example of incremental innovation. The first generation was correspondence study, where printed media in the form of study guides was sent by mail to students. The addition of tape recordings further enhanced it (Roy, 1997:12).

The founding of the British Open University (OU) in 1969 and other Open Universities in the early 1970s heralded the second generation of distance education (Moore & Kearsley, 1996). Now, in the 1990s, some 30 distance teaching universities are active in various parts of the world and most of them have been modelled after the OU. Whilst adopting a Fordist or large-scale approach, these open universities rely heavily on correspondence instruction and concurrently use broadcast and recorded media, especially programmes distributed by radio, television and audio tapes as supportive media. This approach set the pace for the transmission to the third generation, as suggested by Bates (1995). He proposed that

a new model is emerging, based on key elements of interactive communication (via asynchronous computer conferencing) and the learning process. The delivery of course materials by broadcast television videotape, with interaction by telephone, or both delivery and interaction by telephone or satellite, cable or ISDN (Integrated Service Digital Network) lines, characterises this stage of development.

Developments in distance education in the 20th century appear to have taken a two-pronged approach. On the one hand, the advent of information technology and modern media has enabled mass-production or a large-scale approach to be adopted. Open universities, based on the OU model, often produce courses for hundreds and thousands of learners, using just a few tutors. In the single-mode system, distance education is the sole approach to the teaching-learning function. Essentially, open learning refers to the democratisation of education. It does not recognise race, religion, gender, age or prior qualifications and opens the doors to learning. Since everyone has a right to education, open learning was deemed the vehicle to ensure this, unlike many other forms of conventional teaching-learning models (Moore, 1997). Open learning also refers to provisions which try to remove barriers that prevent attendance at more traditional courses and which suggest a learner-centred philosophy. Proponents of open learning seek to empower learners by breaking down barriers to education raised by conventional institutions. They wish to provide unhindered access to learning resources so that technologically supported freedom of information may be turned into freedom of education for people pursuing their own learning needs (Brown & Duguid, 1996:12).

In a document submitted to the National Commission of Higher Education (Committee of Technikon Principals, 1995), which includes a section on "Mode of Instruction", the idea of "fleximodes" of instruction is recommended.

Collis and Moonen (2001:9) attempt to describe the notion of flexible learning as follows:

"Flexibility can involve options in course resources, in types of learning activities, in media to support learning, and many other possibilities".

Hedberg and Corrent-Agostinho (2000) define it as "providing students with choices about when, where and how to study".

Another definition is provided by Fleming & Levie (1993):

“Flexible learning offers the learner a more actively constructive role by providing a framework in which learning goals can be more independently pursued”.

Jonassen *et al.* (1997) add that a flexible learning strategy increases the quality of learning experiences and complements constructivism.

Hart (2000) highlights the economic driver of flexible learning, citing Nunan (1996):

“While part of the framework for flexible delivery may be borrowed from economics, there are progressive interpretations of flexible learning which are structured around competing social and humanist values which have educational expression through concepts such as constructivism, open education, student centred learning, life-long learning, deep learning and accessible learning structures”.

Hence, flexible learning means that the learner is given more control over the time engaged with learning resources and a wider selection of resources, including various technology modes. It could also impact on an institution’s accreditation and entrance requirement policies.

Collis and Moonen (2002:15) point out that more flexibility requires more self-direction, self-motivation and choices by the learner. As indicated in the first section though, many learners would rather have the lecturer make the choices, because they do not feel comfortable to do it themselves.

The authors list the following constraints of flexible learning:

- Flexibility is hard to manage because of limited resources and time of lecturers and the administrative load it creates.
- Flexibility is not acceptable for learners who are familiar with fixed course offerings.
- Flexibility is costly – various options do not allow for economy of scale.
- Flexibility is not achievable if it really boils down to learner choice.

In this light institutions have to find a balance that fits their culture, market and strategic focuses.

Market changes and diversifying demographics reflect the increasing need for lifelong learning. Krempf (1997) notes that the demand for tailor-made courses which contain only relevant content is becoming more prevalent. Relevant outcomes, more so than content, would probably be more suitable for a culture of lifelong learning.

The impact of adopting a flexible learning strategy is delineated by Hart (2000) in Table 3.2.

Principle	Impact
Flexible access – students can choose to work independently or to attend traditional classes and can determine where they enter and/or exit from the course.	Revise support to students, administrators will need to devise new means of accrediting and reporting on students, and lecturers would have to support different entry and exit levels and learning styles of a wide range of students.
Recognition of prior learning – a flexible learning policy takes account of prior formal and non-formal (work experience) learning in developing a suitable course of study for the learner.	Bridging and revision courses, as well as entry tests will need to be provided.
Flexible content – courses are modularized so that learners can take those they need or for which they have not established prior learning evidence. They can also negotiate the content of a course with university staff and employers.	It implies a set of university-wide agreed standards for course structure and credits and requires rigorous instructional design and a team approach to curriculum.
Flexible participation – lecturers are available to times convenient to the learners and communication can be synchronous or asynchronous.	No sign on the door of a lecturer saying “I am not available for consultation between the following hours”.
Flexible teaching and learning methods. The teaching style is based on the requirements of the subject and needs of the individual learner.	Lecturers need more theoretically grounded pedagogical knowledge as well as skills. Learning is individualized, collaboration is encouraged and metacognitive goals are pursued.
Flexible resources – access to a wide variety of resources are provided on and off campus via technology and other infrastructure.	The university must provide state of the art ICT on an equitable basis to ensure that all learners have equal access.
Flexible assessment – assessment needs to be based on competency.	Universities need to introduce alternative forms of assessment such as portfolios and collaborative presentations.
Ongoing education – flexible delivery involves the development, exchange, repackaging and cross-accreditation of modular courses and course elements in multiple media formats.	Evaluation strategies must be built into course designs and results of evaluations must be available to course developers and learners.

Table 3.2 Impact of flexible learning (Hart, 2000)

Some institutions, as indicated in Section 3.6, have ventured into a flexible learning system on a micro level, i.e. initiating specific instructional programmes on a flexible learning basis, whereas others have adopted it on an institutional level. In its totality, as indicated by Hart (2000), a comprehensive flexible learning model leads to *process, product and service* innovation.

Technology innovation plays an increasingly significant role in accomplishing greater flexibility. In Table 3.3, Ely and Minor (1994) provide the following essential components of technology planning at this level:

The field of educational technology	Definitions, conceptual background, theory, dissemination, organisations, policy.
Design functions	Resources, tools, models, procedures, techniques, evaluation.
Delivery options	Hard and soft technologies, telecommunications, media.
Applications and settings	Implementation, context, case studies, use.
Emerging issues	Legislation, cost-effectiveness, research findings, trends, futures.

Table 3.3: Technology planning (Ely and Minor, 1994)

Looking at the above framework, it appears to be a useful tool to apply to the overall planning and implementation of any technology. Schrum and Berenfeld (1997:53) recommend a systematic three-step implementation plan of technology into the educational system. Step one is to enhance the existing curricula with supplemental software packages and on-line activities. They note that “Even though the overall teaching strategy remains conventionally teacher and textbook centred, students with access to on-line resources are exposed to an array of information and confront conflicting opinions that require critical thinking” (1997:53). Another advantage is that both learners and lecturers become accustomed to various technologies as instructional tools, without having to redesign their existing curricula completely. The next step is to progress to technology-based modules and finally, to a situation in which technology is fully integrated into the curriculum. This implies, as the authors note, redefining of pedagogical goals and restructuring of curricular offerings. After conducting extensive evaluation studies, the University of Central Florida (UCF) found that students prefer a mixed mode in which some face-to-face contact time remains (Epper & Bates, 2001:8).

Section 3.4 discusses the design of learning environments that include technology – particularly the *WWW*.

3.4 Instructional technology design

Instructional design of learning environments started being applied on a large scale in the late 1950s and has been studied since the turn of the century. Instructional design is purported to augment learning by incorporating various strategies into courseware, for example structuring, ordering and sequencing content in particular ways, depending on the expected learning outcome (Gagné & Briggs, 1974). It is concerned with improving learning by applying various instructional strategies to the learning environment and could be considered to be an example of *product* innovation. In the early 1960s, researchers started to transfer this concept to electronic environments (Dempsey & Sales, 1993:7). Subsequently, mastery-learning programs with program control (which means the program determines what sequence the learner follows) developed over a period of almost four decades into more cognitive-based, flexible environments with more learner control. Real world educational technology research and development demands a shift in focus from the design of instruction to the design of learning environments (Kozma, 2000:13).

If learning is designed in an electronic environment, it firstly requires familiarity and understanding of the underlying models of the specific technology application, even before the analysis phase commences. This is necessary because different applications are used in different learning contexts.

Simulations are examples of single-purpose software. A simulation is a software application that represents certain features of a real situation to achieve a training objective (Dempsey & Sales, 1993:199). It is used to instruct by imitating or replicating reality; the learner learns through doing. The basic aim of the underlying model is to present a scenario in which an action is required and to update the system based on the feedback of the learner. Simulations have proven to be extremely effective tools for learning (Fleming & Levie, 1993). The development of high-performance simulations allows learners to control the simulation interactively, e.g. modify the laws of physics and study the effects immediately. An example is The Living Textbook Project: Interactive Learning on the Information Highway, which

delivers the results of virtual reality to illustrate tornado prediction models, financial modelling, real-time three-dimensional (3-D) interactive journeys through geographic terrain (Brown & Duguid, 1996:10).

A drill, on the other hand, is used to practise certain knowledge or skills already acquired. The learner learns through rote repetition until automaticity is achieved. In terms of the underlying model, an item is selected from a pool and the learner must respond to it (question and answer). The response is then judged, feedback is provided and another item, which the learner has not yet done or which was previously answered incorrectly, is selected (Alessi & Trollip, 1985).

The constructivist approach to instructional design moves away from direct instruction and systematic design procedures towards participative learning where knowledge is encountered in the context of real-world problems. Whereas the learning theories discussed in Section 2.3 are *descriptive* theories that describe how learning occurs, Section 3.4 covers *prescriptive* theories that set out procedures for developing instruction (Bruner, 1967).

3.4.1 Cognitive instructional technology design

The scope of this study does not allow an in - depth analysis of instructional design models and theories, but rather focuses on cognitive and constructivist design strategies. According to Winn (1990) behavioural roots remain evident in three areas:

- The reductionist premise that the parts of the whole must be identified, and if these are taught, then the whole has been learned.
- The practice of separating design from the actual implementation of instruction.
- The belief that, if design procedures are correctly applied, good instruction will result.

The general process involved in incorporating cognitive strategies in courseware (Smith & Ragan, 1993:94) is as follows:

- “Analyse the requirements of the learning task”.
- “Analyse the learners’ ability to complete the task, including the predictable demands on and limitations of memory”.
- “Select/invent an appropriate strategy” [such as a concept map or a flow chart].
- “Apply the selected strategy”.
- “Evaluate the effectiveness of the strategy used”.
- “Revise as required”.

Tracey (1992:242) provides the following instructional design guidelines:

- Initiate the sequence with materials that are familiar.
- Give learners a framework to use in organizing what they are to learn.
- Place easily learned tasks, broad concepts and technical terms that have application throughout the instructional process early in the sequence.
- Place practical application of concepts and principles close to the point of the initial discussion of the concepts and principles.
- Provide for practice and review of skills and knowledge that are essential parts of tasks to be introduced later in the activity.
- Introduce a concept or a skill in the task in which it is most frequently used.
- Structure learning objectives in closely related, self-contained groups.
- Avoid overloading any task with elements that are difficult to learn.
- Place complex or cumulative skills late in the sequence.
- Provide support for practice of required skills, concepts, and principles in areas where transfer is likely to occur.

West, Farmer and Wolff (1991) propose practical cognitive strategies to foster metacognition and facilitate active creation of mental schemata:

Chunking – rational ordering and classification of knowledge.

Frames – grids to structure concepts, categories, and relationships – either provided by the instructor or partially developed by learners themselves.

Concept maps – visual arrangements with links to represent relationships.

Advance organizers – brief prose introductions prior to new material.

Metaphor/Analogy/Simile – creative links to show similarity between known and new concepts.

Rehearsal – reviewing, asking questions, predicting – with learners playing an active role.

Imagery – mental visualization as a learning aid.

Mnemonics – artificial memory aids, for example, first letter coding.

Another way to foster metacognition is to create a learning environment in which learners interact with each other, as is the case in cooperative learning and constructivism.

3.4.2 Constructivist and open-ended technology design

To support the theory about ill-structured knowledge domains discussed in Section 2.3.10, Jensen (1995:5) contends that the brain is poorly designed for formal instruction and that most group instruction situations that have been tightly and logically planned will have been wrongly planned for most of the group. The result is that learning is ultimately inhibited, distorted or prevented.

Another interesting point is that the brain processes information on many paths, modalities, levels of consciousness and meaning levels (Jensen, 1995:12). Thus the brain prefers multi-processing and a linear pace could reduce understanding. It is therefore crucial to design instructional domains which are not oversimplified or reductionist, but designed in such a way that it simulates the real-world complexity and ill-structuredness of many knowledge domains.

The challenge posed to lecturers is to create a rich learning environment, which is situated in real-life, or which closely resembles real-life within which the learner can construct meaning (White, 1996:69). Opportunity to manipulate the learning environment is crucial, in fact, the more the learner can manipulate the environment, the better. Within an outcomes-based learning system, emphasis is placed on activity-based learning (cognitive apprenticeship) where opportunities are provided to learners to explore ideas and concepts and practise skills. Furthermore, co-operative as well as individual learning contexts should be provided to equip learners with individual and team working skills (Lubisi *et al.*, 1997:26).

It is generally the case that especially web technology lends itself to non-linear design.

In traditional contact and distance education it is almost impossible for lecturers to provide such individual scaffolding and instruction. At best they can create rich learning environments. This notion is supported by Richey (2000:17) who states that students should be flexible and talented enough to be able to work in diverse settings – hence it is almost impossible to design a unique learning environment based on individual preferences and profiles.

3.5 Web-based instructional design

Similar to neural networks in the brain and multidimensional, complex subject matter, hypermedia consists of a web of interconnectedness, made possible through hypertext – also known as Hyper Text Markup Language (*HTML*). Ross (1993) draws a parallel between hypertext design and Bloom's taxonomy and argues that certain designs, such as a highway design, enable the facilitation of learning outcomes on an evaluation level. A highway design allows for interconnectivity between various subjects within a curriculum and combines linear, exploratory, hierarchical and web-like contents. An active, experience-based learning mode associated with the Internet fits well with adult learning (Yakimovicz & Murphy, 1995). Kommers *et al.* (1996:5) recommend concept maps to assist the learner with navigation. The concept maps could provide graphical overviews that show which nodes have already been visited and via which links a previous link can be reached.

The need for rearranged instructional sequences, multiple dimensions of knowledge representation and multiple interconnections across knowledge components make hypertext protocol a potential enabler to cope with ill-structured knowledge domains.

Supporting this view, Mayer (1983) note that knowledge represented as networks is more complementary to the mental organisational structures that individuals use. Four key knowledge structures that are involved in understanding are concepts, semantic networks, schemata and cases (Davalos, 1997:233). However, Tergan (1997:258) argues against the following assumptions:

- Structural and functional features of hypertext/hypermedia mimic the structure and functioning of the human mind (known as the 'plausibility hypothesis') (Tergan, 1997:258).

- Hypertext/hypermedia match instructional principles for self-regulation and constructivist learning.
- Hypertext/hypermedia match the cognitive principles of multiple modes for the representation of knowledge.

Empirical research, although not representative enough, negate these assumptions and include the following findings:

- “Most of the studies indicate that non-linear structuring of subject matter in a hypertext format did not improve learning” (Tergan, 1997:259).
- Learners who had to locate information did perform significantly better with a linear text than with a hypertext document (Tergan, 1997:267).
- Empirical research indicate that non-linear structuring of subject matter in hypertext format did not improve comprehension and retention of subject matter compared to linear text. Moreover “the results indicate that although hypertext-based learning may have advantages in the amount of facts reproduced in a recall test, text-based learning often resulted in better comprehension and reproduction of central concepts” (Tergan, 1997:263).
- Hypertext networks are not nearly as complex as human semantic knowledge structures (Tergan, 1997:261).
- Many learners did not adopt a constructivist learning style when confronted with a hypertext system that promoted pluralistic non-linear thinking (Tergan, 1997:264).

Responding to the fact that learners did not engage in constructivist learning when provided with an appropriate learning environment, “...it takes a relatively long period of time to become completely acquainted with a new study environment, especially an environment that stimulates very different learning facilities compared to printed materials. A student will only explore these unfamiliar functionalities after a certain period of time” (Tergan, 1997:266).

Conversely, Clark (1994:26) purports that media in instruction and learning makes no difference to student achievement.

Initial research (Reed *et al.*, 1996, cited in Reed *et al.*, 1997:288) indicate that learners utilise linear mental models more in contextually strong environments and non-linear mental models more in contextually weak environments. Contextually

weak environments occur where isolated features or steps of hypermedia software are presented in absence of any predisposed sequence or context, and contextually strong environments are characteristic of a strict sequencing of events or actions imposed by the instructor or software (Reed *et al.*, 1997:288). Their conclusion is that, to enable learners to better learn the commands, tools or features in a hypertext learning environment, hypertext designers should not restrict learners to the number of mental models, i.e. linear and non-linear. Therefore, in designing courseware, it is instructionally sound to provide frames/scripts and semantic networks (linear), as well as concept maps and schemata (non-linear). In this way, learners can also choose how they construct their own mental models.

This finding supports the notion by Jensen (1995) that the brain prefers a rich learning environment which is not too structured yet contains enough cues. Some structure is necessary in hypertext learning environments, otherwise navigation is blind and the learner gets lost. Yet many attempts would familiarise the learner with the architecture and prompt a construction of a mental model. Calvi (1997:314) finds that the majority of learners preferred using the concept map (non-linear) when they were involved in task-oriented navigation, and conversely the majority of learners preferred using the content list (linear) when they were engaged in free-navigation. She attributes this to the fact that the map is more complete and was therefore regarded as more appropriate when specific information was sought. Ultimately, Calvi (1997:317) concludes that a correlation exists between comprehension and memory for location (space), which she endorses with the following quote by Bolter (1991, cited in Calvi, 1997:317): "Writing is always spatial and each technology in the history of writing (e.g. the clay tablet, the papyrus roll, the codex, the printed book) has presented writers and readers with a different space to exploit".

Kommers *et al.* (1996:5) note that learner control enhances metalearning and the elicitation of prior knowledge during the learning process. This is endorsed by Apps (1991) who states:

"While there is no universally superior mode of learning, mature, motivated adult students learn best when they are in control of their learning and can reconstruct the material in their own terms and in the context of their own interests". Thus virtual learning environments could facilitate learner-centredness.

Hyperlinks (hot spots) could be used to provide additional information, as footnotes do in print-based material, to verify or explain certain concepts, or to provide more knowledge depth if the learner requires it. The learner should be viewed as an autonomous and responsible individual who retains scope for initiative. A fine balance should be sought between providing learner control and a hypertext system that guides the learner in browsing through the information base. Some possible solutions are provided by Kommers *et al.* (1996:38) which should:

- include a navigational device that shows the learner the current position and distinguish between 'need to knows' and 'nice to knows',
- embed goals in the learning activity in such a way that the learner has to investigate all hyperlinks in order to complete specific learning tasks, and
- accommodate variety through holistic and serial structuring of information.

Another possibility would be to require, as part of the learning task, that the learner add other relevant hyperlinks and motivate the chosen links.

Inherent in an electronic platform is the fact that one can access it at any time and place, and at one's own pace. This is similar to what one would find in self-paced print-based study material, because the learners work through units whenever and in whichever way they wish. Some of the electronic advantages for the learner include immediate feedback, record keeping, tracking of progress and live, interconnected links where hypermedia is concerned. In an empirical study by Reed *et al.* (1997:285-304), it was found that learners with different learning styles performed the same in a hypertext learning environment, which could indicate that hypermedia learning environments accommodate all learning styles. Jensen (1995:129) makes a point that "the whole notion of learning styles becomes irrelevant when we consider how much variety the brain works with".

3.5.1 Collaborative web environments

Essentially, variety and choice should be included in any learning environment if said environment is to be effective. This should be done, not only in terms of the mental models incorporated through instructional design, but also in the modes of delivery. This is supported by Kozma and Johnson (1991) who, though before the emergence

of the Internet in education, highlighted the advantage of multiple representations of knowledge structures. Van der Veen and Collis (1997:7) indicate some of the problems that have arisen in collaborative virtual learning environments (web-based):

- “Difficulties in maintaining course cohesion and momentum as learners become immersed in their respective projects”.
- “Problems in motivating and structuring collaboration and communication”.
- “Problems in organising and executing self- and intergroup evaluation”.
- “Problems related to the workload of the lecturer”.

Conversely, they remark that some of the benefits to the lecturer include a comprehensive overview of the progress of all groups and having effective channels for providing feedback and remarks.

To address some of the problems identified, they introduced a course *WWW* site that integrates study materials, project-work support and communication tools, by means of which group planning and progress can be visible to all participants. Motivational issues have been attended to by applying co-operative instructional strategies, i.e. each group member has a clear and separate contribution to make, and the groups are kept small enough to be manageable and to promote group bonding. There is also a reporter in each group who is responsible for reporting to the lecturer on a weekly basis during on-line activities.

Bonk and Cummings (1998) point out that web courses require clearer expectations and prompter feedback than traditional classrooms. They also suggest that, when tasks are turned in, they might be accumulated in personal portfolios and assessed using dimensional scoring schemes such as whether the work was insightful, persuasive, inspirational, original, and responsive. On another level, Cortinovic (1992:47) mentions the topicality of reference-based training. This concept holds that there is a need in training to get the right information when and where needed, because people no longer have time to learn all the information available; they have to be equipped with the skill to screen the relevant information. Peraya (1994) confirms this by pointing out that the information overload makes any attempt at memorisation almost futile and that it is rather the ability to process and retrieve knowledge, when necessary, that is important. Previously it was stated that learners should be provided with individual and co-operative learning environments. This idea

is supported by Zhiting (1996:93) whose findings indicate that objectivist or constructivist preferences to learning, along with individualism and collectivism are culturally based. Eastern and African cultures are generally considered to be collectivist, whereas Western culture is individualist (Hofstede, 1980).

Section 3.5.2 discusses web-based course management solutions.

3.5.2 WWW-based course-management systems

With the advent of web-based education, innovators at the University of British Columbia created a web-based course management system that would make it easier for lecturers to offer their courses online. The product, called *WebCT* (WebCourseTools) has become a market leader globally. At the same time various initiatives resulted in a range of products that are used at universities and other institutions to facilitate e-learning. Examples include *Blackboard*, currently the other market leader, *TopClass*, *FirstClass*, *Learning Space* and other, in house developed examples like the *Teletop* system at the University of Twente (Netherlands). A comprehensive list of approximately 60 commercially available systems is available online (Landon, 2001).

Collis and Moonen (2001:78) define a *WWW* course management system as follows:

“A *WWW* course management system is a comprehensive software package that supports some or all aspects of course preparation, delivery and interaction and allows these aspects to be accessible via a network”. Focusing on web-based learning, Bonk *et al.* (2000) suggest a web integration continuum to incorporate the *web* into the learning environment.

1. Marketing / syllabi	Informational use and course marketing
2. Student exploration	Informational use and value adding.
3. Student resources	Informational use, posting student exemplary work.
4. Course resources	Informational use and learning.
5. Repurpose web resource	Interaction – discussion.
6. Substantive & graded	Interaction outside class environment.
7. Course activities	Web significantly enhances learning environment.
8. Alternative delivery	Web is central focus of course.

9. Entire course on the web	Web is central focus of course. Often entirely 'at a distance'.
10. Larger programmatic	Web is central focus of course and course is part of and integrated into a complete programme offering.

Table 3.4: Ten level web integration continuum (Bonk *et al*, 2000)

The first four levels of this continuum represent informational uses of the Web, such as course marketing, web exploration, and posting instructional resources.

Level five includes online debates and discussions and level six discussions outside the immediate class community.

Levels seven through ten can be characterised as being the central focus of the course. At level nine, courses are offered entirely at a distance for students around the country, without necessarily including face-to-face contact time. At the tenth level, the course is offered as part of a programme offering, in other words as a fully-fledged web-based programme.

Eastmond *et al.* (2001) recommend an incremental approach to implementing a web course. Essential to their strategy is to incorporate a hybrid, or mix of modalities, in other words retaining some contact, face-to-face time and gradually increasing online activities and or components.

Section 3.5.3 discusses the changing role of the lecturer.

3.5.3 Changing role of the lecturer

One of the greatest challenges faced by lecturers is to create a learning community. Bonk & Wisner (2000:27) maintain that e-learning students are usually very task driven. This results in very little exploration, engagement and discussion. If combined with a teacher centred style by the lecturer, even less interaction takes place.

The following five skills are singled out by Wlodkowski (1999:26) as the most critical skills of an instructor:

- Expertise

- Empathy
- Enthusiasm
- Clarity and
- Cultural responsiveness

Bonk & Wisner (2000:11) add the following qualities that are required in an e-learning environment:

- Patient
- Positive
- Friendly
- Responsive
- Caring
- Flexible
- Web-smart

Other guidelines for learning facilitation in a web-based environment include the following roles of a lecturer (Besser & Bonn, 1997; Bonk & Wisner 2000):

- Facilitator
- Mediator
- Mentor
- Provocateur (prompting critical thinking in learners)
- Observer
- Participant
- Co-learner
- Assistant
- Community organizer
- Host

They also note that a lecturer who offers web-based courses requires the following competencies (Bonk *et al.*, 2000):

Social skills: nurture social interaction and interpersonal relations, be sensitive to learner social and cultural background, ability to interface with technical support staff,

telematic staff, colleagues involved in offering the same programme, create an ethos of mutual support and community.

Managerial and research skills: planning and management of learning environment, adopt a systems perspective - bigger picture of integration of content/resources, learning process and technologies, regular updating of materials, knowledgeable about relevant web-sites in subject-field.

Pedagogical skills: foster curiosity and intrinsic motivation, provide individual feedback and praise, promote thinking and reasoning strategies, guide and pace learners, practice cognitive apprenticeship - learning situated in real-life situations, structure lesson materials and activities in such a way that interaction involves reflecting, annotating, questioning, answering, pacing, elaborating, discussing, enquiring, problem-solving, linking, constructing, analysing, evaluating, and synthesizing, provide clear expectations.

Technical skills: understand technology and know how to use it to augment learning, understand why it aids the development of higher order cognitive skills and knowledge acquisition, ability to adapt to changing technology.

Kulp (1999) points out that small team collaboration in e-learning requires more time and effort and recommends the following student roles:

- Leader/coordinator
- Resource investigator
- Summariser
- Scribe
- Encourager
- Specialist
- Implementer
- Checker

Mason (1998) advocates the organizational, social and intellectual roles of the online lecturer. A pragmatic statement about the nature of education is made by Wilson & Mosher (1997:5) that regardless of the model of pedagogy, communication is central

to the learning environment: “The learning ‘conversation’ is a communication process in which meanings are negotiated to student understanding of curriculum material”. Curtis and Lawson (1999), cited in Bonk and Wisner (2000:24) designed a scheme for analysing online discourse. They identified types of interactions typically found in collaborative learning situations:

- Receiving help and feedback.
- Exchanging resources and information.
- Explaining and elaborating on information.
- Sharing knowledge with others.
- Challenging others’ contributions.
- Advocating increased effort and perseverance among peers.
- Engaging in group skills.
- Monitoring the efforts of others.

3.5.4 Training and support of lecturers

Schifter (2000: 43) lists the following motivating factors that could help lecturers to become involved in learning facilitation via technologies:

- Personal motivation.
- Opportunity to develop new ideas.
- Opportunity to improve teaching.
- Opportunity to diversify programme offerings.
- Greater course flexibility for students.

Interestingly, administrators listed incentives, such as credit toward promotion or additional money as the second highest motivating factor.

An illuminating finding by Henderson (2001) is that lecturers’ motives for teaching online are good predictors for their perceptions of the efficacy of teaching with technologies and that lecturers who are motivated by additional money are often not good lecturers. Other findings include:

- Sometimes faculty and student goals don't match particularly well. More can be done to communicate goals to students.

- Good instructional practice does not always result in high levels of student satisfaction.
- Include strategies for helping students understand with greater clarity why they are asked to do the kinds of activities required in their assignments.

Inhibitors to participation in technology-enhanced learning environments include the following:

- Lack of technical support.
- Lack of release time.
- Concern about faculty workload.
- Lack of grants for materials/expenses.
- Concern about quality of courses.

According to research by Van der Kamp (1996) the following are the main barriers to adult learning:

- Cost
- Lack of time

There is sufficient evidence that virtual learning environments facilitate constructivist learning. It is, however, important to analyse possible practical challenges and solutions.

Wlodkowski (1999) (see Annexure A) provides a comprehensive list of motivational strategies that can be used. The strategies will be discussed when they are later compared to existing practice in samples of the University of Pretoria's web-based courses.

Section 3.5.5 describes the role of project management in the design and development of flexible learning environments.

3.5.5 Project management

Bates (2000:66) argues that the use of project management in an instructional technology environment leads to improved quality and cost effectiveness.

Steyn (1998:2) states that the Project Management Body of Knowledge (PMBOK) describes a *project* as “a temporary endeavour undertaken to create a unique product or service”. He proceeds to define it as “any planned, temporary endeavour undertaken to create a unique product, service or other complete and definite outcome within a limited time scale and budget”. A *programme* is normally a large project that consists of smaller projects.

Project management entails a scope, i.e. project objectives or the sum of products and services to be provided as a project; a work breakdown structure that assigns people to deliverables and time lines and costs (Steyn, 1998:6).

In an instructional design and development environment teams are usually assembled that consist of different roles. The roles are typically those of project or course manager, project leader (academic), instructional designer, subject expert, instructional technologist/author/multimedia developer and sometimes a graphic designer, editor and programmer (Bates, 2000:67). Sometimes the lecturer takes on all three roles of subject expert, designer and developer. A kick-off meeting will clarify design principles, after which an iterative process of design and development is followed. Bates (2000:69) points out that it is best to link such projects at higher education institutions to earmarked funds in order to promote innovation. A helpful tool to achieve this is by means of project proposals. A project proposal should address the budget, team members and roles, copyright, revenue, the educational model, a schedule and a process for revision and maintenance (Bates, 2000:70).

Project management in an educational setting could clash with the culture of freedom and autonomy of academics. Hence its implementation requires flexibility and sensitivity. Bates (2000:72) warns against a perception that can arise of project management being bureaucratic, expensive and unnecessarily complicated. He continues to identify technology and instructional support as two critical factors in the adoption rate of technology in the learning environment. A recommendation of a ratio of one technical support person to every twenty or thirty full-time instructors, and one instructional designer to every thirty to fifty instructors is given. Also that these support staff need to be located close to the department (Bates, 2000:106).

Section 3.6 provides an overview of structures and processes that international higher education institutions have implemented to support virtual education.

3.6 International case studies

University	Approach	Learners	Processes	Structures	Infrastructure
Open University (U.K.) [http://www.open.ac.uk]	To provide flexible learning opportunities to working adults.	The number of learners connected via home computer to the OU to communicate with their tutors has risen from 5 000 in 1995 to 30 000 in 1997 (Daniel, 1997). Students (164 000) in 41 countries, mostly working adults	Project management: Course chair (senior academic), course manager/project manager (administrator), educational technologist/instructional designer, academic computing person.	Knowledge media institute	On a macro level, the OU has moved into a flexible learning system, partly through the use of technology. Print, broadcasting, audio cassettes, video, videoconferencing, CD-ROM, Web-based courses (80 000 students are studying online).
Massachusetts Institute of Technology MIT (U.S.A.)	Competitiveness, value-adding to residential courses	Students	Currently establishing processes to put all courses on the web	Media lab, Centre for Advanced Educational Services [http://www-caes.mit.edu]	Videoconferencing, CD-ROM, video, Web-based courses (Mainly Engineering and Management).

University	Approach	Learners	Processes	Structures	Infrastructure
Virginia Tech (Virginia Polytechnic Institute and State University) (U.S.A.)	To provide flexible learning opportunities to students.	Students (23 000)	CyberSchool's mission is to redesign course offerings that take full advantage not only of emerging instructional technologies but also of shared insights among faculty members about the way students learn using technology. The CDDC has created two publishing systems that enable people to publish online in the form of e-books and e-journals.	Distance and Distributed Learning (established in 1999)[www.iddl.vt.edu], Faculty Development Institute [http://www.fdi.vt.edu], Educational Technology, Center for Excellence in Undergraduate Teaching Center for Innovation in Learning [http://www.edtech.vt.edu/cil] Centre for Digital Discourse and Culture (CDDC), Cyberschool [www.cyber.vt.edu] Electronic Reading room and Distance Learning Classrooms	Print, videoconferencing, CD-ROM, Web-based courses (12 programmes). [www.vto.vt.edu] Both WebCT and Blackboard are used for web-based courses
University of Phoenix	For-profit professional courses Private institution	Adult learners in paid employment 65 000 students	Project management	80 Learning centres in 13 states, centralised courseware design and development unit	Face-to-face contact, web-based, paper-based. Full access online to materials, support, library and administrative services.
Open University of Catalonia		8000 students		Learning centres	Combines multimedia applications, e-mail, videos, tapes and face-to-face contact. Full access online to materials, videos, tapes and face-to-face contact. Full access online to materials, support, library and administrative services.

University	Approach	Learners	Processes	Structures	Infrastructure
Fern Universität (Germany)	Public distance education university, lifelong learning opportunity	56 000 students		60 Learning centres in 10 countries	Paper based, multimedia and web-based. Currently creating a virtual university by providing all materials, academic and administrative support and delivery online.
Indira Gandhi Open University [http://www.ignou.edu.socis/vci]	Adults, lifelong learning, flexible learning	About 6000 students make use of online facilities	Unknown	Unknown	Paper-based, Web-based, satellite-based teleconferencing, and CDROM
National University of Singapore	New market of continuing education through flexible and online learning				Integrated learning environment, 600 courses online
University of Southern Queensland	Blend of distance education and residential – flexible learning	15 000 of which 3000 study off0shor	Project management		24 Courses offered completely online
Virtual-U project (Simon Fraser University (Canada)	Commercial – marketing of courseware and other learning products	7000 students study online			Designed their own web-based management system
Athabasca University (Canada)	Distance education shifting to virtual education				Web-based (50+ courses), paper-based

University	Approach	Learners	Processes	Structures	Infrastructure
Stanford University (Stanford Online)	Adding value to existing programme offering, cost effectiveness		Project management: instructional designers and technologists.	Stanford learning lab	Television, Web-based (especially short courses, management and engineering), multimedia and residential.
Maryland University College (U.S.A.)	Mixed model, flexible learning	More than 60 000 students, mostly employed			Integrated online administrative and academic services (student portal), face-to-face contact, multimedia, video.
De Montfort University (U.K)	E-campus to reach more students				Web-based, videoconferencing, face-to-face contact, video, multimedia, interactive satellite broadcasting. Online library services.
Harvard University	Leading edge, competitiveness	Business school – majority of MBA students study off-campus			Programmes and programme administration provided online (Business School)
British Aerospace Virtual University (U.K.)	Provision of learning resources for immediate reference and work application	Employees (43 000)	Learning goals identified and matched with appropriate study programme.	Learning centres, Online learning and development guide, personal development programmes.	Print, audio cassettes, CD-ROM, Web-based courses.

Table 3.5: International case studies (Sources: HEFCE, 2000; Farrell, 2001; personal visits)

Another California project mandated by an order from the governor in April 1997 and in design through August 1998 is the California Virtual University (CVU) (Deloro, 1997). Offering centralised access to course listings and related services, CVU was planned as a comprehensive virtual catalogue of the state's 106 community colleges, 164 independent colleges and universities, 23 California State University System campuses and nine University of California campuses. Currently close to 2000 courses are offered online and 95 institutions are participating (Farrell *et al.*, 2001:33). It seems however as if the university has found initial private sector funding to be insufficient and is struggling to remain sustainable. This is reminiscent of the Western Governor's University (WGU) – a partnership between about twelve major public universities in the western United States. WGU is basically a clearing house of online courses, specifically related to work-related, competence-based qualifications.

Section 3.7 gives an overview of the South African higher education landscape. It includes a brief discussion on telecommunications infrastructure in Africa.

3.7 South African context

Many residential higher education institutions in South Africa have adopted distance education as part of their main- stream activities in an attempt to meet market needs. An overview is provided in Chapter Four.

Flexible learning is a vehicle for transformation, as encapsulated in the *White Paper on Higher Education*: “To promote the development of a flexible learning system, including distance education and resource-based learning on open learning principles” (South Africa, 1997, 5: 1.27).

“It will promote the development of a flexible learning system, progressively encompassing the entire higher education sector, with a diversity of institutional missions and programme mixes, a range of distance and face-to-face delivery mechanisms and support systems, using appropriate, cost-effective combinations of resource based learning and teaching technologies” (South Africa, 1997, 7: 2 6).

The Department of Education has adopted an outcomes-based approach to education, the quality of which will be assured by the South African Qualifications Authority (SAQA) (South Africa, 1997).

The main principles underlying outcomes-based education are lifelong learning, flexible education and training structures, the integration and transfer of learning, and the need to teach towards critical, cross-field and specific outcomes. Competence is seen as combining skill, values and knowledge (Gultig, 1997).

Critical, cross-field outcomes are considered working principles and are generated across sectors in a process of consultation among stakeholders. These cross-field outcomes would promote the development of basic skills such as **communication, critical thinking, problem-solving** and **team working skills**, which are necessary for functioning in a changing, modern society (Lubisi *et al.*, 1997:11). In this sense, a broad band of competence will gradually build capacity in South Africa and possibly contribute to a better economy.

Specific outcomes are context-specific and describe the competence which learners should be able to demonstrate in particular areas of learning at certain levels. These outcomes should be assessed according to criterion-referenced methods, which means that performance standards and criteria are clearly communicated to learners (Mager, 1991). Learners are subsequently measured against the pre-stated criteria and are not assessed against other learners' performances, as has been practised in norm-referenced assessment. It follows that because learners know what is expected of them, the assessment process is transparent and does not rely on the subjective impression of the lecturer.

Technology-enhanced summative assessment remains something to be explored, as invigilation and very strict security systems will be required.

An important shift in the outcomes-based approach is that there is often more than one answer to a problem, depending on the context involved. This, along with the emphasis on formative assessment rather than only summative assessment, agrees fully with constructivist principles, as learning is a process and continual assessment and feedback are essential.

Alley, (1996) contends that assessment is far too undervalued as a potentially active tool of quality learner-centred learning. It should be woven into the basic fabric of the teaching and learning process so that it both reflects and enhances learning. Many books and articles have been written describing creative tactics for embedding assessment which, at its best, becomes a continuous cycle of feedback to both the learner and lecturer, not only about learner achievement, but also about learners' need for effectiveness and focus from the self-adaptive, technology-supported learning environments that are now feasible.

Outcomes-based education focuses on learner-centred education, which is aligned with the constructivist principle that the learner has to construct meaning. The same principles are echoed in outcomes-based education, viz. "Different learning styles and rates of learning need to be acknowledged and accommodated both in the learning situation and in the attainment of qualifications. The ways in which different cultural values and lifestyles affect the construction of knowledge should also be acknowledged and incorporated in the development and implementation of learning programmes" (Lubisi *et al.*, 1997:4). This need for cross-cultural portability of learning environments is explored later.

Other important principles in outcomes-based learning facilitation are:

- An understanding of the role of motivation in learning,
- assessing and using learners' prior learning,
- inventoring learners' learning styles,
- understanding the nature of learning processes and how to best-fit learning styles,
- using collaborative/co-operative learning,
- using problem-based learning,
- assessing course and learner outcomes, and
- knowing how to use instructional technologies (Gultig, 1997).

One of the most pressing problems facing society is the digital divide. South Africa is an ideal research ground in which both the first world and third world co-exists. According to a report on the status of the African Internet (Jensen, 2001), the Internet has grown rapidly in Africa. There are now more than a million dialup Internet subscribers and the total international Internet bandwidth reached over 1 gigabyte per second. Jensen notes, however that this growth has been largely confined to major cities in Africa where the minority of the population lives. He mentions South

Africa as an exception which have points of presence (POPs) in about 100 cities and towns. The connectivity in South Africa is remarkable if one takes into account that there are only 250 POPs in total in Africa. The dominance of South Africa in this regard can be seen graphically in Figure 3.4.

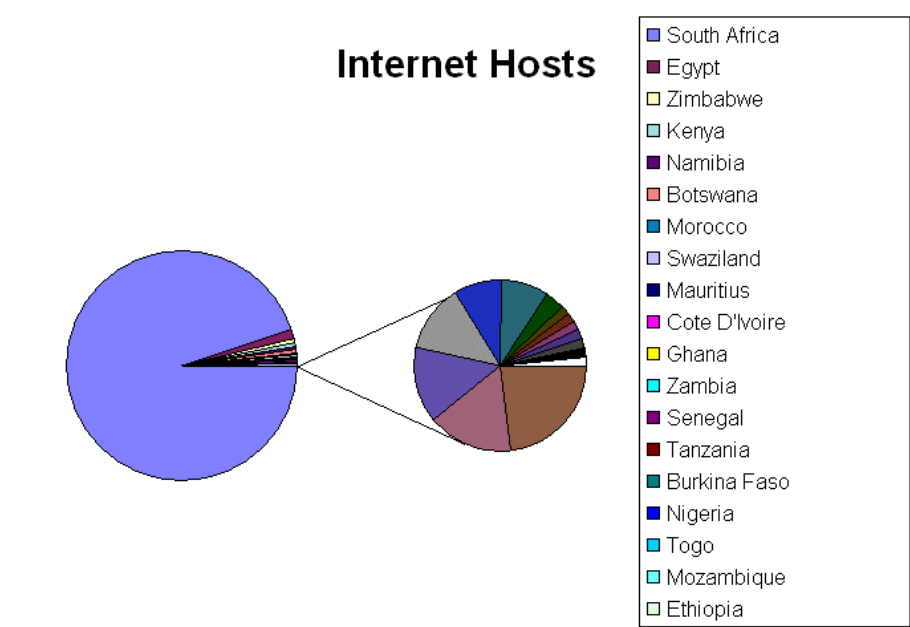


Figure 3.4: Status of the African Internet (Jensen, 2001)

It is difficult to estimate the total number of Internet users in Africa. The number of dialup subscriber accounts of the ISPs in Africa total more than 1 300 000. Of these 750 000 are in South Africa, 250 000 in North Africa and remaining 300 000 in the remaining 50 African countries. According to Naidoo & Schutte (2001:95) a ratio of one Internet user for every 5000 people is implied, compared to a world average of about one user for every 30 people and the North American and European average of about one in every 3 people. As can be seen from these statistics South Africa is by far the leader in Internet connectivity and its average is close to the North American / European average.

The average total cost of using the Internet is still very expensive in Africa. Based on an estimate by Jensen (2001), the average total cost for 20 hours a month is about R 600 a month. This includes usage fees and local call telephone time, but not the telephone line rental. Initiatives to improve public Internet access include a rapidly growing number of kiosks, cyber cafés and PCs in phone-shops, schools, police stations and clinics.

Obtaining sufficient international bandwidth still remains a major problem as can be seen from Figure 3.5, which gives an overview of Internet access and bandwidth in Africa.

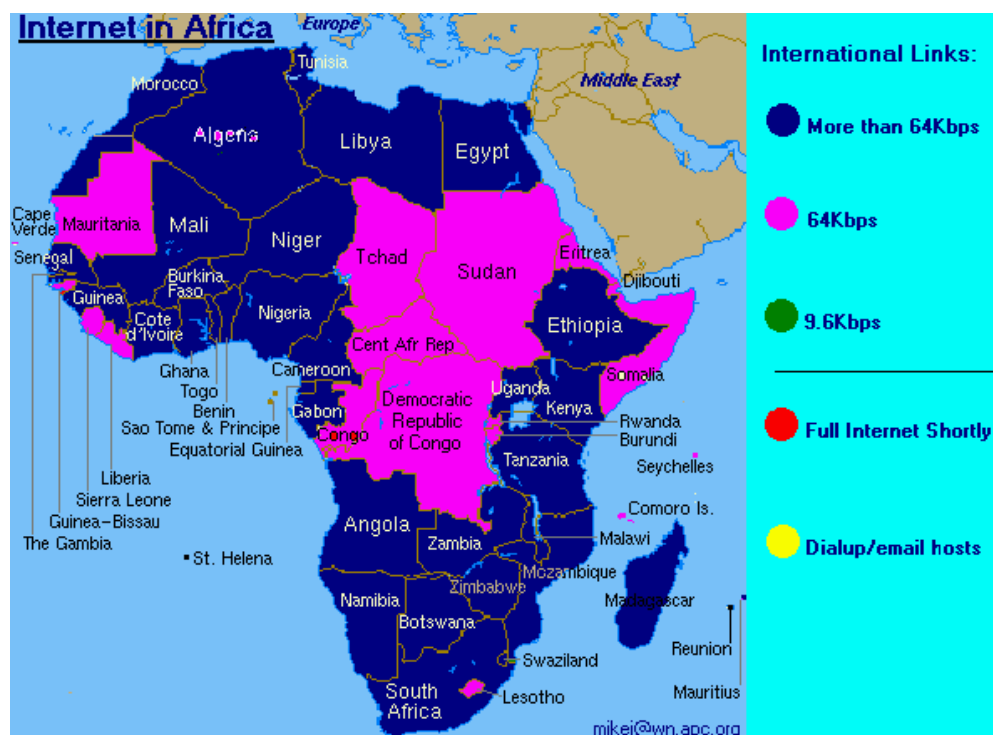


Figure 3.5: Internet Access and Bandwidth in Africa (Jensen, 2001)

Despite the "digital divide" the use of ICT in higher education is not only a priority in developed countries but also a matter of extreme urgency in developing countries such as South Africa. It is of great importance that universities in South Africa remain competitive in the international higher education market. The importance of ICT in higher education is emphasized in the report "Towards a New Higher Education Landscape: Meeting the Equity, Quality and Social Development Imperatives of South Africa in the 21st Century (CHE, 2000). The report outlines the challenge to integrate information and communications technologies. President Mbeki also acknowledged the influence of ICT on higher education in his State of Nation address in February 2001 when he emphasized that the application of modern communication and information technology in the fields of education, health, commerce and government will be expedited.

Section 3.8 provides a benchmark regarding quality in virtual education.

3.8 Quality in virtual education

Quality in education has become prevalent with the shift to a more customer- focused orientation and questions about the cost of higher education.

The Institute for Higher Education Policy (2000) conducted an evaluation of Internet-based electronic education. The results are published in an article: "Quality on the Line": Benchmarks for success in Internet-based electronic education. After an extensive research process, 45 benchmarks were identified to ensure quality in Internet-based electronic education. They selected 6 institutes to rate these benchmarks according to importance, i.e. 1 = not important, 5 = very important. They recommended **24 benchmarks** essential for quality Internet-based education. The purpose of these benchmarks is to assist policymakers of universities and colleges as well as faculties and students to make reasonable and informed judgments with regard to quality of Internet-based electronic education.

The benchmarks will be applied to the case study in Chapter Four.

Benchmarks

Institutional support

1. A documented technology plan that includes electronic security measures (i.e., password protection, encryption, back-up systems) is in place and operational to ensure both quality standards and the integrity and validity of information.
2. The reliability of the technology delivery system is as failsafe as possible.
3. A centralized system provides support for building and maintaining the electronic education infrastructure.

Course Development

4. Guidelines regarding minimum standards are used for course development; design and delivery, while learning outcomes – not the availability of existing technology – determine the technology being used to deliver course content.
5. Instructional materials are reviewed periodically to ensure they meet program standards.
6. Courses are designed to require students to engage themselves in analysis, synthesis and evaluation as part of their course and program requirements.

Teaching/Learning

7. Student interaction with faculty and other students is an essential characteristic

Benchmarks

and is facilitated through a variety of ways, including voice-mail and/or e-mail.

8. Feedback to student assignments and questions is constructive and provided in a timely manner.
9. Students are instructed in the proper methods of effective research, including assessment of the validity of resources.

Course structure

10. Before starting an online program, students are advised about the program to determine:
 - If they possess the self-motivation and commitment to learn via electronic education and
 - If they have access to the minimal technology required by the course design.
11. Students are provided with supplemental course information that outlines course objectives, concepts and ideas and learning outcomes for each course are summarized in a clearly written, straightforward statement.
12. Students have access to sufficient library resources that may include a “virtual library” accessible through the *WWW*.
13. Faculty and students agree upon expectations regarding times for student assignment completion and faculty response.

Student Support

14. Students receive information about programs, including admission requirements, tuition and fees, books and supplies, technical and proctoring requirements, and student support services.
15. Students are provided with hands-on training and information to aid them in securing material through electronic databases, interlibrary loans, government archives, news services and other sources.
16. Throughout the duration of the course/program, students have access to technical assistance, including detailed instructions regarding the electronic media used, practice sessions prior to the beginning of the course and convenient access to technical support staff.
17. Questions directed to student service personnel are answered accurately and quickly, with a structured system in place to address student complaints.

Faculty Support

18. Technical assistance in course development is available to faculty who are encouraged to use it.

Benchmarks

19. Faculty members are assisted in the transition from classroom teaching to online instruction and are assessed during the process.
20. Instructor training and assistance, including peer mentoring, continues through the progression of the online course.
21. Faculty members are provided with written resources to deal with issues arising from student use of electronically accessed data.

Evaluation and Assessment

22. The program's educational effectiveness and teaching/learning process is assessed through an evaluation process that uses several methods and applies specific standards.
23. Data on enrolment, costs, and successful/innovative uses of technology are used to evaluate program effectiveness.
24. Intended learning outcomes are reviewed regularly to ensure clarity, utility and appropriateness.

Chapter 4 Case Study

“The seen is the changing, the unseen is the unchanging”.

Plato

4.1 Introduction

Chapter Three provides an overview of the higher education landscape, indicating that the impact of technology on higher education is significant.

This chapter describes *process, product, and service* innovation of the virtual campus. The researcher draws on theory discussed in Chapter Two in order to apply theoretical concepts to the case. In turn, emerging knowledge generated by the case study is used to inform the theoretical fields discussed in Chapter Two. Figure 4.1 illustrates how Chapter Four fits into the structure of this thesis.

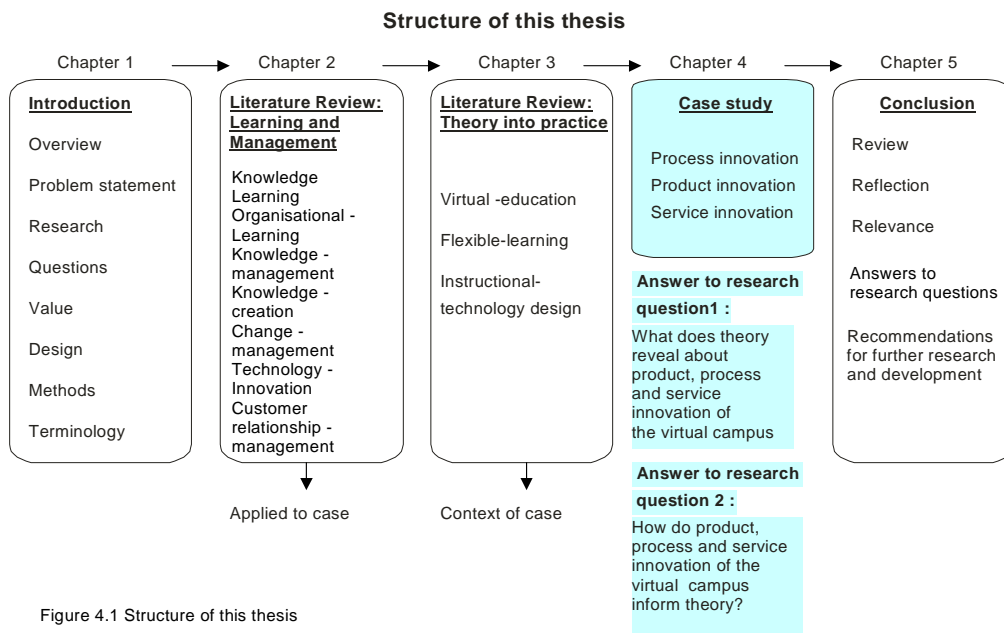


Figure 4.1 Structure of this thesis

As mentioned in Section 2.6, Nadler and Tushman (1995:55) propose that top management have to adhere to three challenges in times of discontinuous change, namely timeous recognition of external forces that could cause disequilibrium, making appropriate strategic choices to reposition the organisation and re-architecting the organisation.

The virtual campus was created in response to the following global changes:

- rapid changes in the economy as a result of the knowledge explosion and the consequent need for continuous reskilling fuel greater demands to flexible access to higher education and lifelong learning opportunities (Davis & Botkin, 1994:172)
- a rapid increase in world population, predicted to be 7.2 billion in 2015 and concomitant increased need for access to education (CIA, 2000). Massification of education and training to lifelong learning demand different approaches to teaching and learning from what is found in traditional universities (Gates, 1996)
- a new economy leading to a widening gap between developed and developing countries (Tapscott, 1996)
- a gradual decrease in government subsidies to higher education institutions as governments become reluctant to fund the increasing demand for higher education (Duderstadt, 1999:3)
- a change in student demographics - students are increasingly older and diverse in terms of race, gender, home language, nationality and economic background. They demand a higher degree of quality and relevance in their education (Mail & Guardian, 1997:12)
- the proliferation of information and communications technology is causing disintermediation (middleman falls away), resulting in business encroaching on the educational market. It also requires integration of technology into the learning experience (Twigg & Oblinger, 1996:4)

Although various technologies are used in virtual education, the Internet has proven to be the most powerful technology in terms of range, functionality, connectivity, access and cost (Tapscott, 1996). It is particularly suited to an institution-wide innovation.

Digital network and software solutions in a virtual organisation are typically used for:

- Course offering and delivery.
- Communication
- Management and provision of administrative student services such as academic records, payment and application for admission.
- Learner support e.g. enquiries and consultation.

(Farrell, 2001:2)

Based on the case, the researcher defines a virtual campus as a web-enabled product and service offering of an institution.

The design of the virtual campus of the University of Pretoria was integrated with existing technology architecture and functionality. The reasons are as follows:

- To avoid duplication. The University of Pretoria is a residential institution with a corresponding business model.
- To save costs.
- To service on campus and off campus students.

Section 4.2 provides the background of the virtual campus.

4.2 Background of the virtual campus

The University of Pretoria is committed to relevant quality teaching and research of the highest standard while pursuing internationalisation. The University has nine faculties, in which more than 500 programmes are offered - increasingly by means of a flexible educational model. It is the largest residential university in South Africa and provides training for approximately 50 000 students (of which 25 198 students are residential students).

The University of Pretoria moved into the arena of distance education in 1995 in order to provide more flexibility to learners. The move highlighted a need - and provided the impetus for developing a new, more appropriate education model.

For some time the University had practised a limited mixed mode of delivery, including broadcasting, videoconferencing, multimedia, and web-based courses combined with contact sessions. In July 1997 the University Council approved telematic education as a mainstream activity of the University and the Department of Telematic Education was established. *Telematics* is defined as the use of a range of technologies to support intra and interflexibility in the learning environment and to provide improved access and quality of course offerings (Van Harmelen, 1997). The mission of the telematic education initiative is to create flexible learning environments by making use of a wide range of delivery modes.

A new education model, based on a technology-enhanced flexible learning (telematic education) paradigm, was established in 1997. Telematic education is based on the innovative integration of contact tuition, paper-based distance education and electronic education. The correct combination of technology is determined through instructional design.

Staff at the Telematic Learning and Education Innovation department include instructional designers, photographers, graphic designers and video editors to audiovisual and

broadcasting experts. Project managers coordinate projects and the design, development and maintenance of programmes.

Electronic education is provided via the WWW and through the appropriate integration of various information and communication technologies (ICT) such as interactive multimedia, computer assisted assessment, interactive television and videoconferencing.

Although certain aspects of a virtual learning environment were present at the university in 1997, it was necessary to adopt an integrated strategy to ensure a streamlined, compatible and effective system that can be easily managed. At the time, limited strategy for the design and development of web-based courses existed and there was no infrastructure to support an institution-wide initiative. The researcher was appointed in 1998 as the project leader to establish the virtual campus. In order to create the required integrated infrastructure, five task teams were formed with representation by five support departments and faculties: Academic Information Services (Library), Information Technology, Academic Administration, Financial Administration, academia and Telematic Education.

The University of Pretoria developed a virtual campus [<http://www.up.ac.za>] that augments the physical campus by providing web-based access to integrated:

- administrative services such as web-based application and payment;
- web-based courseware and instructional materials;
- web-based academic services such as access to full text articles and electronic databases, student records, exam rosters and examination results; and
- web-based communication facilities allowing interaction between lecturers and students, as well as between fellow students.

The main contributing factors which led to a decision in 1998 to establish an integrated virtual campus at the University of Pretoria, relate to the above considerations. By an *integrated virtual campus* is meant that administration services such as payment and application are integrated with library, teaching and learning systems to be accessible via the Internet (Farrell, 1999; Lazenby, 1998). Hence an integrated product and service offering is provided. The strategic reasons behind the decision can be encapsulated in a sentence. Increased competition, decreased funding and a shift in global trends in higher education have made the risk of not moving in this direction a threat to remaining competitive (Tovstiga & Kaehler, 1998; Lazenby, 1998).

The virtual campus infrastructure, processes, products and services were created over a period of two years. More products and services continue to be developed.

Instead of implementing an expensive *ERP* system, portals were developed for staff and students that integrate with *WebCT*; providing access to legacy systems and enabling transactions via the web. The virtual campus renders some of the benefits of an *ERP* system, such as web-enabled, customer-focused services and information.

The University of Pretoria currently offers 70 web-enabled degree programmes and additionally, all registered students can make use of the virtual campus to access information about their studies and to conduct transactions. To date, 31908 students have made use of this service. Other supporting media such as *CDROM* and video create a richer learning environment.

Learning opportunities created by the virtual campus do not replace physical contact tuition. Contact learning opportunities are reduced but also enhanced and enriched to address the challenges of a learner centred teaching and learning approach in a context of growing student numbers.

At the University of Pretoria, scalability of software, adequate infrastructure (capital and human resources) and continuous improvement on current practice remain challenging. The biggest challenge is to bring about institution wide change in teaching and learning practice.

Section 4.3 explains how theories in Chapter Two are applied to the case of the virtual campus.

4.3 Selected theories

Figure 4.1 illustrates how the selected fields in Chapter Two are used to analyse the *process, product and service innovation* components of the virtual campus. The philosophical foundation of epistemology underlies all theories. The theories interface with one another, as was explained in Chapter Two; and each enriches the interpretation of *process, product and service* innovation. The products and services fan out of the cross-divisional spiral as shown in Figure 4.2.

Process innovation will be described and interpreted through document analysis of non-technical literature and the application of theory. *Service innovation* is mostly described by

means of statistics and by comparing practice discussed in Chapter Three. The researcher continues to describe and interpret *product innovation* through the application of theory, by means of descriptive statistics, and through questionnaires and interviews.

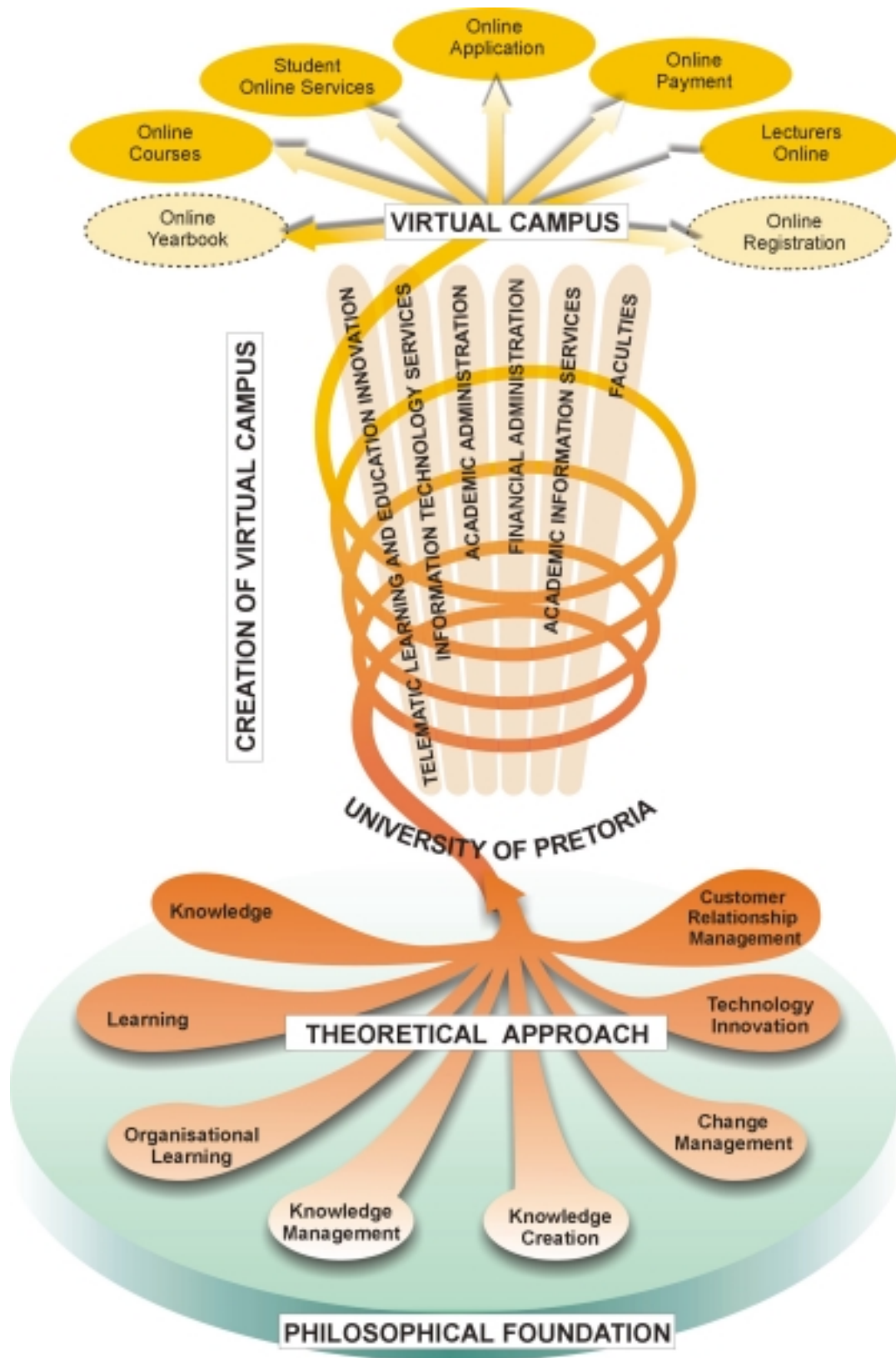


Figure 4.2: Fields used to analyse the creation of the virtual campus at the University of Pretoria

Table 4.1 indicates the products and services of the virtual campus.

Product	Service
Online courses	Student Online Services
Online yearbook and degree audit	Online Application
	Online Payment
	Lecturers Online
	Online Registration

Table 4.1 Products and services of the virtual campus

The *online yearbook* and *online registration* respectively are indicated in perforated lines in Figure 4.1 because they are failed objectives.

Processes established by the virtual campus project team refer to new processes that were established to offer the new services and products indicated in Table 4.1

As discussed in Chapter One, the theory in Chapter Two is applied to the case of the virtual campus to answer research question one and research question two:

<i>Research question 1 (Chapter Four)</i>	
What does theory reveal about <i>process, product and service innovation</i> of the virtual campus?	
<i>Method</i>	
Investigation of the creation and evolution of the virtual campus in terms of theory and practice.	
<i>Goal</i>	<i>Data collection methods</i>
<i>Action</i> (Using the theoretical framework as a tool to investigate the manifestation of its elements in the case study)	<i>Qualitative methods:</i> <ul style="list-style-type: none"> • Application of theory, interpretation of interviews, questionnaire surveys, document analysis of non-technical literature and content analysis of courses.
	<i>Quantitative methods:</i> Collection of quantitative survey data and limited statistical analysis. <ul style="list-style-type: none"> • Adoption rate of services. • Adoption rate of products. • Aspects of web-based courses.
<i>Research question 2 (Chapter Four)</i>	
How do <i>process, product and service innovation</i> of the virtual campus inform theory?	
<i>Method</i>	
Building more knowledge about innovation management and various theoretical fields.	

<i>Goal</i>	<i>Data collection methods</i>
Development and interpretive	<p><i>Inductive methods and qualitative methods:</i></p> <p>Examination of theories and practice being applied in practice, and induction of ways to implement them.</p> <p>Qualitative inquiry into how the theoretical elements function in different aspects of innovation.</p> <p>Qualitative inquiry of how the findings of the case study contribute to knowledge about innovation in higher education.</p> <p>Motivation: The interpretive design is characterised by subjectivity and the study of individual experience. In this study the theoretical approach is further informed by practice, tending to become grounded theory.</p>

Table 4.2 Research questions and methods used to answer them

Table 4.2 shows that both qualitative and quantitative data collection methods are used to answer the two research questions.

Figure 4.3 is a framework for the management of educational innovation. It illustrates how the various theoretical constructs manifested in the creation of the virtual campus in its various components of *process*, *product*, and *service* innovation. Project management and change management are keys to innovation and are central to continuous knowledge creation enablers and conditions. It is a continuous cycle of learning through doing, accompanied by market adoption as time passes. Knowledge enablers and conditions for knowledge creation should be included as active steps in an educational innovation process.

Innovation Process

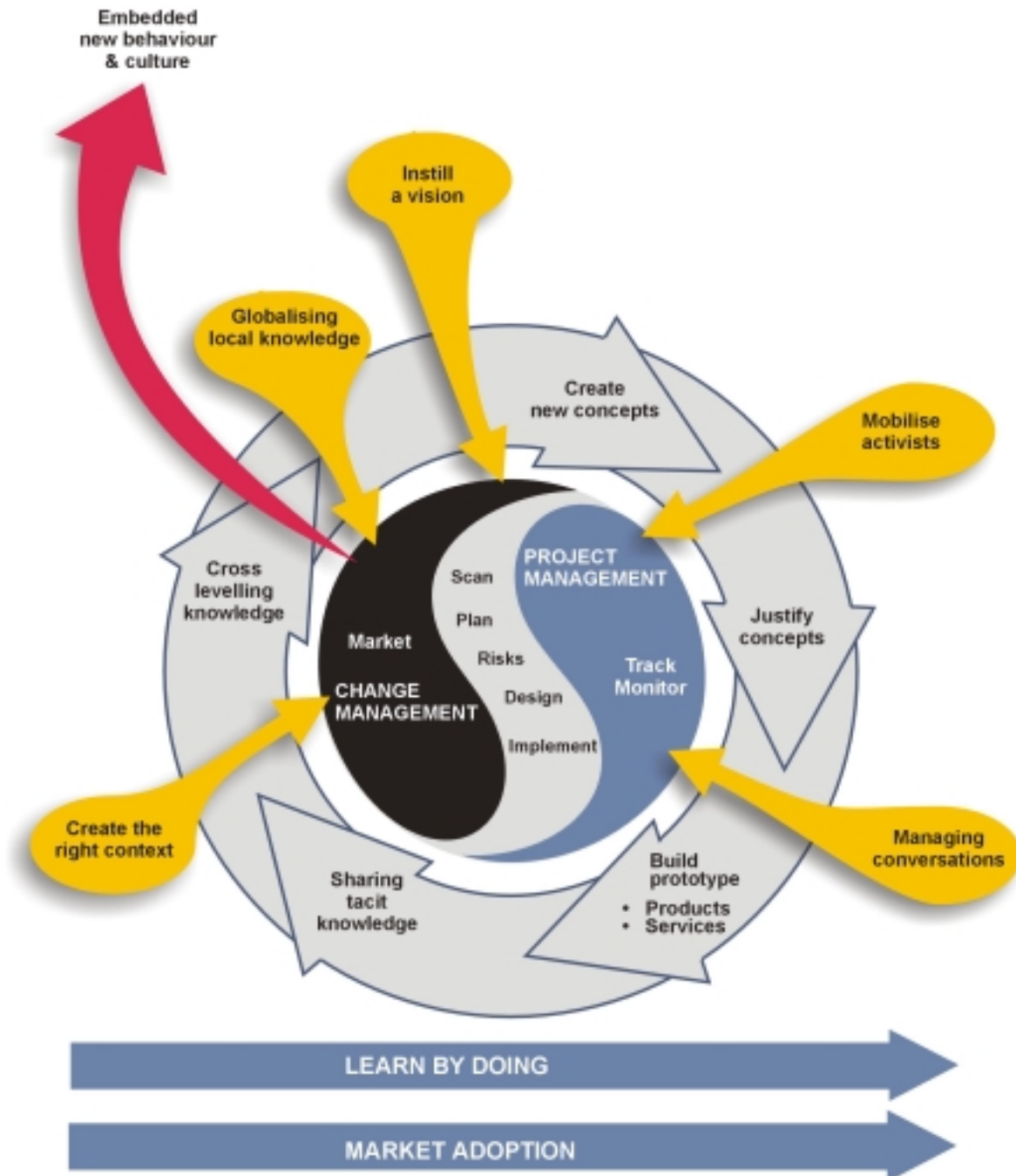


Figure 4.3 Framework for educational innovation management

Table 4.3 indicates which aspects of particular theories were used in the creation and management of the virtual campus.

Strategy	Knowledge creation	Change management	Project management	Technology innovation
Scan environment		x		x
Formulate response/strategy		x	x	x
Create a vision	x	x		x
Create a plan		x	x	x
Identify risks		x	x	
Sell concept	x	x		x
Identify key players	x	x	x	
Refine plan with key players	x		x	
Create teams	x	x	x	x
Implement plan	x	x	x	x
Monitor execution and test on experimental base	x	x	x	x
Adapt based on feedback of customers and process owners	x	x	x	x
Market	x	x		
Reflect on process	x	x		x

Table 4.3 Synthesis of intentional strategies used to create the virtual campus

Table 4.3 shows that most aspects or steps listed in the first column form part of the mentioned theories or strategies. In other words, the steps used to innovate are steps common to a variety of theoretical fields.

Section 4.4 is a document analysis of non-technical data.

4.4 Qualitative Analysis of process innovation

Section 4.4 of this chapter is a qualitative analysis of non-technical data (documents and reports) and focuses on *process innovation*. Non-technical data collected in the case study is analyzed and interpreted in light of knowledge creation, organizational learning, change management and innovation discussed in Chapter Two.

Section 4.4.1 commences by exploring the planning phase of the virtual campus.

4.4.1 Project charter

The researcher drafted a project charter. The project charter was distributed in April 1998 to Executive Management and Senior Management (Deans and Directors). The project charter provided a vision for the university, posed reasons why it was deemed necessary to establish the virtual campus and explained the various components of the virtual campus. The reason for its distribution was to introduce the concept and to initiate the alignment process.

Certain aspects of the project charter are mentioned in the following sections in order to explore them from a theoretical stance. The first month at the university was used to assimilate adequate knowledge about the institution. The newly assimilated knowledge, combined with experience and prior knowledge resulted in a plan on the development of the virtual campus for the university.

From a Change Management perspective, the project charter or project plan meets with some of the requirements of a change management plan provided by Senge *et al.* (1999) (as discussed in Section 2.6 and highlighted in frames). The original text of the project charter is in italics:

A broad statement of purpose that articulates the organisation's ultimate goals and portrays what kind of organisation the change is intended to create.

Vision

To become an international leader in higher education through technologically advanced infrastructure, services and products.

A description of core values that the organisation considers most important, such as quality, innovation and service.

A statement of the core strategies, including a definition of businesses, markets, and offerings and a determination of particular bases for competition.

Project description

The virtual campus aims to establish a web-based platform that is integrated with the existing infrastructure of the University of Pretoria that will provide a range of administration services,

tuition and support to residential and remote students as well as an improved, streamlined service to both academic and administration staff.

<i>What</i>	<ul style="list-style-type: none"> <i>To create a virtual UP campus that is integrated with the existing campus and that will improve existing services, support and products.</i>
<i>Function</i>	<ul style="list-style-type: none"> <i>An integrated web-based system which incorporates an administration interface, communication with tutors/lecturers and courseware and which manages access to relevant information, knowledge and resources.</i> <i>A communication tool within UP (Intranet and extranet), a global marketing tool (Internet) and an interface with other virtual campuses.</i>
<i>Why</i>	<ul style="list-style-type: none"> <i>The need for a strategic enabler to provide a global market and competitive advantage.</i> <i>The need for an integrated web-based system that offers quality support, renders excellent administrative service and a rich learning environment.</i> <i>Integration of existing functions, infrastructures and expertise.</i>
<i>Format</i>	<ul style="list-style-type: none"> <i>Virtual - UP will operate on a platform which is compatible with the existing IT systems (where possible), and products will be used as identified through benchmarking and action research.</i>

Objectives

- to create the necessary mindshift (change management) among staff and learners to facilitate the successful implementation of the virtual campus, including new performance management measures,*
- to train staff and students to utilise appropriate technologies,*
- to provide easy access to workstations and networked information services,*
- to register learners for on-line interactive courseware and to provide on-line registration and payment,*
- to provide totally integrated on-line instruction, which includes assessment, tutoring and accreditation,*
- to provide accelerated, self-paced learning, i.e. the learner can progress at his or her own pace, place and time and, consequently, can complete an instructional degree, diploma or short course more rapidly,*
- to provide an integrated academic and administrative service to learners and to staff (simplified interfaces, procedures, and documentation for accessing networked information services).*

Operational performance: the actions that will be taken to improve the effectiveness of the core operations, including process redesign, quality, cost reduction and service and product innovation.

Ownership

The ownership of the virtual campus lies with the Faculties, Finance, Information Technology, Administration, Academic Information Services, Telematic Education and students.

Organisation: a broad framework for the architecture of the enterprise – the structures, processes, and systems that will enable people to perform the work required by the strategy and vision.

Overall requirements

- *Adequate technology equipment for administrative and academic staff and networked instructional environment and secure access from anywhere.*
- *Integrated instructional technology unit to provide staff with instructional design and development and integrating technology into the curriculum.*
- *Technical support and maintenance (to support faculty with well-defined projects for experimenting with new technologies and innovative ways of employing them in the teaching, learning and research processes).*
- *Ownership by staff, students, Management, Information Technology, Academic Administration, Financial Administration and Academic Information Service.*
- *Monthly reporting line to management/vice-chancellor/representative committee.*
- *Structured project management and instructional design processes linked to relevant market research and environmental scanning.*

Although no human due diligence was conducted as recommended by Conner *et al.* (1998), the university underwent a restructuring and downsizing exercise at the time. No additional capacity was created – meaning that staff had to engage in the virtual campus project in addition to regular workloads.

Returning to the work by Senge *et al.* (1999) the project plan is measured against qualities of important change initiatives in Table 4.4.

They are connected with real work goals and processes.	Yes. The products and services that were created are central to the university's core business.
They are connected with improving performance.	Not necessarily performance of people, but more effectiveness and efficiency and improved quality regarding products and services.
They involve people who have the power to take action regarding these goals.	Yes. In a sense the virtual campus team did not have the power to make strategic decisions, yet they were the only ones who could implement the changes due to them being the knowledge champions of the various domains.
They seek to balance action and reflection, connecting inquiry and experimentation.	Not sure. Short timelines left little time for reflection although it was a continuous process of building knowledge, implementing and adaptation based on experience.
They afford people an increased amount of 'white space': opportunities for people to think and reflect without pressure to make decisions.	No. In this project no additional capacity was created. Apart from their regular work they had to cope with additional pressure.
They are intended to increase people's capacity, individually and collectively.	Yes. In terms of building new knowledge and improving processes and systems.
They focus on learning about learning, in settings that matter.	Yes.

Table 4.4 Application of qualities of important change initiatives (Senge, *et al.*, 1999)

If one reflects on the two main differences between theory and practice, the team members were not necessarily the most empowered group in terms of authority and status. Yet they had the ability to execute changes and their knowledge was central to product and service innovation. Furthermore there was no additional time or resources provided, which means that either people create their own 'white space' to reflect or it is not necessary to reflect on the changes. The researcher would postulate that reflection takes place in any case and that it is not a requirement to build white space into a change management plan. To support this it is important to emphasise *a sense of urgency* (Kotter, 1995:61) that is necessary to keep momentum.

Section 4.4.2 describes the reporting line of the project. The procedure by which the virtual campus project team was established as well as the tasks set out in the project plan are discussed and listed below.

4.4.2 Execution and implementation: procedures and processes

The researcher reported to the Director: Telematic Learning and Education Innovation in line function, and to the Vice-Chancellor and Principal in the capacity of an intrapreneur (Pinchot, 1985) during the first year of creating the virtual campus. In this light, the Director: Telematic Learning and Education Innovation acted as the *Sponsor* and the Vice-Chancellor and Principal as the *Protector*. The researcher is of the opinion that top management support was one of the critical success factors of the project.

Based on previous experience, the researcher decided to adopt a matrix management style for the project, in other words working horizontally across various departments and faculties. In Section 2.5.2 Von Krogh *et al.* (1998:133-136) note that an organisation's performance depends on the extent to which managers can mobilise knowledge resources held by individuals and turn these into value-creating activities, such as the creation of new knowledge. A strategy was followed to hand pick individuals with the most tacit knowledge from the departments, illustrated in Figure 4.2. Apart from being *knowledge champions*, some of them were also *middle managers* in their departments – the most important knowledge creators in an organisation - as discussed in Section 2.5.2 (Nonaka & Takeuchi, 1995:129).

The individuals were first approached by the researcher to get their buy-in to take part in the virtual campus project. As a next step, senior management was approached to permit the selected staff members to serve on the virtual campus project team. A total of twenty members served on the team, comprising four project managers and one project leader.

The virtual campus project team met on a monthly basis in the Council Hall opposite the Vice-Chancellor and Principal's office. This created an official and mandated environment for the project team and contributed to what is described in Section 2.5.3 as *ba* – an enabling context or place in which knowledge is shared, created and used. The meetings were used to discuss constraints and share detailed progress.

Using constructs proposed by Von Krogh *et al.* (2000:178) discussed in Section 2.5.3 the process followed by the project team was reminiscent of the four ways of creating *ba*:

Originating interaction.

Conversing.

Documenting.

Internalising.

The researcher used *MS Project* as the project management tool. The original high level work break down structure (WBS) and project overview of 1998 is provided in Annexure B. A detailed list of tasks was constructed by the project leader (Annexure C), based on the project charter and knowledge assimilated from project team members and key individuals in the university. Hence, the initial analysis and design phases were in place and the deliverables, or specific tasks served as a conceptual prototype or blueprint that could be implemented. Each deliverable was tightly scheduled by the project leader. This was a deliberate strategy to act as a push factor and create momentum. Kotter (1995:61), as discussed in Section 2.6, argues that *establishing a sense of urgency* is a strategy to create organisational change. Although it refers more to competitive realities, the short time lines contributed to a sense of urgency. The vision of becoming more competitive by means of creating a virtual campus was continually communicated. Each project manager had to report back in writing before the next meeting. The feedback was included in a status report that was distributed to members beforehand. This procedure ensured that members keep their momentum and assisted with the knowledge creation process. The report also served at the strategic technology committee of the university, on which the Vice-Chancellor and Principal have a seat – which was an implicit top-down strategy that encouraged members to keep to the stated deadlines. By providing frequent written feedback on tasks in progress, *explicit* knowledge was created from *tacit* knowledge then *justified* during the meetings. The resulting products and services can be interpreted as *explicit* knowledge, which in turn would be adapted on an ongoing basis as team members grew more comfortable in the innovation environment and learned through trial and error what worked best. It proved to be true *learning by doing*.

In the first status report the researcher wrote the following:

WE WILL HAVE TO ACCEPT THAT THE PROCESS IS TYPICAL OF WHAT IS TERMED 'CHAOS MANAGEMENT' BECAUSE OF THE NATURE OF THE FIELD AND THE FACT THAT AN INSTITUTION USED TO AN ORDERED AND PREDICTABLE WAY OF OPERATING HAS INADVERTENTLY BEEN PLUNGED INTO A PERPETUALLY CHANGING ENVIRONMENT.

If one applies the work of Nonaka and Takeuchi (1995: 74-83) the conditions for enabling knowledge creation, i.e. *intention*, *autonomy*, *fluctuation* and *chaos* were conditions that the project team was exposed to.

The cross-functional nature of the project team required project members to work across departments – a difficult task in an institution with a silo-based culture where people are accustomed to work vertically within their departments. This challenge, combined with having to cope with normal workloads caused interesting dynamics. As project leader, the researcher observed the following:

- Reactions to the change was individual-based, but often influenced by the culture of a particular department.
- Some middle managers on the team participated superficially, but never committed through action – it is the researcher's view that this occurred because of strong silo-based behaviour by their managers.
- A lack of resources in the Department of Information Technology led to the appointment of a programmer to create the necessary infrastructure required for the virtual campus.
- Some members worked against the initiative by duplicating the infrastructure without informing the team. This behaviour can be interpreted as positive in the sense that it indicated that they had bought into the vision – i.e. web-enablement of services and products. It also created *redundancy*, unfortunately not only of information, but also of systems. A negative interpretation is that they did not experience ownership of the project and resorted back to a silo-based culture because they did not feel comfortable working cross-divisionally.

In terms of the comparison between Japanese-style versus Western-style organisational knowledge creation discussed in Section 2.5.3, characteristics from both styles manifested in the virtual campus project. Table 4.5 illustrates which characteristics manifested.

Japanese style of knowledge creation	Western style of knowledge creation
Group based	Explicit knowledge orientated
Tacit knowledge orientated	Strong on externalisation and combination
Strong on socialisation and internalisation	Emphasis on analysis
Emphasis on experience	Less redundancy of information
Group autonomy	
Creative chaos through overlapping tasks	
Requisite variety through cross-functional teams	
Ambiguous organisational intention	

Table 4.5 Types of organisational knowledge creation in the virtual campus project

The reason why “ambiguous organisational intention” is listed is because the virtual campus as a concept was never propagated by the Vice-Chancellor from any public platform. He supported it in concept, through individual discussions and by giving resources, but it was never driven as a formal strategy of the university. It proved to be a good strategy. The researcher is of the opinion that, had the Vice-Chancellor officially driven the virtual campus, more institutional resistance would have emerged than was the case with the more subversive process.

A direct advantage was that the virtual campus project team made decisions based on their collaborative experience and then proceeded to implement without having to wait for approval by senior or executive management. It contributed to maintaining momentum and fostering motivation because the team felt empowered. This is consistent with Kotter (1995:61) who states that *assembling a group with enough power to lead the change effort* and *empowering others to act on the vision* ; are two success factors in organisational transformation.

The deliberate selection of project team members and academic champions to drive the pilot or lead projects are in line with the recommendation by Duderstadt (2000:268) to “identify key individuals at different levels who will buy into the transformation process and become active agents to drive it”. Furthermore, to focus them on different aspects of the transformation; as discussed in Section 2.7.3.

Table 4.6 shows an application of the innovation management process of Tidd *et al.* (1997:36) in creating the virtual campus.

Basic ability	Contributing routines
Recognising	The signals of virtualisation, lifelong learning, customer focus and globalisation triggered the decision to create a virtual campus.
Aligning	To ensure a good fit with the business model and strategy of the university, the virtual campus was integrated with existing infrastructure and not developed as an add-on fixture.
Acquiring	Owing to limited resources, <i>WebCT</i> was selected by combining forces with two other institutions. Therefore an off-the shelf product was bought instead of developing an in-house developed system.
Generating	The university created the capacity to build the virtual campus architecture in-house, mainly because of the need for a customised interface with legacy systems.

Basic ability	Contributing routines
Choosing	It was decided to initiate the use of <i>WebCT</i> on a postgraduate level, primarily because postgraduates are thought to be more independent learners and possibly have better access to Internet technology than undergraduates because most of them are employed.
Executing	The project team of the virtual campus fulfilled the function of managing the development of products, services and processes from the initial idea through to the final launch.
Implementing	The project leader held numerous information sessions to ensure acceptance and effective use of the virtual campus. Although diffusion has occurred, it is the researcher's opinion that change management, of which marketing is a component, was not adequate.
Learning	The process of evaluating and reflecting upon the innovation process of the virtual campus and identification of lessons for improvement in management routines is a continual process.
Developing the organisation	New structures, processes, procedures and policy have been embedded into the institution.

Table 4.6 Application of innovation management model to virtual campus (adapted from Tidd, *et al.*, 1997:36)

Through the two-year process of working cross divisionally some of the project team members acquired *generic knowledge*, i.e. knowledge about change (Section 2.7.3). The team brought together talent and views from across the organisation, while at the same time moving outside their silos. The experience equipped them to better understand and deal with change.

The tasks were assembled during the first two months with the responsibilities listed below each department. Many of the tasks required cross-functional activity. The deliverables (tasks and outcomes) were first drafted by the project leader and then discussed and negotiated with team members. The documentation is original and has not been altered since 1998 in terms of content, but only in terms of format for the purpose of this study. Standing items on the agenda of the project team are also included as non-technical data (framed). A ✓ or x is shown next to deliverables/tasks to indicate success or failure (Annexure C).

Section 4.5 describes the architecture of the virtual campus.

4.5 Virtual campus architecture (process innovation)

The Information Technology members had the task of creating the required infrastructure to support the virtual campus. This entailed an adequate network backbone and secure access to the virtual campus from anywhere in the world. Furthermore, additional infrastructure had to be created on campus to improve accessibility. The department had to take responsibility for the hardware (servers) of the virtual campus and the abovementioned infrastructure. A critical responsibility was to integrate processes across departments – specifically the library (Academic Information Services), Academic Administration and Finance to ensure that students have seamless access to relevant information and to transactions. An important task was to assist Finance to identify correct protocol for e-commerce (credit card payment on the Internet) transactions.

In 1998 two facilities (*PC Anywhere* and *Netblazer*) were available for especially support staff to access the mainframe and e-mail from home. The project manager of the IT component of the project team initiated a subproject to investigate the possibility of a better solution. A contract for dial-up facilities from home (*Icon*) was signed in May 1999 and implemented. The Internet Service Provider (ISP), *Internet Solutions* remains the contractor to date.

The virtual campus server was implemented in December 1998 and *WebCT*, the selected web-based teaching and learning solution described in Section 4.10 was installed.

In February 1999 a dedicated programmer was appointed on contract to develop the interface between *WebCT*, Student Administration, Student Accounts and Academic Administration and Academic Information Services. The virtual campus architecture is illustrated in Diagrams 4.1 – 4.4. In effect the virtual campus architecture provides the functionalities of an *ERP* system by means of integration on the front-end. In other words, a portal architecture was created that provide integrated access to personalised information and secure transactions via the web.

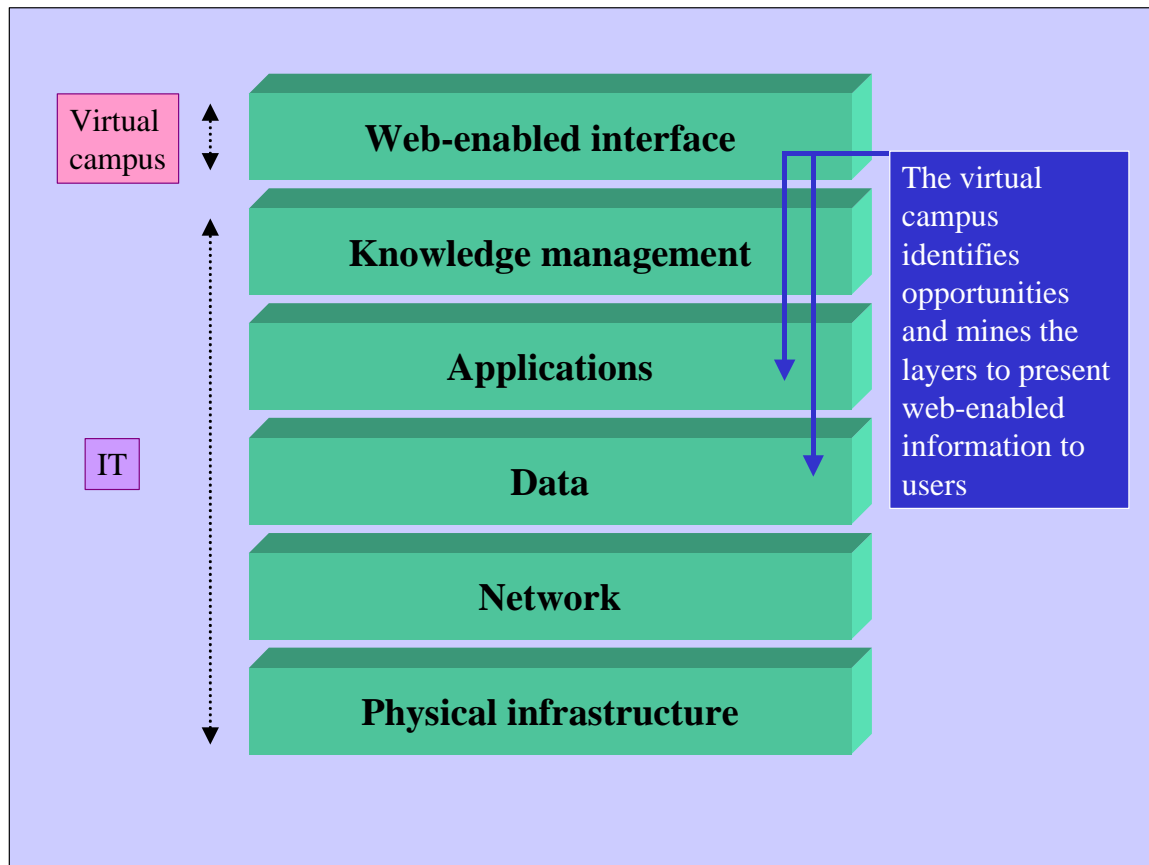


Diagram 4.1 Illustration how the virtual campus provides a view of data otherwise not accessible

This diagram illustrates how the virtual campus provides a view of data otherwise not accessible to customers. This relates specifically to student administration and student accounts on the mainframe; *WebCT* course access and access to information sources on various databases.

What is important to note is that the virtual campus architecture was not a duplication of infrastructure, but merely integrated distributed data to provide a seamless client interface for lecturers and especially students.

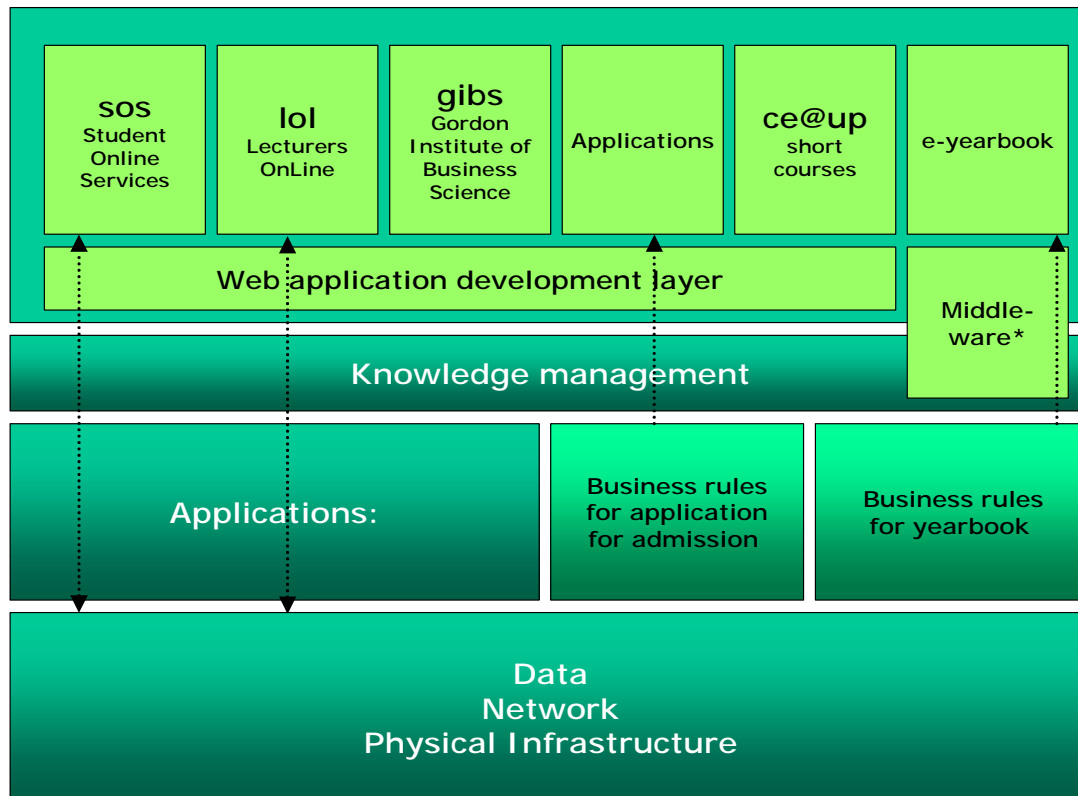


Diagram 4.2 Service applications of the virtual campus

The top layer of the diagram shows the service applications of the virtual campus. *WebCT* was also implemented at the Gordon Institute of Business Science, an affiliate of the university, and at [CE@UP](#) - Continuing Education at the University of Pretoria.

The virtual campus architecture is based on a data warehouse concept in the sense that it mines data from various databases and makes it accessible to users via the web. This is made possible through a *MySQL* database. The virtual campus server runs on Linux as the operating system.

A recent addition to assist with writing back to the *Natural Adabas* databases on the mainframe is middleware, called *Broker*. It is possible to use the system, which runs on an *NT* server, to execute queries initiated from a web page by proxy through the main database engine and return web-formatted results to the user.

The following section will demonstrate the portals that have been created as part of the virtual campus.

The architecture of the web application development domain

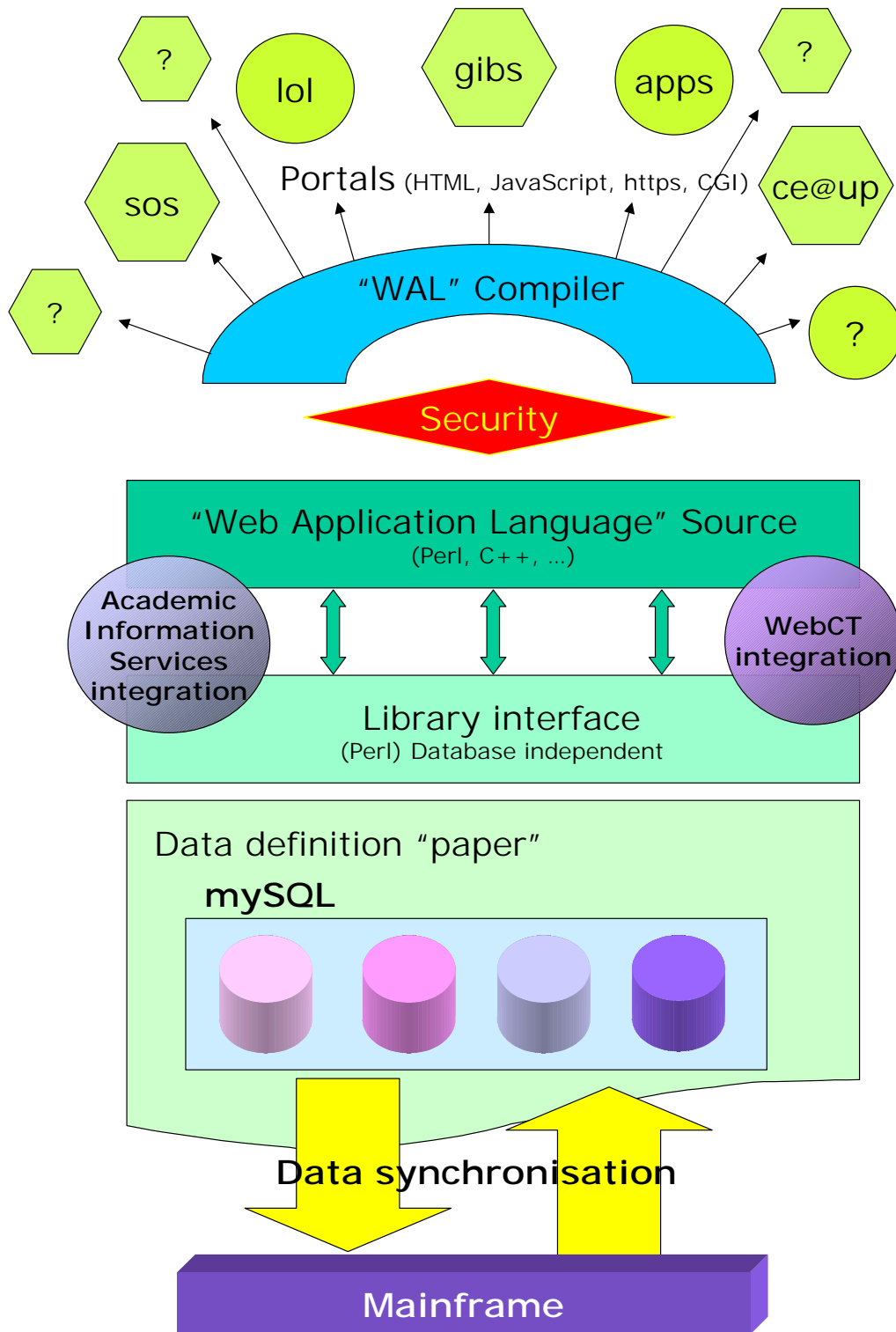
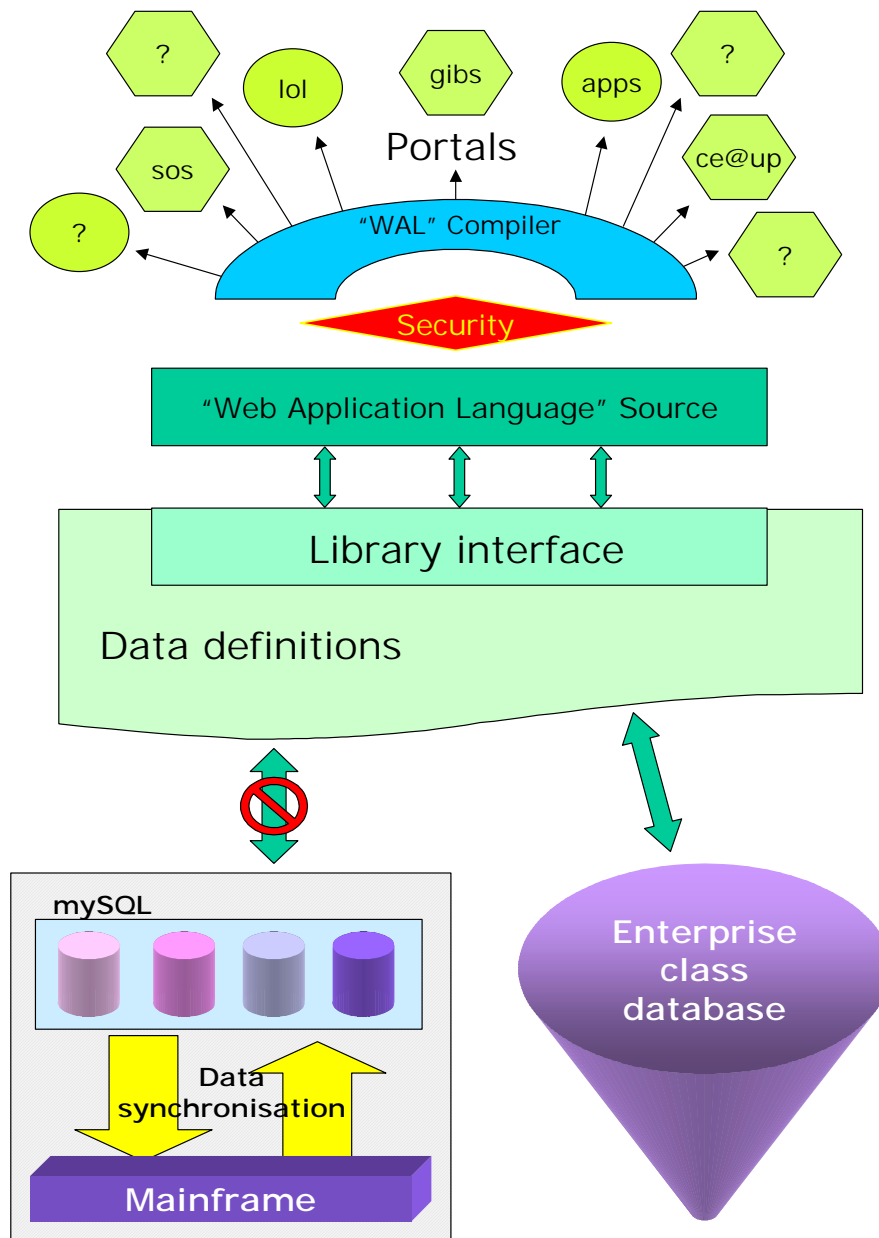


Diagram 4.3: How the Web application development domain functions

Diagram 4.3 shows how the diverse components work together to web-enable enterprise transactions. The virtual campus component runs on a set of Unix servers, using *SQL* database technology, married with *CGI* and *Perl* scripts providing web ready output. The

system receives daily updates from the repository on the mainframe and supplies student results and payment details in return. The different portals aim to give users universal access points to the full variety of services the enterprise supports. This meets the requirement of an Open Data Base Connectivity (*ODBC*) architecture.

The system's development has been highly cost effective, since open source techniques were used and almost no licensing fees had to be paid to any party for any of the software. The portability of the system is assured by its usage of standard web technologies, i.e. *Perl* and generated *HTML*. In terms of function, the usage patterns show the way, since almost all students at the university have at one or other time used it. The fact that a single programmer did all the work in a span of less than one year is evidence of rapid, cost-effective deployment. A detailed diagram of the virtual campus architecture is provided in Annexure D.



No change in functionality, no need to recode anything

Diagram 4.4 Data mining procedure

The above example shows the wisdom of having chosen a solution that meets the classical criteria for information technology deployment; i.e. cost effectiveness, functionality, rapid rate of deployment and portability. It also happens to meet the stated requirements of a solution proposed by an IBM report (IBM, 2000), since the present problem with data duplication will be eliminated by improved data-warehousing techniques.

In terms of information technology, emphasis has always been placed on the ability to maintain continuity with existing systems, while at the same time keeping open several possibilities of action. The advantage this brings becomes clearly evident when one studies recommendations made by IBM in 2000 (IBM, 2000). The list of recommendations follows:

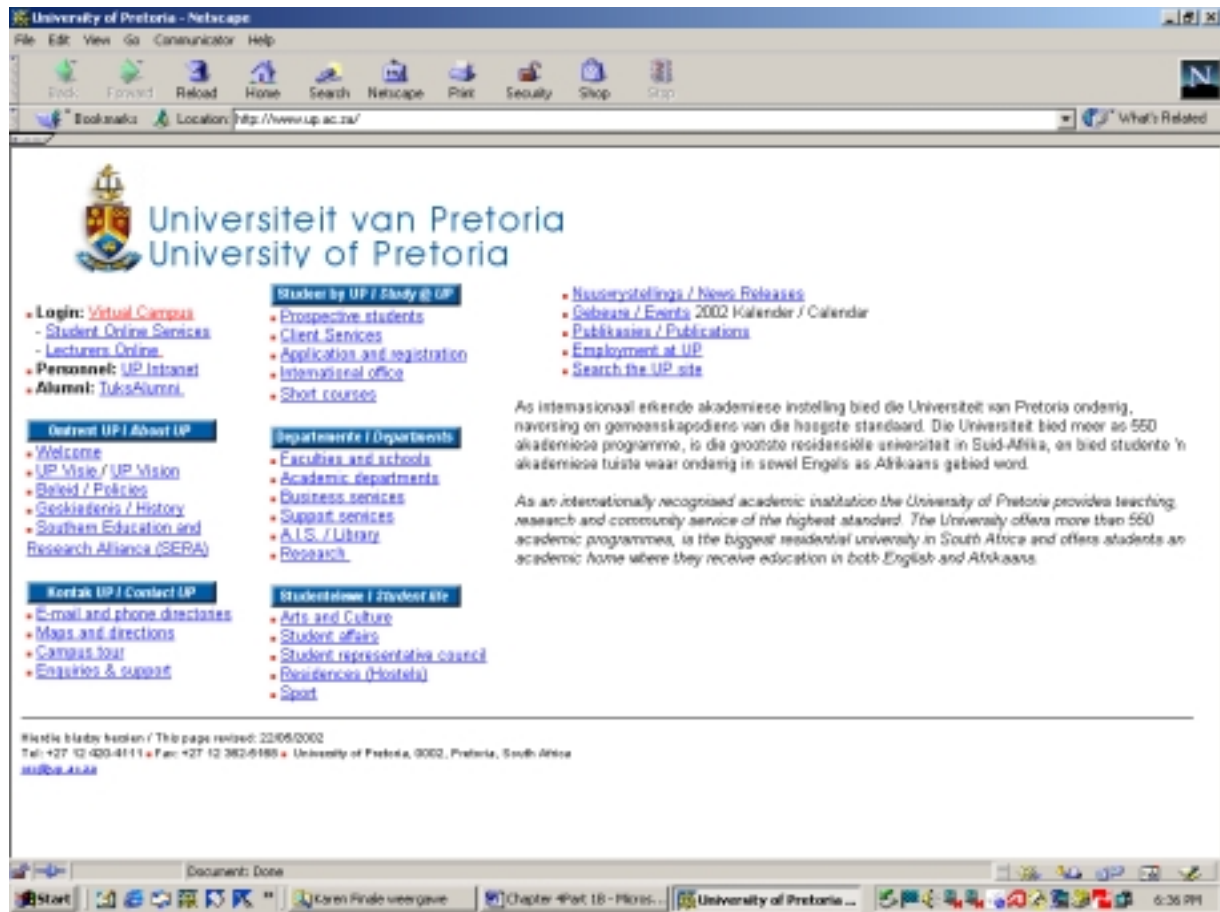
- Move towards an open architecture and open standards
- One primary logical database
- Data must be captured once only
- Asynchronous transaction completion must be possible
- Applications should separate business logic, presentation and data

Some of the key findings of the report are as follows:

- Internet enabled systems and solutions are required & evolve rapidly
 - New access channels such as kiosks and handheld devices soon to be supported
 - Network computers / Thin clients
 - Rapid growth in telematic education and the virtual campus concept
- There is a need for data warehousing, data marts and business intelligence

The virtual campus web site serves as a universal access point for both students and personnel. As envisaged, its role will expand to include the full student life cycle. Unfortunately the scope of this study does not allow the inclusion of the Client Service Centre, which has evolved from the virtual campus – covering a wider range of services to students via multimedia contact channels.

Screen capture 4.1 illustrates the current access point to the virtual campus on the home page of the University of Pretoria.



Screen capture 4.1 Login to the virtual campus on the home page of the University of Pretoria

The virtual campus was marketed to staff by means of numerous presentations and information sessions. A formal launch was held on 21 October 1999, with guests ranging from the Mayor of Pretoria to Vice-Chancellors of Universities and Technikons in South Africa. However, the researcher is of the opinion that more marketing was required – especially among students. Very little was done in terms of marketing to primary user groups.

The design and development of all components of the virtual campus was complete by September 1999, consisting of the following products and services:

4.6 Student Online Services (service innovation)

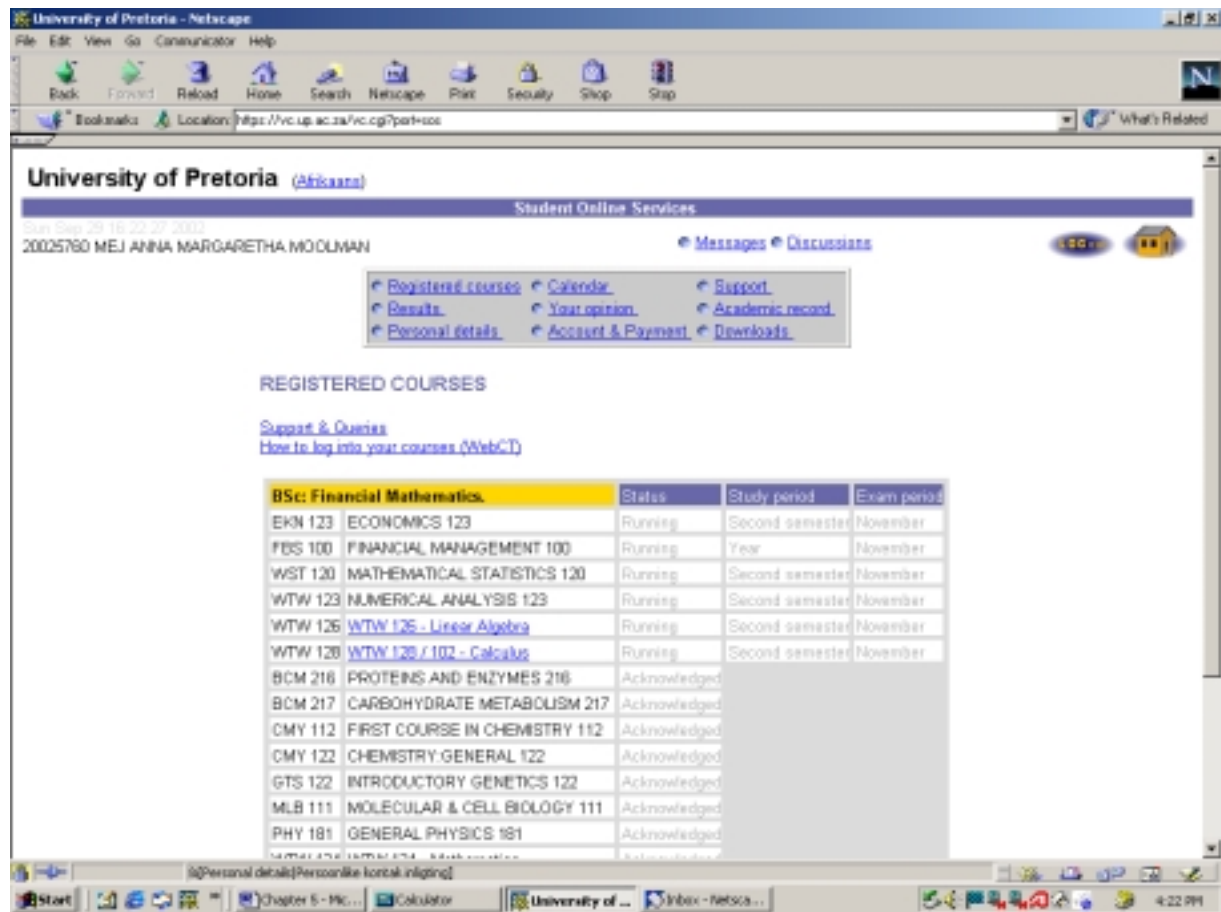
A web portal for all registered students at the university was developed where they have secure access to their unique profile regarding the following aspects:

- Courses
- Exam results
- Academic records
- Rosters
- Account statements
- Credit card payment facility
- Biographical information

This portal allows any registered student at the university to log into the system and commence with supported transactions.

In terms of CRM, Student Online Services has given students great flexibility in terms of place and time of accessing relevant information and doing transactions. The institutional benefit is that administration person-hours are reduced significantly because students self-service.

Screen capture 4.2 illustrates Student Online Services. Web-enabled courses in *WebCT* are hyper-linked for easy access, as in the cases of WTW 126 and WTW 128 in the illustration.



Screen capture 4.2 Student Online Services

The development process followed the knowledge creation steps provided by Nonaka and Takeuchi (1995:84), also illustrated in Figure 4.3.

The new concept of a virtual campus that will provide seamless access to information and transactions fits the step of *create new concepts*. *Justification* of the concept occurred by means of continuous presentations and discussions – the latter mostly held during project team meetings. This phase assisted with diffusion of the new idea by building awareness, understanding and in some instances, commitment. A *prototype* was developed, based on numerous conversations and workshops with various process owners. The prototype was implemented and activated without pilot testing the services. Supporting these new processes, products and services led to sharing of tacit knowledge as cross-divisional teams worked together in a new environment. *Knowledge management* resulted through *cross-leveilling of knowledge* – i.e. making new knowledge gained by experience (tacit knowledge) flow by *sharing tacit knowledge*.

Market adoption took place without resistance – probably because of a captured market requiring access to the particular products and services. Another possible factor is the ease of use of Student Online Services. The system is user-friendly, which is a contributing factor

to successful adoption as discussed in Section 2.6.2 (Davis, 1989, Rogers, 1995) and Section 2.6.7 (Collis, *et al.*, 2000).

STUDENT ONLINE SERVICES

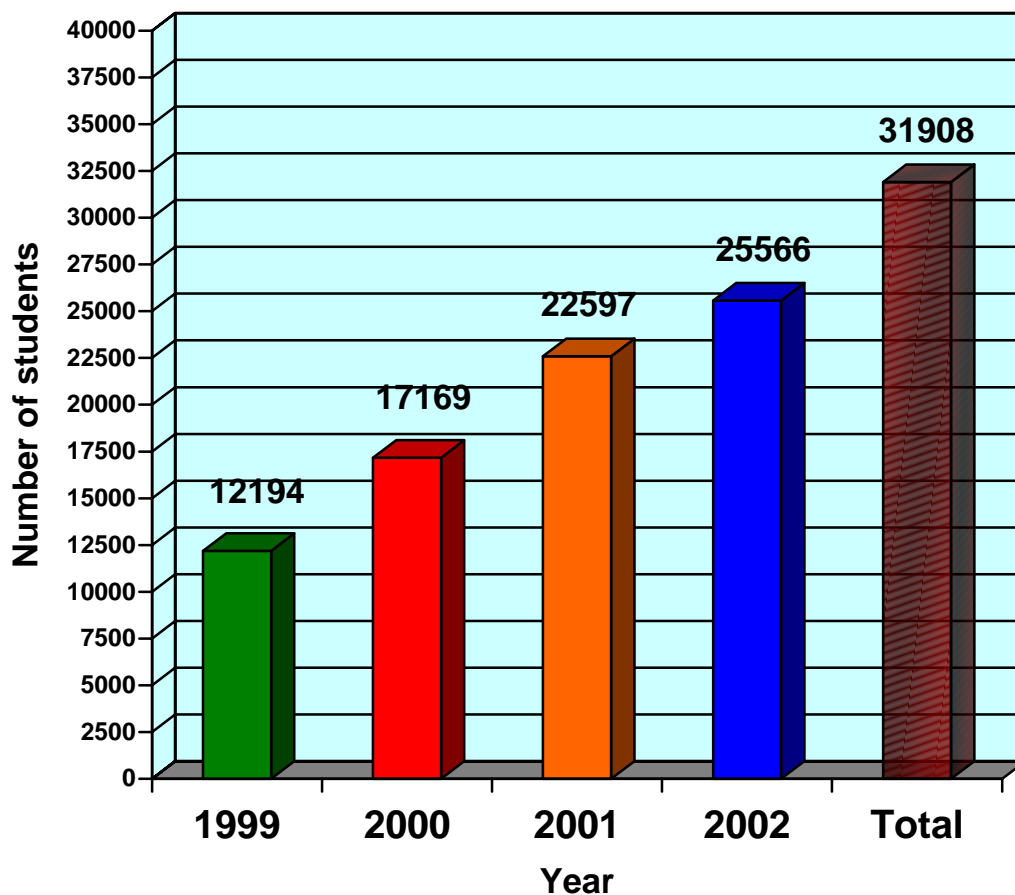


Figure 4.4 Student Online Services – total unique student users to date

Figure 4.4 shows the classic 'S'-curve which will probably reach a saturation point as the majority of students (captured market) use it. Yet an increase in the use of the system will depend on added functionality. Almost four years have passed without making major adjustments to the system. New functionality will be required to remain innovative. The total of 31908 students refers to individual students who have accessed the system. A cumulative total would be inaccurate because the same users access the system until they graduate.

Section 4.7 describes Lecturers Online as a service innovation.

4.7 Lecturers Online (service innovation)

Lecturers Online is a web interface for all lecturers to view student information and manipulate class lists. It is linked to *WebCT* but is also available for lecturers who do not use *WebCT*. The initial specification was that lecturers would be able to upload student marks to the mainframe system via this interface. This effort never succeeded for two reasons. A duplicate system with more functionality was released a year later by Academic Administration. The additional functionality was possible because they are the owners of the student administration data. Unfortunately the new system was not linked to *WebCT*, because the particular developers did not collaborate with the project team stakeholders. The two systems created confusion among web lecturers and impacted negatively on the diffusion of Lecturers Online. Both Lecturers Online and Student Online Services receive data from the mainframe and Student Online Services also updates data on the mainframe. Screen capture 4.3 is an example of a class list. Each student name has an active link to student specific information.

The screenshot shows the 'Lecturers Online' web interface in a Netscape browser window. The page title is 'University of Pretoria - Lecturers Online'. The user is logged in as 'MEVLMOSTERT'. The interface includes a navigation menu with links for 'My info', 'Messages', 'Calendar', 'WebCT', and 'Help'. There are also icons for 'LDS' and a home button. A 'Modules' dropdown menu is set to 'WTW 158', with a 'Go' button. A 'Students' section contains a search box. Below this, the 'CLASS LIST for WTW 158' is displayed for the '1st Semester 2002'. A table lists student records with columns for Number, Title, Initials, Surname, Email, and Status. Each row includes a small icon and a link to the student's profile.

Number	Title	Initials	Surname	Email	Status
20124041	MWR	F	WELTHAGEN	wf@up.ac.za	Inactive
20020118	MWR	FB	MARGIS	mamarg@up.ac.za	Inactive
20020200	MWR	FOGH	COETZEE		Inactive
20118074	MWJ	L	BEZUIDENHOUT	beza7@up.ac.za	Inactive
20022209	MWR	PW	DMART	eddm@up.ac.za	Inactive
20009720	MR	M	FABER	mfab@up.ac.za	Inactive
20030111	MRS	NAA	DIKANGA	nadik@up.ac.za	Inactive
20044100	MWR	A	DE WAAL	adewa@up.ac.za	Inactive
20082111	MWR	OP	VAN ZYL		Inactive
20041022	MWJ	L	BODDYSON	lboddy@up.ac.za	Inactive
20080008	MR	SJ	FOORTMAN	sjfoort@up.ac.za	Inactive
20000071	MWR	WS	BURGER	wsbu@up.ac.za	Inactive
21118008	MR	S	SUNTHEN	sunthe@up.ac.za	Inactive
21100014	MWR	B	REYERS	br@up.ac.za	Inactive

Screen capture 4.3 Lecturers Online

LECTURERS ONLINE

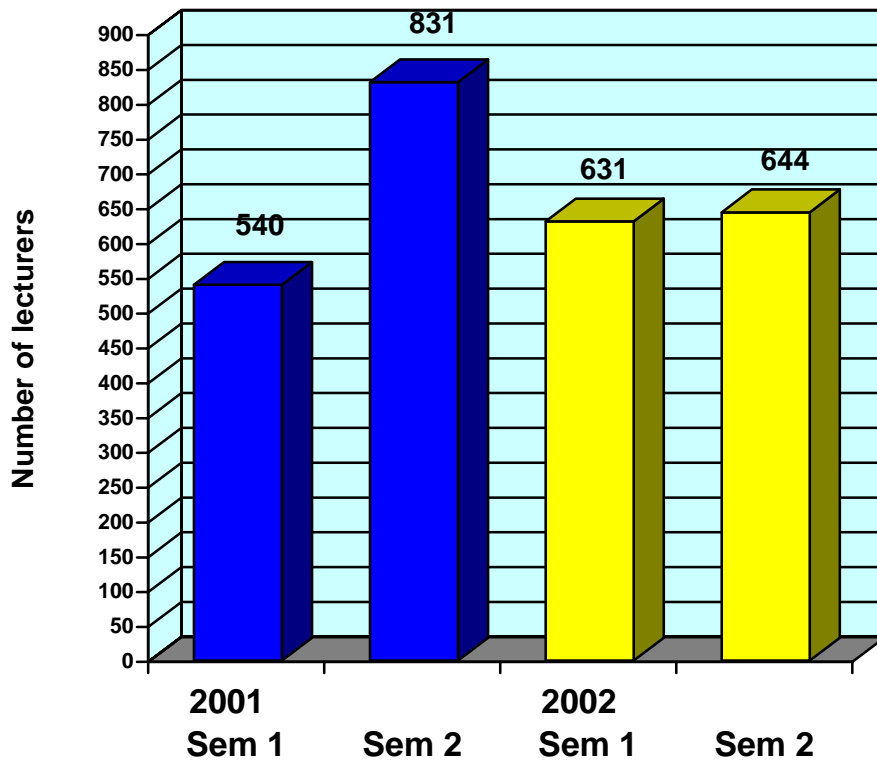


Figure 4.5 Usage of Lecturers Online

Figure 4.5 shows a slow adoption rate of Lecturers Online, which could be attributed to a duplicate system (that causes confusion) and a lack of marketing.

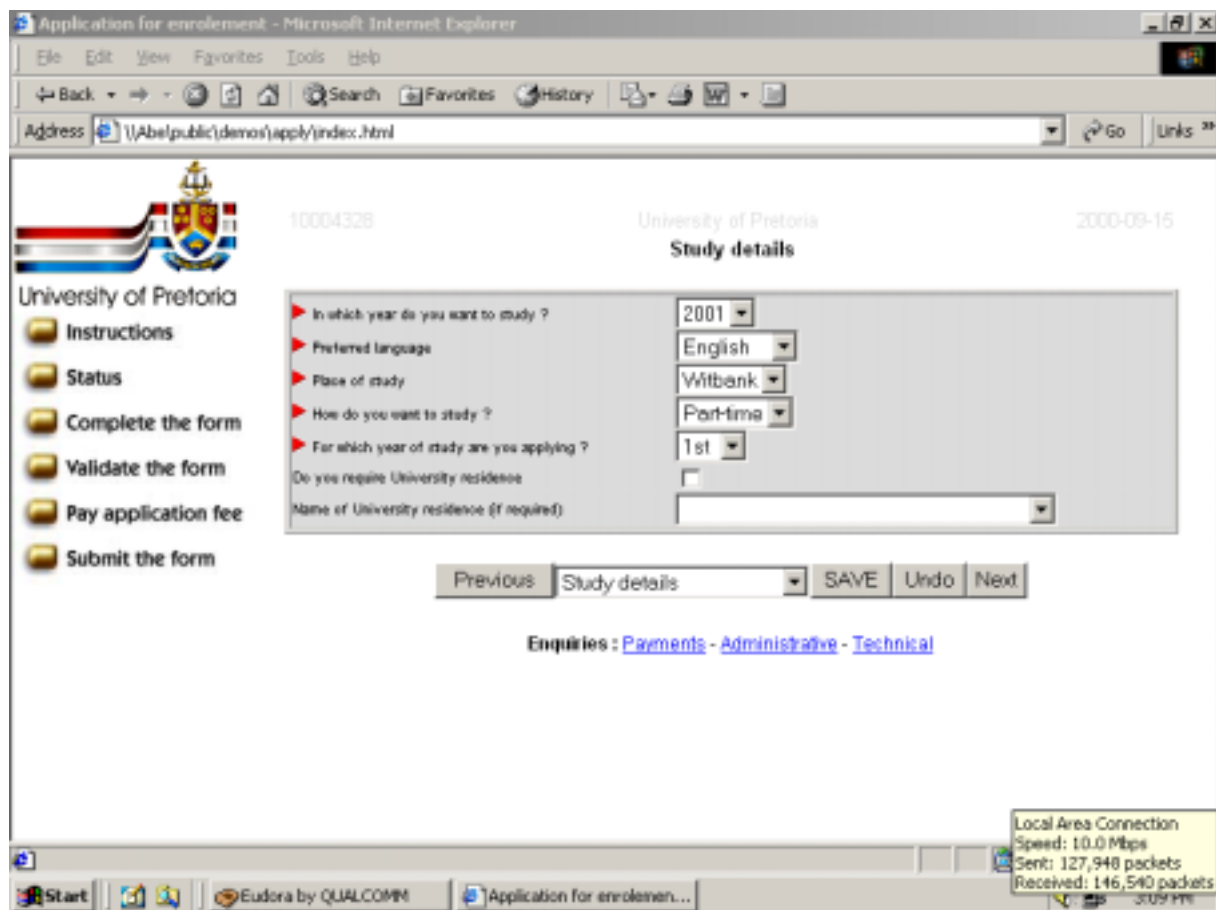
Section 4.8 describes the web-based application system as a service innovation.

4.8 Web-based application system (service and process innovation)

The main task of Academic Administration was to integrate the student administration database on the mainframe with the virtual campus so that students can access their profiles via the web. It included the development of a more sophisticated yearbook and degree audit as well as registration via the web.

An analysis that continued over a year pointed to the difficulty of developing a web-based registration system. The main constraint is that business rules in faculties are complex and change – requiring sophisticated expert systems to web enable this service. The *application for admission* business process proved to be simple enough to be coded. Consequently, an

interactive web-based application system was developed. In the past, students had to complete a hard copy and either post it to the university along with a cheque payment or had to physically go to the campus to hand in the application form. The constraints of such processes for employed and international students are obvious. Academic Administration was closely involved in providing the business requirements of the new system. It now constitutes 10% of applications received by the university.



Screen capture 4.4 Application for admission system

Students can apply online for admission via the web-based application system. It is not simply a form, but a dynamic system that verifies compulsory fields, linked to the online payment system. The design of the system, however, is outdated and needs to become more intuitive. Another limitation is that it was never integrated at the 'back-end' with the mainframe, because Academic Administration felt that student data belong to them. This kind of silo-based thinking has jeopardised the quality of new services.

ONLINE APPLICATIONS

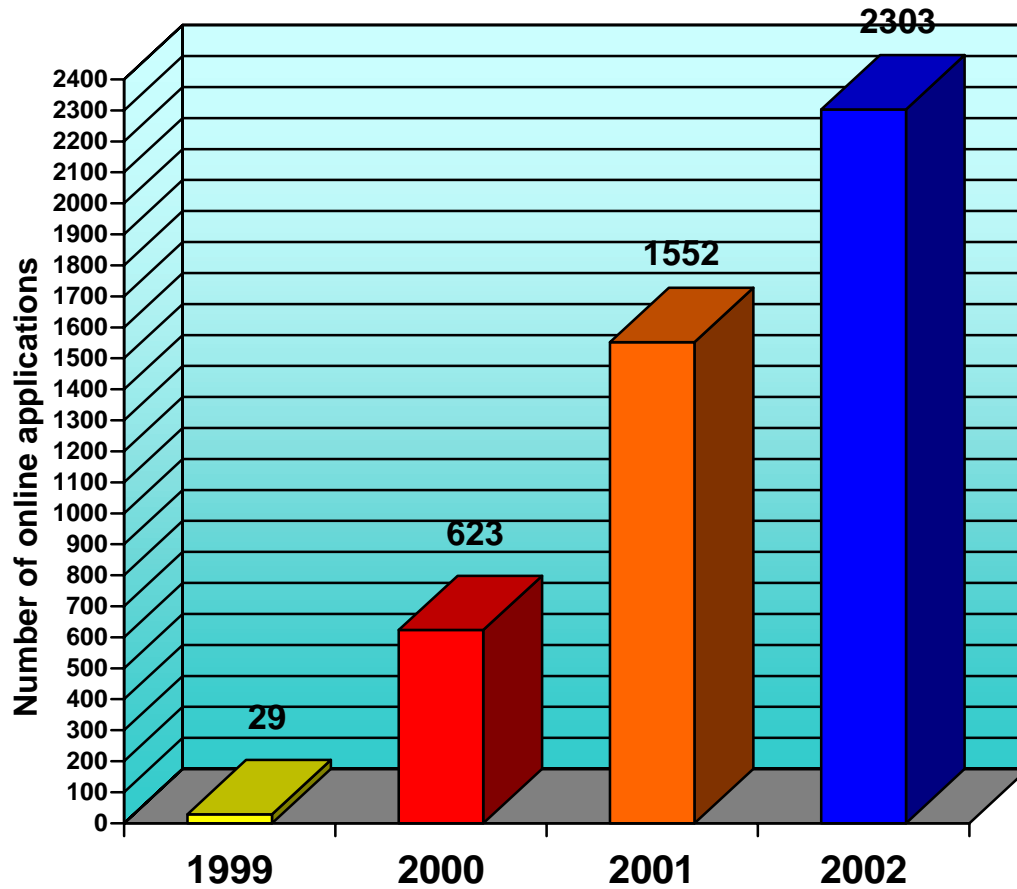


Figure 4.6 Web-based applications

Figure 4.6 shows an exponential growth rate – resembling the ‘S’-curve. As mentioned before, it constitutes 10% of applications received by the university. If the system goes down during an application, it saves the transaction so that the user can resume where he or she left off.

Figure 4.7 depicts the new process that was created to support the service innovation.

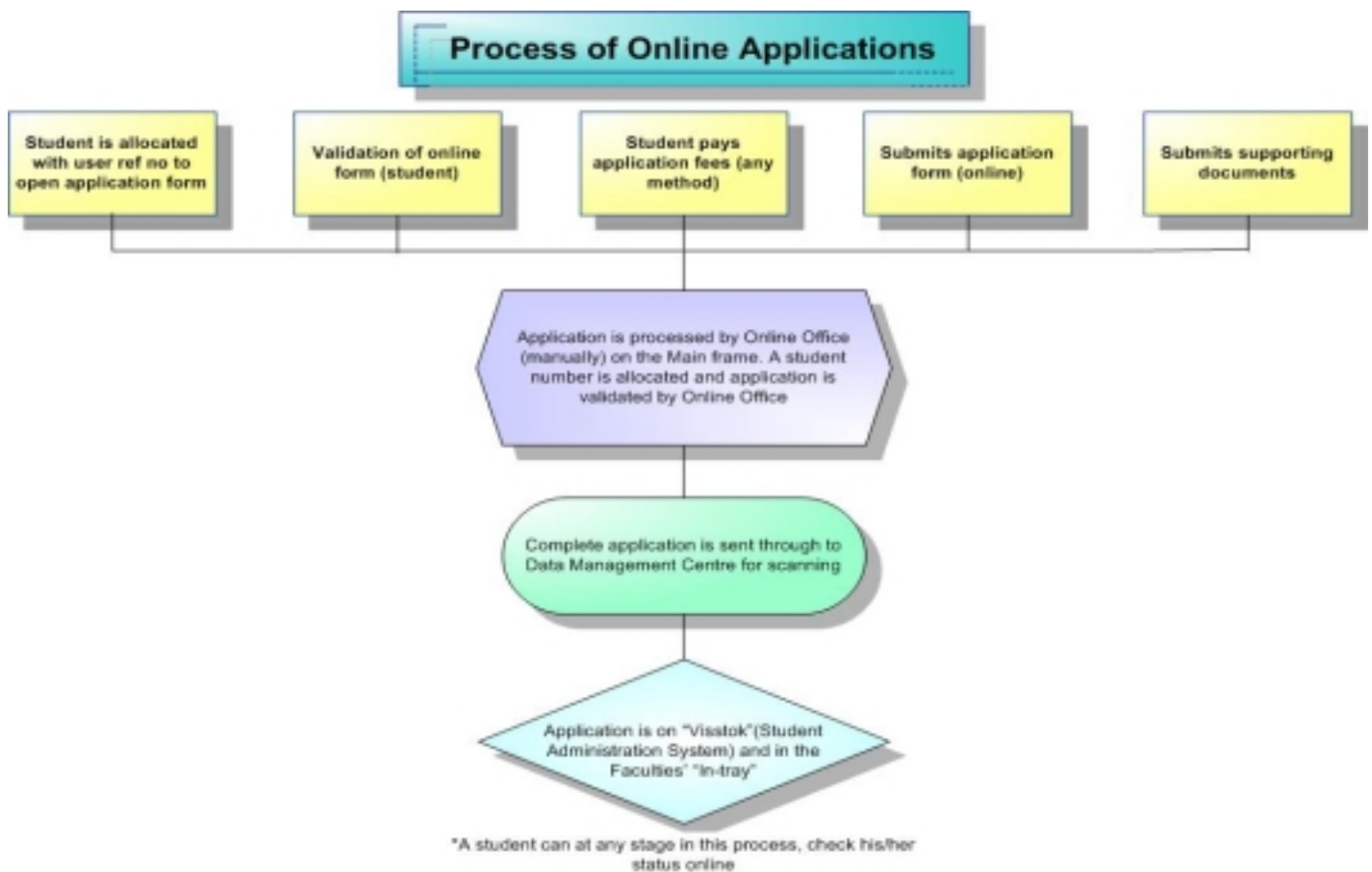


Figure 4.7 Web-based application process

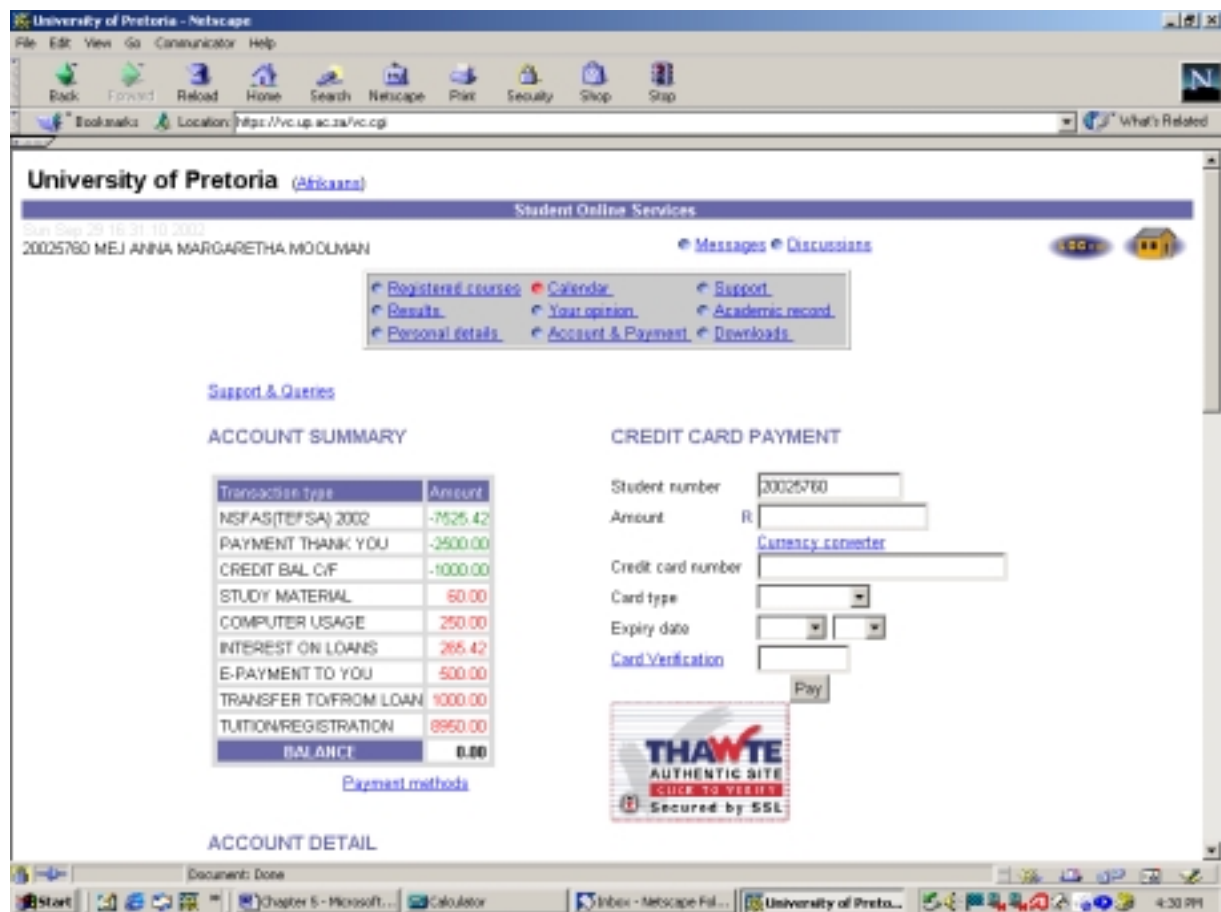
The central admissions office was decentralised in 2002 so that Faculties take responsibility for admissions. Hence, the online application process feeds into another process whereby all applications are scanned centrally by the Data Management Centre and are then made accessible to Faculties to proceed with the admissions process. A time lag is often experienced when payment is outstanding or when additional information is required from the student before the application form may be scanned, such as proof of identification. These outstanding documents are normally faxed to the Online Applications officer.

Section 4.9 discusses the web-based credit card payment system.

4.9 Web-based credit card payment (service and process innovation)

The web-based credit card system has been a successful service innovation. A decision was made to outsource the functionality to an e-commerce company. The university has moved to a different e-commerce company than the particular company used at the launch of the service. Fortunately the transition was seamless enough and did no harm the adoption rate. The Finance Department - specifically Student Accounts - was responsible to investigate, evaluate and implement online banking, investigate how tuition fees for online courses should be structured and to integrate student accounts with the virtual campus.

An extensive process was followed to provide specifications to banking institutions and to select the best e-commerce company. Although students could conduct Internet banking at the time, i.e. pay an amount into a bank account of the university over the Internet, the new service immediately confirms payment and allows the student to proceed with transactions or of accessing information and services.



Screen capture 4.5 Credit card payment

ONLINE PAYMENTS PER YEAR

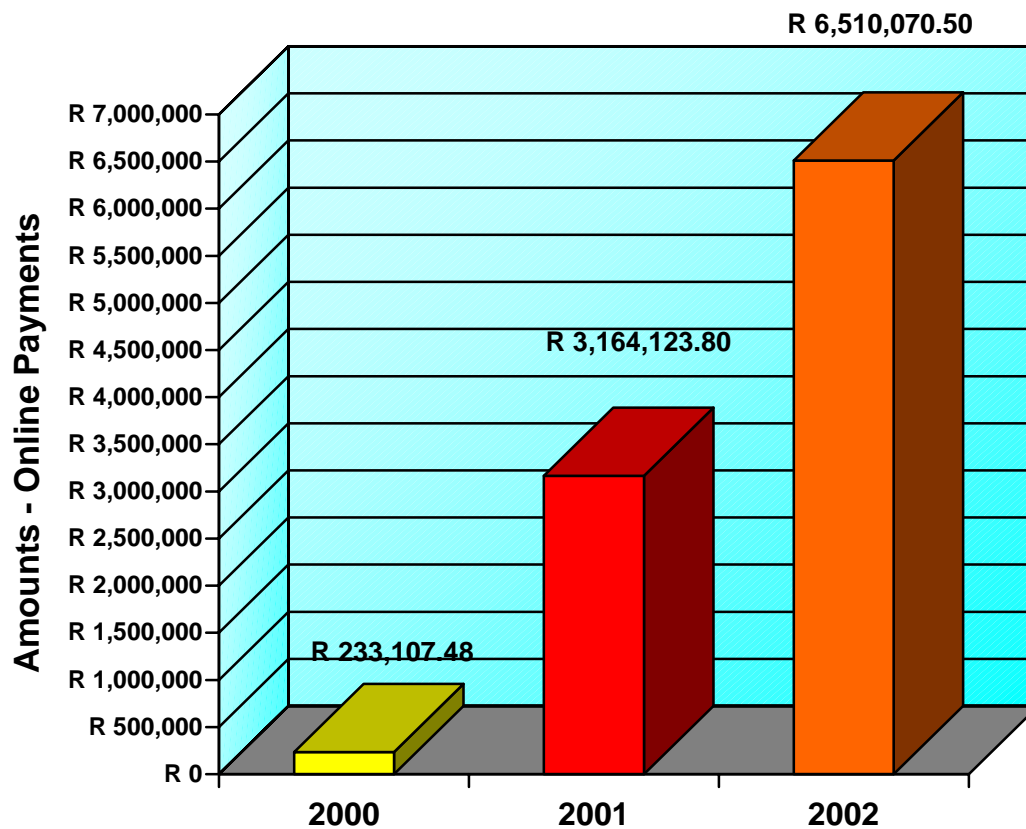


Figure 4.8 Web-based payments

Figure 4.8 shows a tremendous growth in web-based credit card payment. It is encouraging to see this trend because it means that clients (students and parents) find it an easy and fast service to use. The benefit of the payment functionality in Student Online Services is that there is contingency – the debit amount is shown and can be credited immediately without having to wait for an account statement in the post. Setcom is the e-commerce service provider that the University uses.

Figure 4.9 illustrates the process that supports web-based credit card payment.

Process of Online payment via Setcom

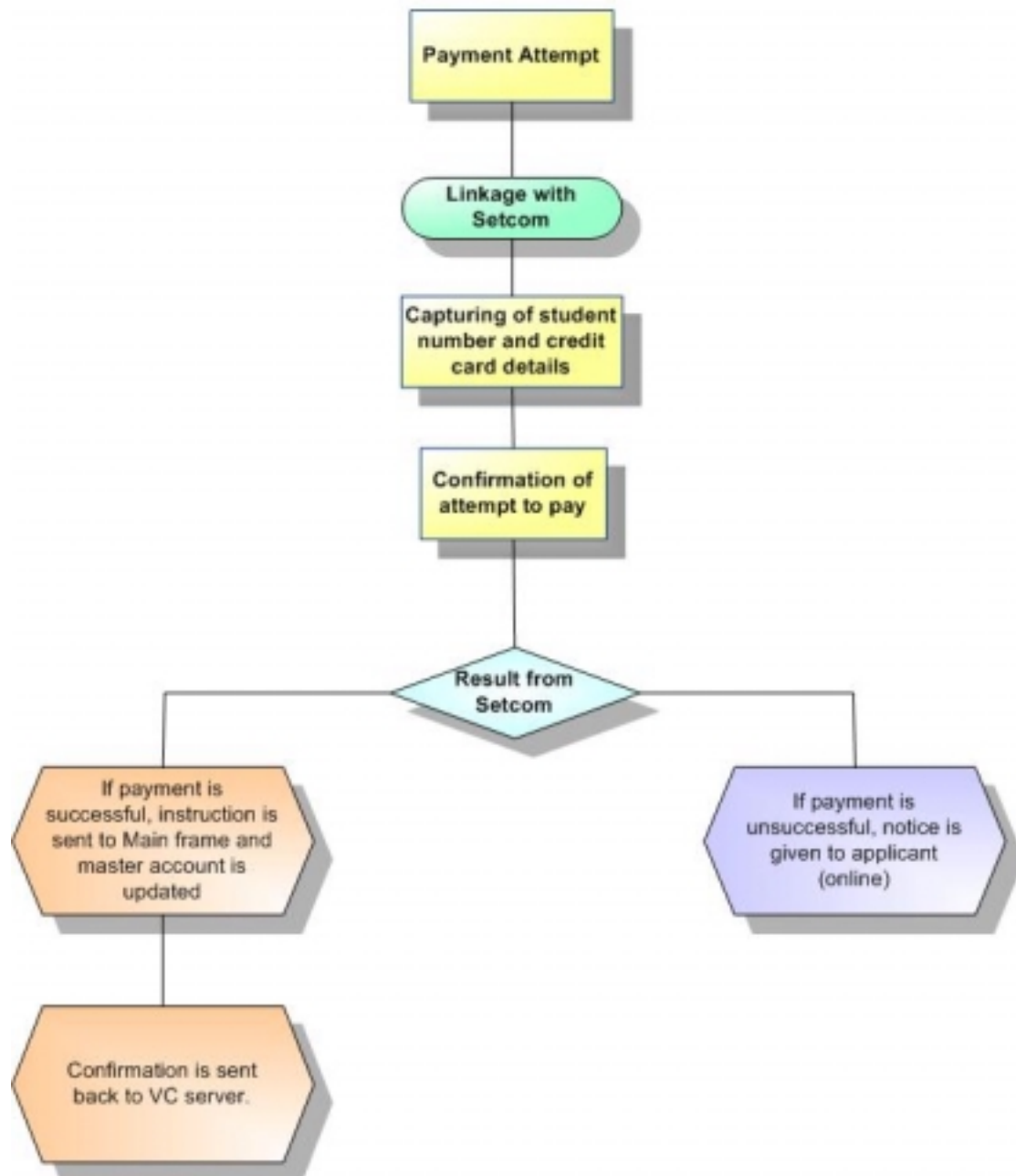


Figure 4.9 Web-based credit card payment process

4.10 Web-supported courses (product and process innovation)

A decision was made to choose a pilot project in terms of a web course management solution. The reason was to follow an incremental technology innovation strategy (Tidd *et al.*, 1997:58-63), discussed in Section 2.6.9 and to gain a short term win (Kotter, 1995:61) discussed in Section 2.5.

4.10.1 Collaboration with other universities

From the onset, the aim was to create an integrated virtual campus. Therefore the new web-based course management solution had to interface with the existing student administration and student accounts systems of the university. At the time, the university, the University of Potchefstroom and the University of Stellenbosch, used a shared system called Unikom. Consequently, workshops were held with the universities to create shared infrastructure. The workshops revealed that shared infrastructure regarding online application, registration and student accounts would prove too complex. It was subsequently decided to join forces to select an appropriate web-based teaching/learning management system. At the time, all three universities were in the process of investigating such solutions. Cross - institutional project teams were constituted with the researcher as the project leader of the team responsible to evaluate and select a web-based course management solution.

4.10.2 Selection of Web course management system

A panel representative of all three universities was involved in determining how the appropriate system will be evaluated. It was agreed that the instrument containing the specifications would be used by a smaller group to accomplish an initial elimination of systems that do not meet with the specifications. Remaining systems would be further tested by a questionnaire that had to be completed by the relevant company/supplier, upon which piloting would take place (evaluation copy implemented and tested). The list of solutions that were evaluated is as follows:

Lotus Learning Space, SERF, WebCT, TopClass, Librarian, Online Learning, Personal Learning System and Course info (Blackboard).

A rigorous evaluation process was used and additional team members were co-opted, for example the student representative body and certain lecturers were included at the University of Pretoria.

4.10.3 Evaluation criteria

A list of criteria, including functional and strategic considerations was drawn up, after which weights were attached to each section. A core team consisting of IT and telematic staff from the three institutions spent four weeks evaluating three solutions at the respective institutions. The main elements of the criteria are provided in Table 4.7.

Criteria	Sub criteria
Learning- and learner centeredness	Intuitive user interface (easy to use); Functional navigation (simple and effective); Off-line facility Easy communication (student-lecturer; student-student en group communication); Evaluation (monitor own progress) Constructivist elements / learner control
Lecturer-friendliness (user friendliness)	Intuitive user interface (easy to use); Use standard, familiar tools for development; Support flexibility in terms of instructional design; Text in user interface adaptable concerning language / terminology; Easy communication (lecturer-student; lecturer-group communication); Limited support to lecturer / developer in terms of maintenance and delivery of programmes / course units; Relative easy / simple micro-administration (grouping of students, moderation of chat forums, assignments, administration of marks);
Conform to IMS/certification by IMS (medium-term potential)	Possible exchangeability / re-usability of learning objectives; Protection of investment in development.
Integration with local information architecture	Transparent integration with student administration system Transparency of electronic communication Adjustable functionality
Affordability	Client software should be affordable Cost effective support of total environment necessary License prerequisites Student license Centre license Support costs
Supplier	
Software engineering	

Table 4.7 Criteria used for comparative evaluation of Web-based course management solutions

Each category and criteria was weighted by means of an instrument according to strategic importance and the respective institutions evaluated the solutions according to this instrument. The comparative evaluation resulted in a process of elimination illustrated in Table 4.8.

Process of elimination by applying the evaluation criteria:	
Successful	Unsuccessful
<i>Course info (Blackboard) (install and test)</i>	<i>Lotus Learning Space</i>
<i>WebCT (install and test)</i>	<i>Librarian</i>
<i>Online Learning (investigate)</i>	<i>Personal Learning System</i>
	<i>Manager's Edge</i>
	<i>Oracle Learning Architecture</i>
	<i>TopClass</i>
	<i>SERF</i>

Table 4.8 Selecting the top three Web course management solutions

WebCT scored the highest in all three evaluations, primarily due to price effectiveness and robustness.

On 17 November 1998 *WebCT* was recommended to the Directors of IT and Telematic Education at the three institutions and *WebCT* version 3 was installed at the University of Pretoria in December 1998.

The University of Stellenbosch and University of Pretoria implemented *WebCT*, whereas Potchefstroom University decided to develop their own system, called *Varsity*.

WebCT is used by 2654 institutions worldwide (*WebCT*, 2002).

Since the implementation, many other higher education institutions have implemented *WebCT* and it has become the dominant design in South Africa. This has resulted in new knowledge creation in the field of e-learning in South Africa. A *WebCT* forum with 120 delegates was held in September 2002 at University of Pretoria in order to share experience. The University of Pretoria migrated to *WebCT* version 3.1 in 2000 and plan to migrate to *WebCT* version 3.8 in 2003. The continued use of *WebCT* at the University of Pretoria will be reconsidered in three years' time. Table 4.9 shows the current number of *WebCT* courses of each institution. A request about the number of *WebCT* courses was sent to

individuals responsible for e-learning at various institutions that appear on the South African *WebCT* database (held by the local suppliers – Lighthouse Digital).

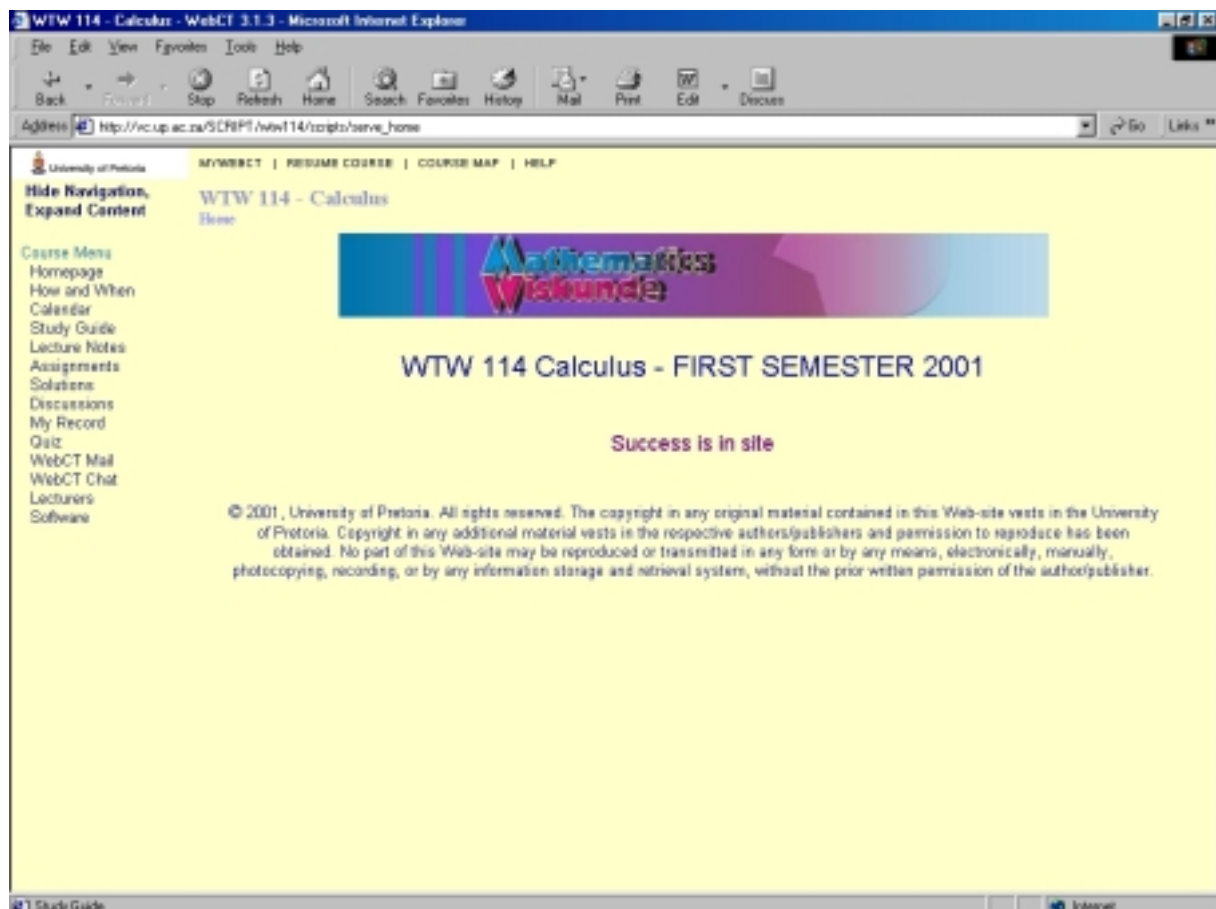
List of higher education institutions using <i>WebCT</i>:	
Institution	Number of <i>WebCT</i> courses
Natal Technikon	27
Free State Technikon	41
Cape Technikon	developing 74 courses – no active courses
Pretoria Technikon	1749 courses – unknown how many are active
Rand Afrikaans University	310
Cape Town University	130
Stellenbosch University	534
University Orange Free State	75
University of Zululand	112
University of the North	1
University of Natal	200
University of Pretoria	509

Table 4.9 Diffusion of *WebCT* in South Africa

The table is not necessarily complete as it reflects only cases where a particular institution responded to the researcher.

WebCT was integrated with enterprise systems. It was a deliberate strategy to provide students with integrated access to learning and administrative products and services. As a *knowledge management* strategy it has proven to be successful in giving customers (students) access to information and knowledge at their convenience. It also assists management and preservation of the University's Intellectual Capital. Lecturing notes and materials are normally not available in digital format or in hard copy. This causes a lack of continuity if a lecturer resigns and leads to the loss of knowledge. The fact that the study guide, assignments, evaluation policy, references and often content are available in *WebCT* makes it a depository of Intellectual Property.

The following screen captures illustrate two of the university's web-based mathematics courses that have been functional for longer than two years.



Screen capture 4.6 Calculus course (WTW 114)

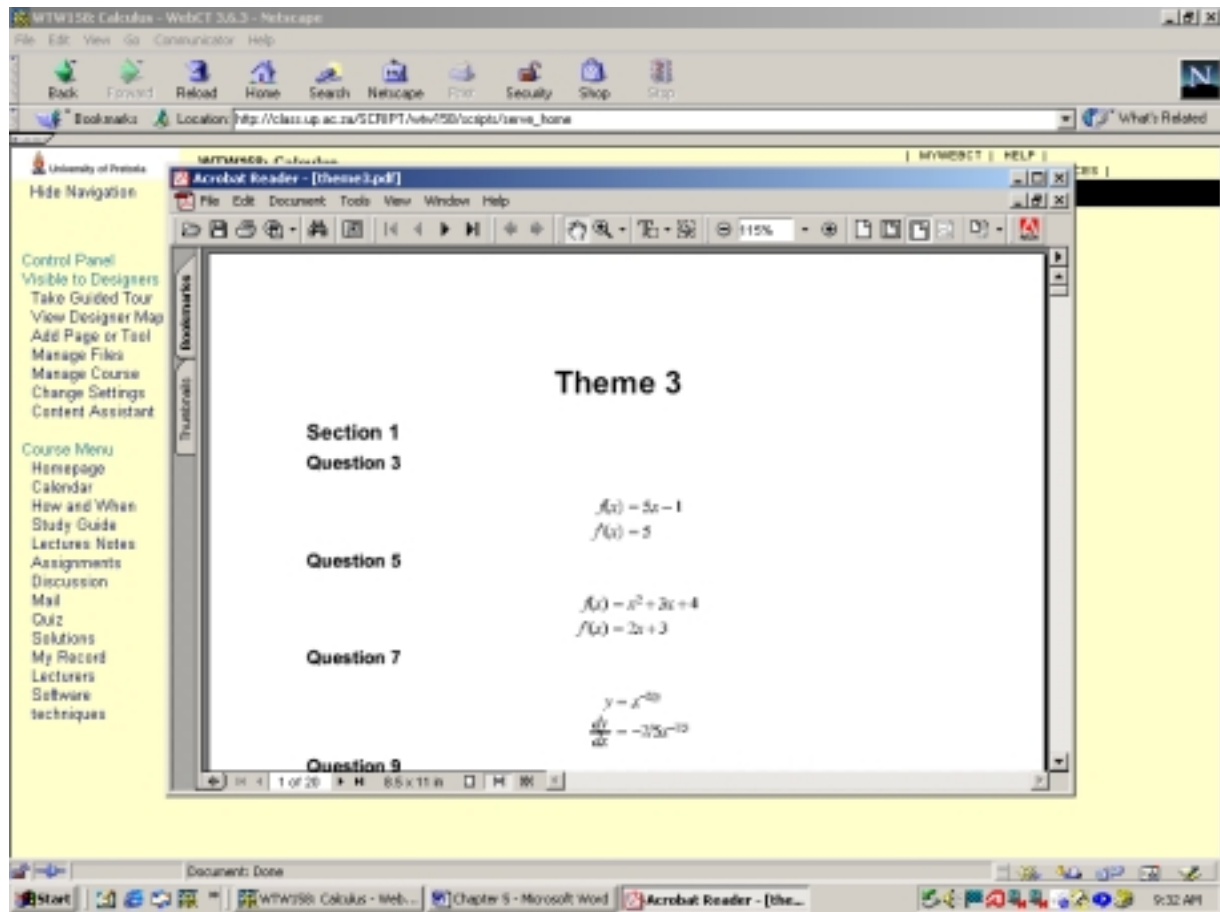
Calculus is one of the champion courses at the university, in which more than a thousand first year students make use of it every year since 2000. The particular lecturers refer to a *thin WebCT* course versus a *thick WebCT* course. The former contains mostly contact elements and *WebCT* is used as support. This model is used in 9 undergraduate mathematics courses. *Thick WebCT* courses pertain to a *WebCT*-based model where it forms the bulk of the course with one one-hour contact session per week. The latter model is used in 6 undergraduate courses, for students who have failed their course. Their findings over the past three years include that the attrition rate has stayed the same in both models; that there are fewer students with distinctions; and that students prefer the flexibility offered by the web-based model (Harding & Engelbrecht, 2001:1-9). Research into a possible relation between the use of the web in education and academic maturity of students is being conducted by Dr Harding and Prof Engelbrecht. They pose that the use of the web leads to more academic mature and independent learners.

The screenshot shows a WebCT Quiz interface. The main content area displays 'Quiz 6' for Dr AP Harding, starting on Oct 04, 2002, with 50 minutes allowed. The first question asks for the local maximum point of the function $f(x) = x^3 - 27x + 13$. The interface includes a 'Time remaining: 30 min.' indicator, a progress bar for 5 questions, and a 'Save answer' button.

Duration	Grade	Attempts
Q 09:30	30 minutes	/15
Q 21:00		Completed: 0 Remaining: 1
Q 10:40	20 minutes	/15
Q 21:00		Completed: 0 Remaining: 1
Q 07:30	20 minutes	/10
To: Sep 04, 2002 21:00		Completed: 0 Remaining: 1
From: Aug 30, 2002 10:35	35 minutes	/30
To: Aug 30, 2002 22:00		Completed: 0 Remaining: 1
From: Aug 30, 2002 11:15	25 minutes	/8
To: Aug 31, 2002 21:00		Completed: 0 Remaining: 1
From: Aug 30, 2002 11:15	20 minutes	/10
To: Aug 31, 2002 21:00		Completed: 0 Remaining: 1
From: Aug 30, 2002 11:15	20 minutes	/14
		Completed: 0

Screen capture 4.7 Quiz in Calculus (WTW 158)

The concerned lecturers have been very innovative in terms of their use of *WebCT*. Screen Capture 4.7 shows a Quiz in WTW 158. Screen capture 4.8 shows how they provide solutions to problems via *WebCT*.



Screen capture 4.8 Solutions to problems provided via WebCT

The benefit of this model is that students have to first solve problems on their own or in groups and then have access to the solutions that are posted after they have submitted their own solutions.

TOTAL WEBCT STUDENTS PER YEAR

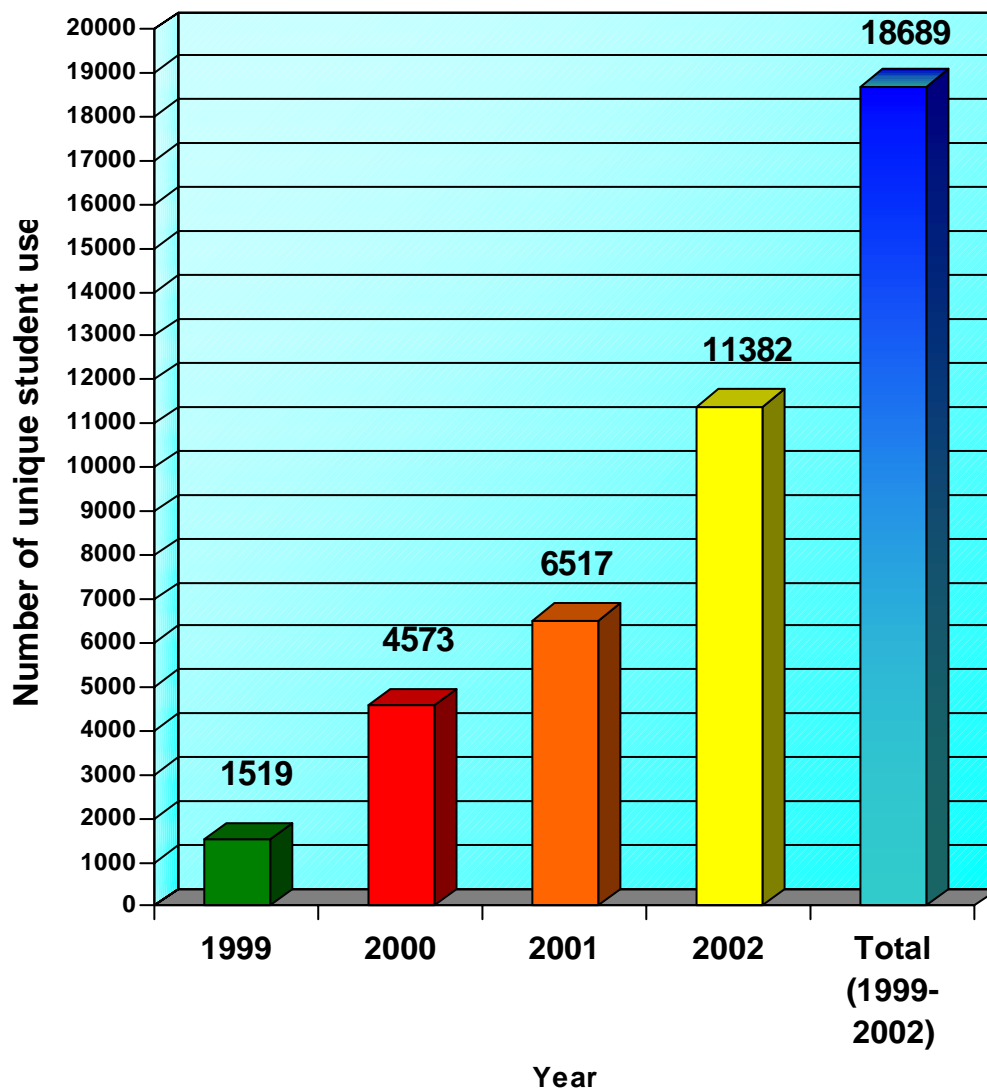


Figure 4.10 Total unique *WebCT* students per year

Figure 4.10 Illustrates that a total number of 18689 students have used *WebCT* since its implementation. As the strategy shifts towards more undergraduate courses the numbers will show exponential growth. The graph clearly illustrates the 'S'-curve.

A total of 17 148 students are currently registered for courses supported by *WebCT*, although as indicated in Figure 4.10 only 11382 of these students use *WebCT*. This means that 34% of students who are registered for a *WebCT* supported course have never accessed *WebCT*. The diagram below indicates the actual student users, i.e. unique students/users who have logged onto *WebCT*.

WEBCT STUDENTS

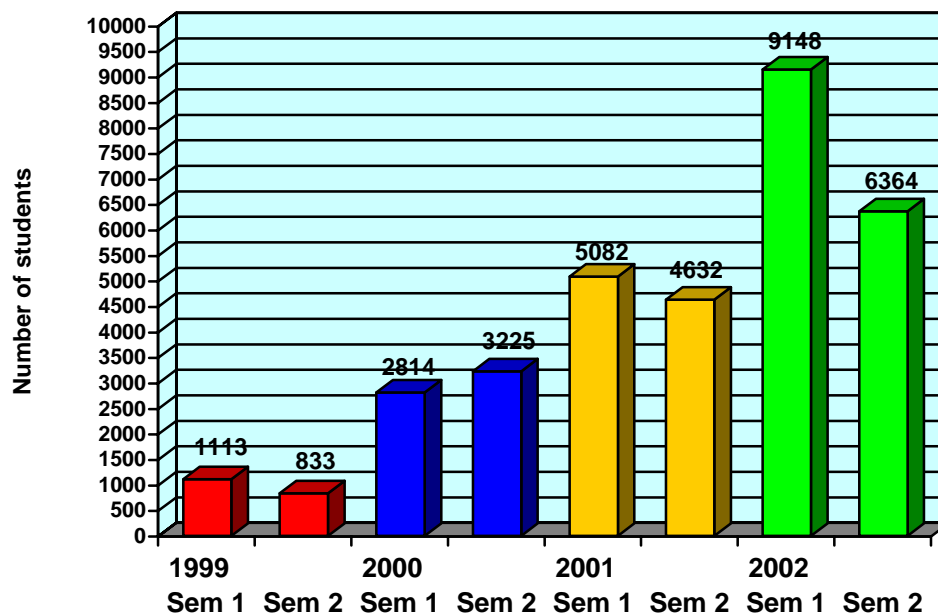


Figure 4.11 *WebCT* students per semester

It should be pointed out that it is problematic to present accurate statistics because of semester shifts and different cycles of courses.

Figure 4.12 illustrates the total number of *WebCT* courses.

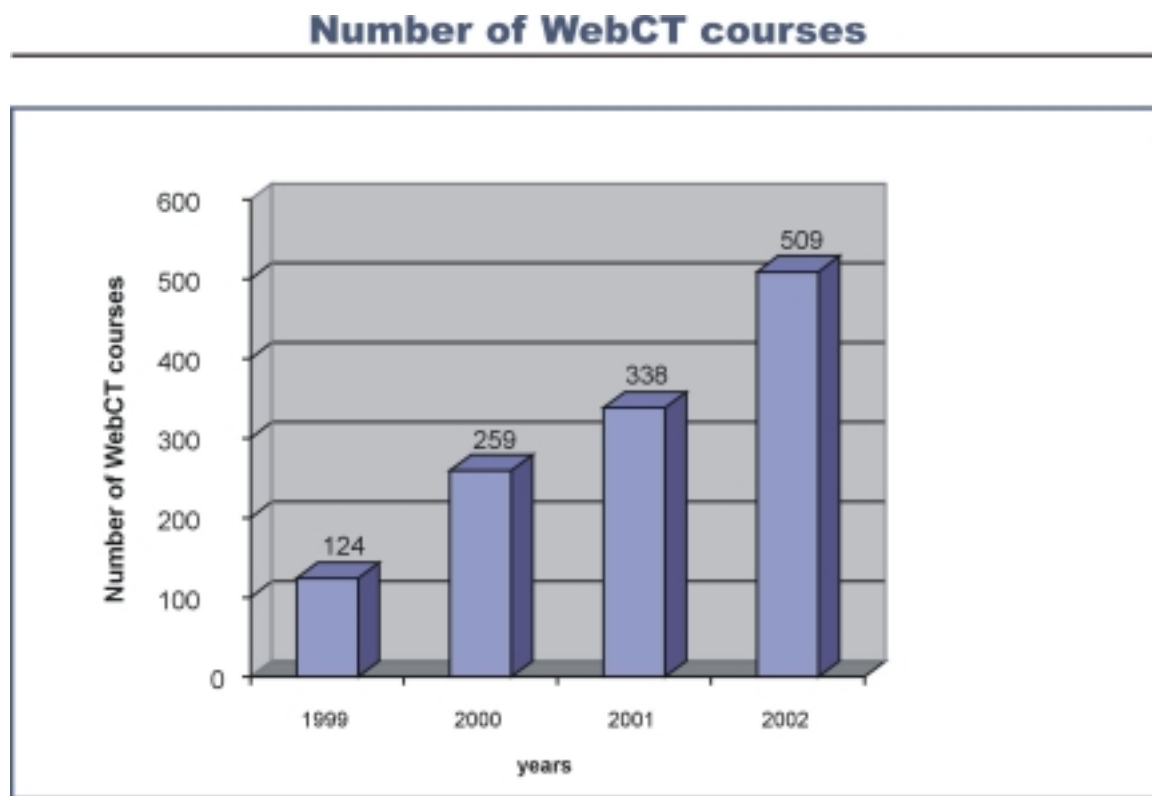


Figure 4.12 Number of *WebCT* courses

There are currently 70 programmes (degrees or diplomas) running in *WebCT*. If one uses the web continuum model by Bonk *et al.* (2000) it means that 70 programmes at the University of Pretoria resort on the highest level (level 10) in which courses are integrated and part of a larger and complete programme offering. Most of them are post-graduate programmes. In addition many lecturers opt to offer only certain modules/subjects via *WebCT*. The total number of courses making use of *WebCT* stands at 509. The 'S'-curve is clearly visible.

Section 4.11 explores the instructional design and development model in light of process innovation.

4.11 Instructional design and development (product and process innovation)

Most lecturers at the university are familiar with contact education while the creation of courseware is foreign to them. The virtual campus requires a paradigm shift in terms of a move away from lecture-based teaching methodologies to the adoption of learner-centred approaches.

The Telematic Education department operates according to project management (Bates, 2000) principles. It manages to deliver products and services due to its ability to mobilise resources on-demand, whilst at the same time being continually involved in numerous official (registered as a project and funded by the university) telematic programmes. Role players include project managers, instructional designers, educational advisers, Web-programmers, computer-based testing experts, graphic artists and photographers. In many cases an individual is multi-skilled and works on a variety of products simultaneously. A project manager spearheads projects through consultation sessions with relevant lecturers, from which project proposals are generated and approved or disapproved by management. Since the creation of the virtual campus in 1999, six instructional designers have been appointed to assist with web-based course design and development. The time it takes to design and develop a course can range from a couple of days to a couple of weeks, depending on the magnitude of the elements that lecturers include and depending on the quality of the information and format provided.

Over the past year development has changed from providing study guides in *html* to providing them and other course content in *PDF (Portable Document Format)*. The reason is that most students continue to print their online materials and *PDF* provides a better quality printed product. Hence the considerable research on learning benefits via *html* that is discussed in Section 3.4 is no longer appropriate in this specific context.

Section 4.11.1 describes the project proposal as an important component of the instructional design and development process.

4.11.1 Project proposals

Project proposals are written according to the following guidelines:

- Market for the project
- Student profile
- Additional students generated by offering a programme telematically
- Identification of the need for offering a programme telematically
- Identification of the modules and lecturers involved in the project
- Budget
- Return on investment
- Assistance required from Telematic Learning and Education Innovation

The Department of Telematic Learning and Education Innovation assists faculty members to draft project proposals. Project proposals are then submitted to top management for approval. Funding for successful project proposals are paid to academic departments in two instalments a year, depending on the duration and progress of the project.

4.11.2 Project management

As the number of *WebCT* courses increased in 1999, a project management process for *WebCT* courses was developed. The process was again refined in 2000, as indicated in Figure 4.13.

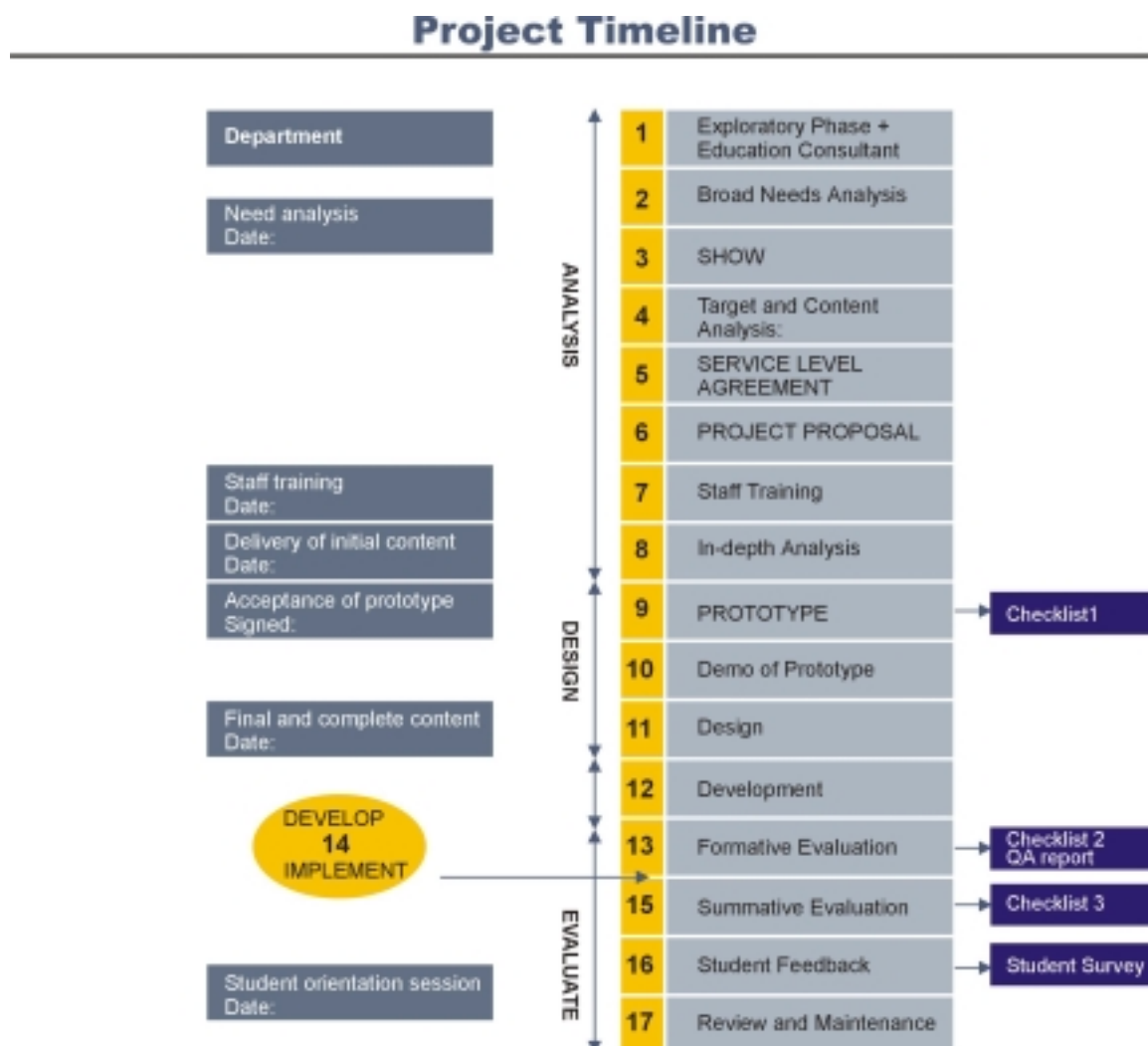


Figure 4.13 Project time line (Telematic Learning and Education Innovation, 2000a).

In Section 3.5.5 Bates (2000:72) recommends that project management should not be too bureaucratic and that it should fit the culture of an institution. The researcher is of the opinion that the project time line is rigorous but that it also provides sufficient flexibility. The rigour is necessary to ensure a quality product and a corporate image.

4.11.3 Service Level Agreement and roles

It was soon realised that a more structured approach needed to be followed in order to ensure that the various stakeholders involved in a *WebCT* project keep to their responsibilities and also understand the different roles. As a result a Service Level Agreement (SLA) form was created in 2000. Service Level Agreements are signed by programme leaders and the project manager. The Service Level Agreement and roles are shown in Annexure E.

4.11.4 Minimum requirements for web-based courses

In 1998 Prof K Visser, one of the champion lecturers spearheading *WebCT* in the Masters in Engineering Management (MEM) programme, compiled minimum requirements for a *WebCT* course. A decision was made that the minimum requirements should consist of the study guide that is used in contact tuition. The reason for this decision was two-fold:

- A phased-in or incremental approach was used by starting out with the study guide and gradually adding full-text references and content, followed by an increasing use of *WebCT* communication facilities.
- The study guide is useful in providing students with clear information about aspects of their course.

Format requirements and processes for the design and development of *WebCT* courses were then designed and implemented in collaboration with faculty members. It remains the basis of the minimum requirements provided to lecturers. The minimum requirements are shown in Annexure F. The benefit of making a study guide a minimum requirement is that it aids preparation and planning by the lecturer in advance. Another advantage is that it provides learners with a comprehensive overview of what is expected of them before the course resumes.

Screen capture 4.9 shows one of Prof Visser's courses – Maintenance Management. It further illustrates the initial design for the look and feel of the MEM programme.



Screen capture 4.9 One of the first *WebCT* courses

These requirements, along with the Service Level Agreement and Project Timeline, contribute to quality assurance. It points to the benefit of a centralised design and development support department such as Telematic Education.

The researcher is of the opinion that any successful institution wide initiative requires centralised leadership, coordination, training and support, whereas especially institutions in the United States started out with the 'lone ranger' model where every lecturer who got the notion of offering a course online designed a web site (Bates, 2000). The Campus Computing Project Survey of Green (2001) shows that 53% public and 70% private universities in the United States use a course management system. Institutions such as the Rand Afrikaans University in South Africa headed out without a design and development team and have come to realise (after 310 courses) that lecturers require design and development support. Stellenbosch University provides training and support and lecturers do

their own development. The model followed by the University of Pretoria is flexible in that lecturers can choose whether they would like to do their own design and development within the requirements of the department.

Section 4.12 gives an overview of training and support over the past four years. In light of the adoption curve, the early majority require considerable support before they will adopt new technology. Consequently, market acceptance in innovation is dependent on a model that provides sufficient support to the early majority. Especially quality assurance could pose a risk if every lecturer is free to do as pleases. The model used at the University of Pretoria is increasingly being followed by institutions globally as indicated in the international case studies in Section 3.6.

4.12 Training and support (process innovation)

Adequate training and support is required for successful market adoption and subsequently for innovation to take place. Section 4.12.1 reports on a learning process that commenced in 1998, indicating how training was adapted based on feedback from lecturers. It echoes the process of *learning by doing*.

4.12.1 Training

Seven telematic staff members were trained in mid-December 1998 and in the first week of January 1999. In February, a person was appointed, wearing the hat of *WebCT* administrator and technical support person for students and lecturers. It was the same person as the virtual campus programmer. Since 1998, close to 500 lecturers have been trained to use *WebCT*. Initially, two types of training courses were offered, namely the orientation course (two-day hands-on) and the development course (four-day hands-on workshop). These workshops are offered by Lighthouse Digital (the South African supplier of *WebCT*) in collaboration with staff members from Telematic Learning and Education Innovation. The development course covered authoring on the first day, learning how to use the communication tools on the second day, use of the file manager and path editor on the third day and the fourth day deals with student and course management. All workshops on *WebCT* are fully subsidised as an incentive to lecturers to innovate.

The initial objective in 1999 was to train only those lecturers who had submitted project proposals for funding (seed money), but the interest of lecturers was such, that it was decided to accommodate those with formal projects as well as those who want to do their own development without additional funding. The training courses have been adapted over

the years. It was found that lecturers could not spend four days away from class. The courses and attendance for 2001 and 2002 (to date) are provided in Table 4.10.

Type of course	Number of lecturers 2001	Number of lecturers 2002
High Impact course (one day) Presented at the last Monday of the month. Focuses on learning facilitation.	132	46
FrontPage course (one day) design principles using different media, e.g. FrontPage, PDF, etc. Presented 4 times a year	25	11
Intermediate course How to do maintenance on an existing <i>WebCT</i> course Presented 4 times a year	Course not offered in 2001	8
<i>WebCT</i> Designer course (two days)	30	5
Total	187	70

Table 4.10 *WebCT* training attendance

There is a significant decrease in the numbers of lecturers who attended training courses in 2002. It could indicate that diffusion is not progressing to early majority stage.

4.12.2 Support

The support mechanisms for *WebCT* include online support to students by which queries are routed to either the lecturer, *WebCT* administrator, instructional designer or Academic Information Services, depending on the type of enquiry. Where possible, face-to-face sessions are held with students to give them orientation in the use of *WebCT* and to obtain feedback after a trial-run period.

Instructional designers support lecturers continuously, provided that it occurs in terms of the Service Level Agreement. A site was created in 2000, called the Online Resource Centre (ORC). It is located on the intranet and accessible via Lecturers Online and *WebCT*. The ORC provides rich resources and links about e-learning and particularly web-supported teaching and learning environments.

Apart from the workshops and face-to-face support, a list-serv was created in 1999 for all lecturers offering their courses through *WebCT*. It evolved into a means of informing lecturers of the utilisation of new features in *WebCT*, IT-related information, and information about training courses. However, lecturers did not share experience via the listserv, which shows that knowledge creation regarding e-learning amongst lecturers was not successful.

A South African listserv is in the process of being created and will be hosted at the University of Pretoria. Many *WebCT* users in South Africa make use of the international *WebCT* listserv.

Section 4.13 explains the innovation process at Academic Information Services (AIS).

4.13 Academic Information Services (service and process innovation)

Academic Information Services had to align the electronic Academic Information Service project with the virtual campus and add certain functions, services and infrastructure to support *WebCT*-supported courses.

An important task was to clarify copyright procedures and policies regarding electronic sources. Another was to provide seamless access to information sources in various databases and to full text articles. Part of the virtual campus budget was used to create a cyber space in Academic Information Services (where students can access Student Online Services) and to purchase a high quality scanner to scan full text articles.

Academic Information Services' infrastructure is in place and provides copyright clearance and scanning of information sources in *WebCT*. The Service Level Agreement between the Academic Information Services and Telematic Education can be seen in Annexure G.

A concern about simply giving students access to full text articles was raised by lecturers, because they felt that especially postgraduate students have to acquire the skill of searching for and identifying relevant sources. The concern was addressed by providing access to search in electronic databases and to give access to the library catalogue online. To date a total of 10 050 full text articles have been scanned.

A shift has taken place from a notion of multiple copies to multiple sources.

Figure 4.14 illustrates the process flow of the scanning of articles for *WebCT* courses. Being a new process that supports an innovation and that has been embedded in the institution, it is regarded as process *innovation*.

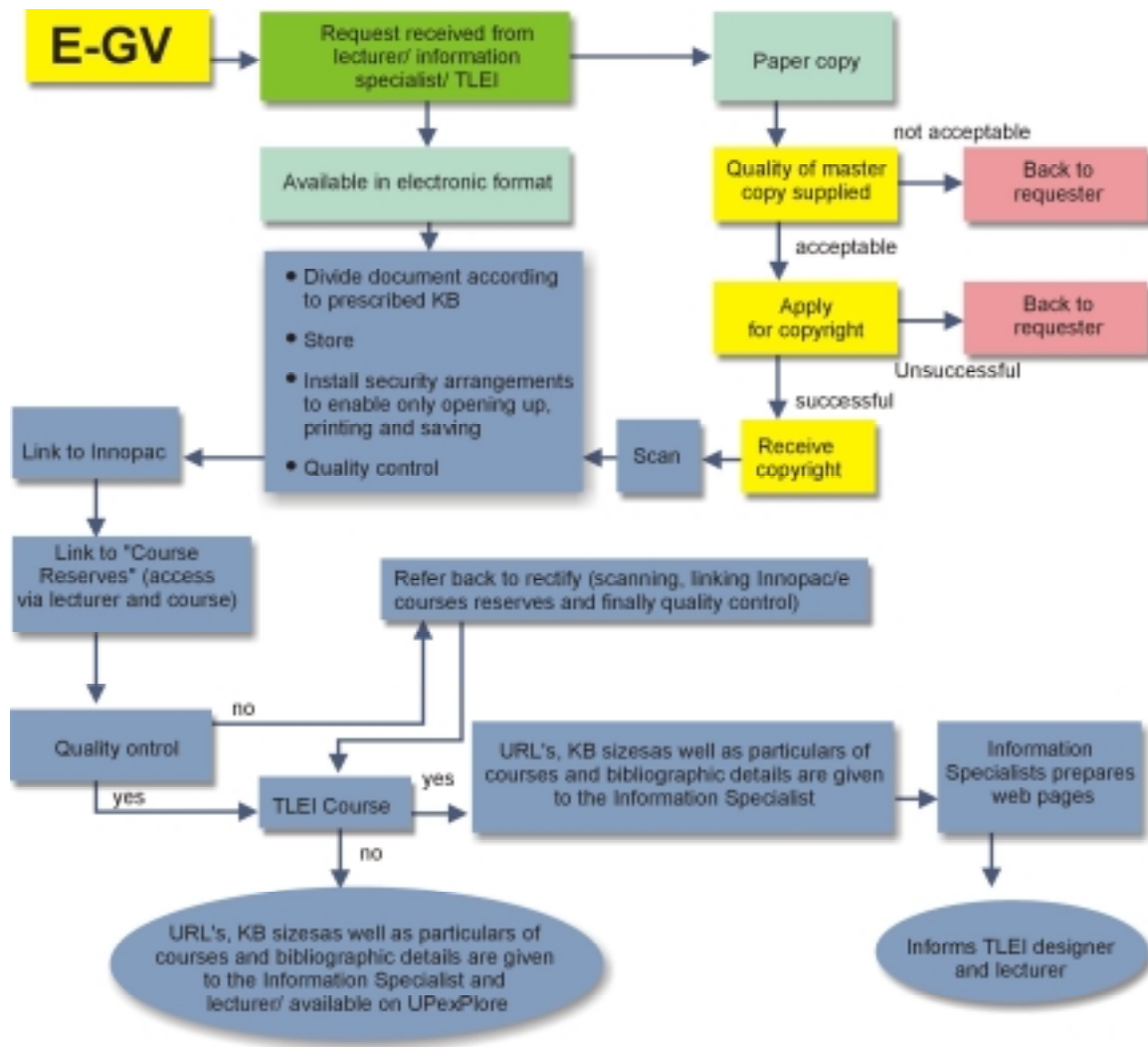
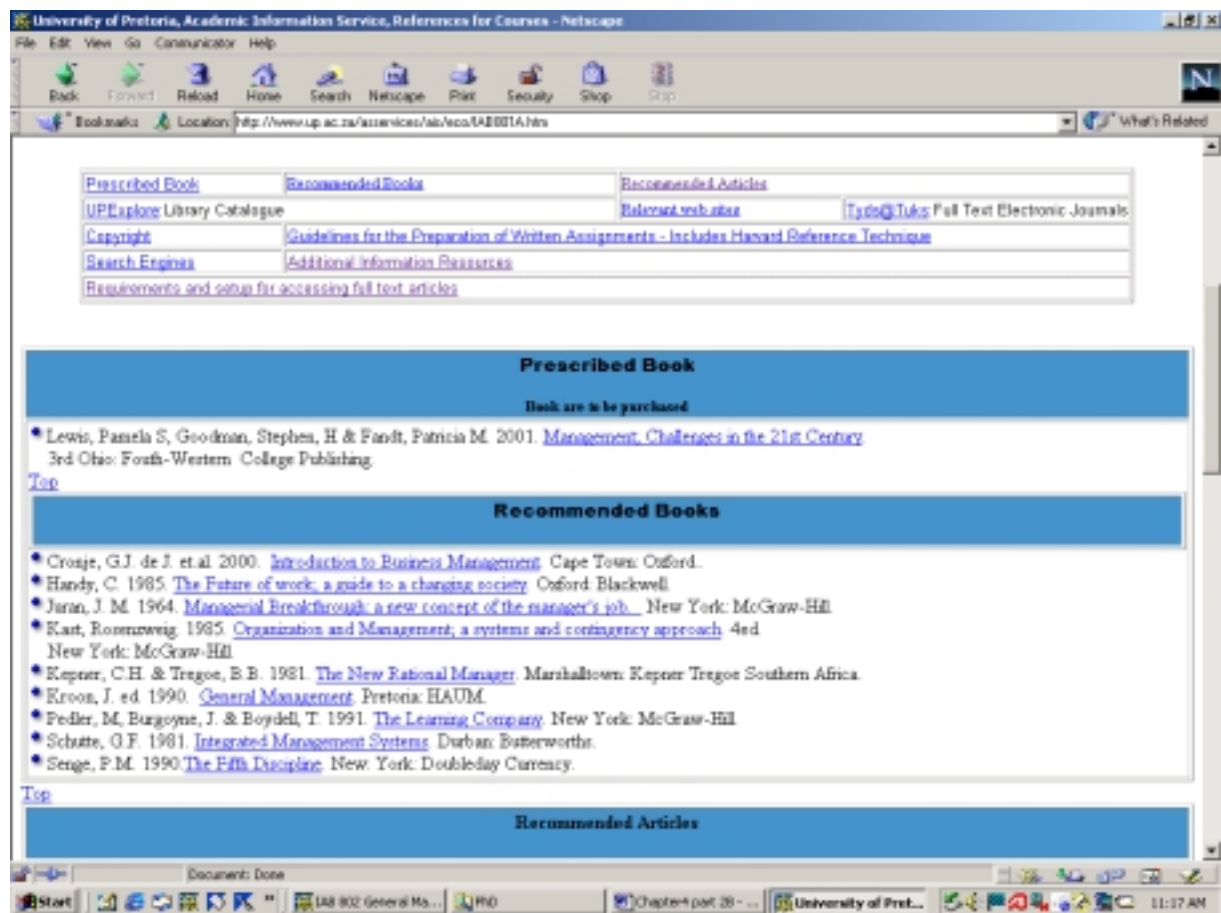
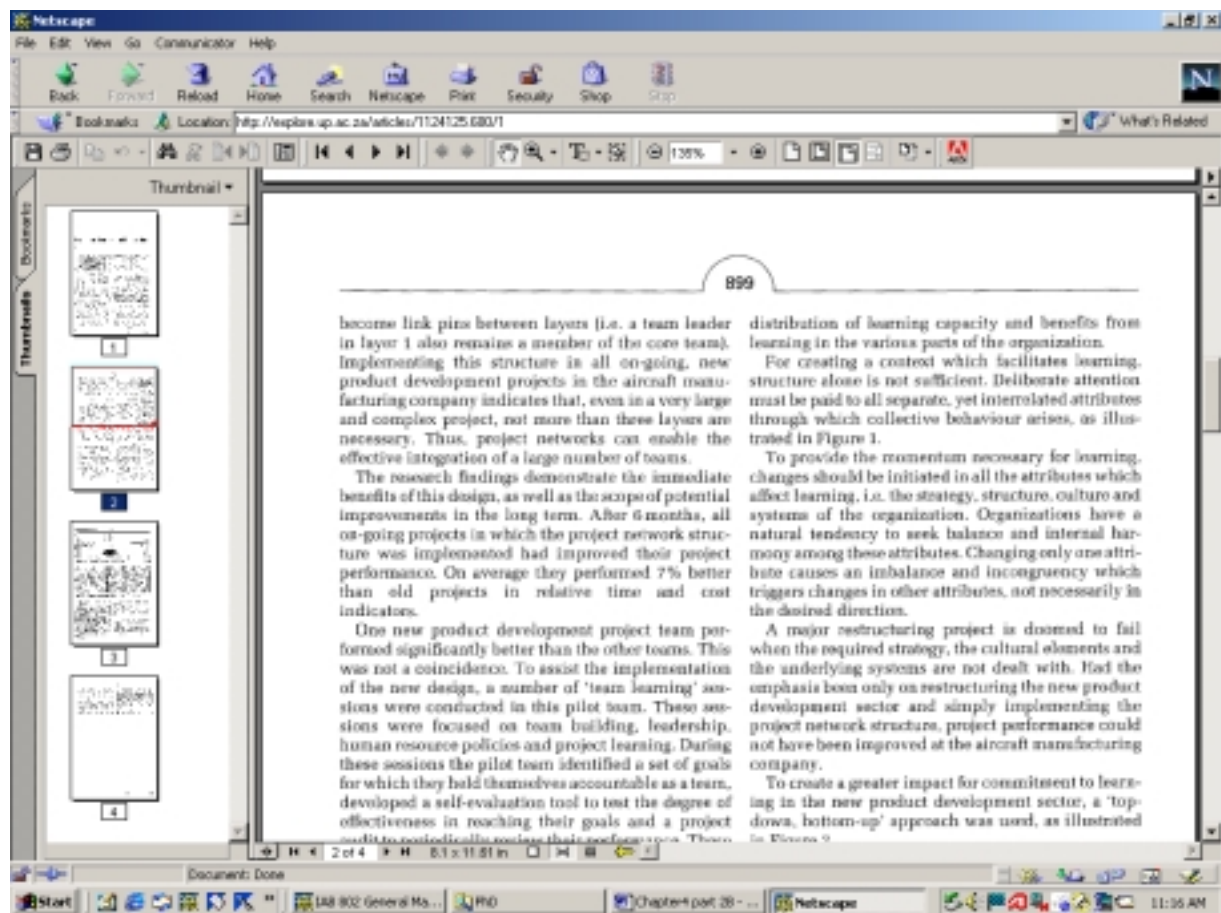


Figure 4.14 Process flow for scanning of articles (Academic Information Services, 2000).



Screen capture 4.10 References of General Management

The references are integrated with other components of a *WebCT* course in order to create contiguity and consistency.



Screen capture 4.11 Full-text articles of General Management

Full-text articles provide flexibility to learners regarding access. Learners are often not able to pay a physical visit to a library and subsequently access to full-text articles eliminates frustration.

4.14 Synthesis

If one considers the critical success factors for technology innovation in an educational context (Laurillard, discussed in Section 2.6.9), it is clear that the majority of critical success factors were addressed:

- The Department of Telematic Learning and Education Innovation has an innovative process in place that ensures synergy among all aspects involved in a flexible education model.
- The project management time line of Telematic Learning and Education Innovation is responsive to curriculum development and allows for creative team-based collaboration.

- The Telematic Learning and Education Innovation department provides a staff development programme that supports academic and production staff in their exploration of ways of utilising technology for teaching and learning.
- The Telematic Learning and Education Innovation department assists faculty with seed funding to grow new educational models. Resource planning and activity costing procedures are embedded in the costing model of the department.
- A technical infrastructure is provided in collaboration with the IT Department to support all learners and staff.
- Quality assurance mechanisms have been put in place.
- Collaborative partnerships are few, but more are being explored.

Table 4.11 applies the types of innovation to *process*, *product* and *service* innovation of the virtual campus.

Service or product	Virtual campus	Student Online Services	Lecturers Online	Online application	Online Payment	WebCT-Supported courses
Type of innovation						
Radical/revolutionary	x	x	x	x	x	x
Incremental/evolutionary	x	x	x	x	x	x
Disruptive						
Sustaining	x	x	x	x	x	x
System	x	x	x	x	x	x
Architectural	x				x	x
Modular						
Process/procedure	x	x	x	x	x	x
Product/service	x	x	x	x	x	x
Market pull	x	x	x	x	x	x
Market push	x	x	x	x	x	x

Table 4.11 Application of types of innovation to virtual campus

If one considers the virtual campus in totality, then it could be classified as both radical and evolutionary innovation. It is radical in the sense that it has established a dominant design, which is embodied in components that are linked together in a new architecture and which have led to organisation-wide competitive advantage. It has also changed consumer behaviour of students – in that adoption rates show that students and staff increasingly make use of the virtual campus components.

A predominantly incremental or evolutionary innovation strategy was followed regarding technology architecture.

Section 4.15 combines qualitative and quantitative analysis of selected products of the virtual campus over the past four years.

4.15 Quantitative and qualitative analysis of product innovation

4.15.1 Feedback (1999-2001)

In February and March 1999 the main complaint from students was that they struggled to access their online courses from work and home (Lazenby, 1999:299). At the time, the University experienced difficulties with its *ATM* network backbone. A decision was made to connect the virtual campus server with *Fast Ethernet* rather than the *ATM* backbone. Subsequently, fewer complaints were received. Other complaints included *JavaScript* errors that appeared in *WebCT*, which were solved in collaboration with the local suppliers. On several occasions students accessing their courses from work were denied access by their companies' local firewalls.

Students initially complained about the communication features in *WebCT*. They found it too cumbersome to access the various communication tools in every course to see if a message had been posted. This frustration was exacerbated during the network problems. The complaint was addressed for students taking the Master's in Engineering Management (MEM) by creating a cross-course e-mail facility on the home page in *WebCT*.

Certain lecturers almost withdrew their courses during the network crises. Understandably they had to cope with high frustration levels of students, some of whom were threatening to cancel their courses, and most of the time they could not do their course development or communicate with their students. Although the network has stabilised, infrastructure remains a concern.

A series of three focus-group interviews was held with lecturers who offered courses via *WebCT* and those who started out doing so (Lazenby, 1999). Each focus group had seven lecturers from various departments. The departments of Psychology, Information Science, Archaeology, Electronic Engineering, Engineering Management and Social Science were represented). Data analyses revealed the following themes:

WebCT

- Lecturers felt that the interface of *WebCT* is “clumsy” and not intuitive enough.
- Lecturers disliked the spreadsheet in *WebCT* that is used for student marks.
- Lecturers mentioned that the synchronous communication facilities do not work.

Innovation adoption is more probable if new technology is easy to use, as discussed in Section 2.7.2. An added constraint is that the *perceived usefulness* (Davis, 1989) of the technology was negative.

Computer literacy of students

- Lecturers indicated that engineering students are not necessarily computer literate.
- Lecturers felt that the orientation course was inadequate and that it was essential to attend the development course to get ownership – even if a telematic staff member is responsible for development.

Change management

- Some lecturers felt that they had no choice but to go the route of Web-based courses and found it a difficult process to make the transition while attempting to remain experts in their research fields.
- Some lecturers felt that contact education accommodates (rightly or wrongly) an external locus of control of students, but Web-based learning often does not.
- Some pioneering lecturers preferred to preserve their existing Web sites and felt that *WebCT* was “in the way”.

This could indicate negativity in the phase of *Persuasion* (Rogers, 1995) although they had already made the decision to use the new technology. It also reflects the notion of *Complexity* – the degree to which an innovation is perceived to be difficult to understand.

Infrastructure

- Lecturers pointed out that students often struggle to access *WebCT* due to port problems.

Culture

- Some lecturers conveyed frustration that their students don't regard books as an investment, let alone a computer. A culture change is necessary among students to realise that the computer skills they will acquire by following a Web-based course are life skills and furthermore that a computer is an investment.

A master's dissertation study on organizational transformation and information technology at the University of Pretoria (Vercueil, 2001:126-129) found that those lecturers using *WebCT* felt more competent ($p < 0,01$) and were more positive about the virtual campus. Vercueil posited that this could indicate that training contributes significantly to increased feelings of competence and also an increased ability and confidence to use IT for communication purposes.

Section 4.15.12 analyzes *WebCT*-supported learning environments from the perspective of lecturers.

4.15.2 Questionnaire for *WebCT* lecturers

The purpose of this section is to explore certain aspects of *WebCT*-supported learning environments from the perspective of lecturers.

As explained in Chapter One, an interpretive case study entails that the researcher analyzes, interprets and theorises about the phenomenon against the backdrop of a theoretical framework. It is important to emphasise the systems perspective, in that both the researcher and respondents are subjective and create meaning in the expression of their world view by means of language. Also, language is used to construct the meaning co-constructed by the researcher and the respondents.

The research procedures followed in this section will subsequently be described.

4.15.3 Population

The population consists of lecturers at the University of Pretoria who have been using *WebCT* for one year and longer.

4.15.4 Sampling procedure

As was indicated in Section 1.5.6, purposeful sampling is used when the researcher selects a sample from which the most can be learned (Merriam, 1998:31). In this instance the sample was drawn in August 2002 from a database of lecturers using *WebCT*. Only those who have been using *WebCT* for a year and longer were included in the population. A purposeful sampling was then made of the population group.

4.15.5 Sample size

The bigger population of lecturers who currently use *WebCT* is approximately 260. This means that approximately half of lecturers who have been trained use *WebCT*. Of these approximately 170 have been using *WebCT* for a year and longer. Only a further 60 of these have been using *WebCT* frequently. This was calculated by selecting lecturers who, on the *WebCT* database, accessed their courses at least 100 times during 2001. Hence the population for this section is 60. The smaller the population, the larger the sampling ratio that is needed for a high degree of accuracy. Consequently, a convenience sample of 40 was chosen, which can be seen as adequate for a population of 60. The sample therefore represents 67% of lecturers who have been using *WebCT* frequently for one year and longer. All forty respondents completed the questionnaire. Some of their courses are illustrated in Annexure J.

4.15.6 Instrument

A questionnaire (Annexure H) was developed to investigate aspects of web-supported learning environments from a lecturer's perspective. The theoretical basis for the selection of the questionnaire items was a thematic analysis. The questions are based on the extensive literature study conducted in Chapter Two and on the experience of the researcher. Certain constructs emerged around which the researcher formulated the questions. The constructs are listed below.

- a) Support and benefit in terms of flexibility to students.
- b) Constraints experienced.
- c) Learning/teaching model used.
- d) Role of the lecturer.

A total of 19 questions were included in the questionnaire, which was sent to the respondents via e-mail.

The questions of the six constructs appear in random order in the questionnaire and can be categorised as follows:

Section A: Support and benefit in terms of flexibility to students

Questions 1 – 2

Section B: Constraints experienced

Question 3

Section C: Learning/teaching model used

Questions 4 – 17

Section D: Role of the lecturer

Questions 18 - 19

Responses to open ended questions were clustered according to themes that were generated in the answers. Therefore, individual experiences were classified into experiential categories. Descriptions were then made of the shared experiences as a way of creating a pattern of ideas and experiences. These were in turn clustered into themes to which meaning was ascribed, based on the researcher's understanding, knowledge and experience of web-based education.

4.15.7 Open ended analysis

Section A: Support and benefit in terms of flexibility to students

95% (38) of respondents indicated that the use of *WebCT* provides more flexibility to students, especially on a postgraduate level. One respondent pointed out that the following variables dictate the flexibility of a course:

- Nature of the course.
- Approach and methodology of the lecturer.
- Levels and degree of computer literacy of the lecturer and students.

This response indicates that lecturers realise the strategic benefit of using *WebCT* or any similar tool to enable flexible education.

One respondent mentioned that *WebCT* is an appropriate tool for certain subjects and that it should blend with other modes. The respondent warned against regarding it as the solution to all educational problems.

One respondent indicated that it promotes experiential learning. This comment is encouraging because it means that a high level of learning can be facilitated via *WebCT*.

Section B: Constraints experienced

Individual respondents mentioned the following constraints that have been categorised into themes:

Bandwidth and infrastructure

Bandwidth and reaction time make it impossible to use certain applications on the internet. Lack of IT/network support is a constraint “When I’m uploading commentary on a topic and responding to student assignments, I cannot afford to send a ‘one stop’ request that takes over 24 hours to get a response”.

Lab access on campus should be improved. “Supervisors of the *WebCT* lab are not always keen and the lab is often locked”.

Internet and bandwidth limitations of off-campus students.

Students don’t have regular access or have unreliable servers.

The emergence of this theme is consistent over the past three years. It relates to *ease of use* that is lacking, in the sense that the infrastructure to support the innovation is not perceived as adequate. It could threaten diffusion between the *early adopter* and *early majority* stages.

Design and development

One lecturer would prefer physical proximity of instructional designers, i.e. a designer per School or Department. This confirms the recommendation by Bates (2000:106) that instructional designers and technical support staff should be close in proximity to lecturers, as discussed in Section 3.4.5.

The freedom to design and develop web pages without prescriptions from the University was expressed as a need. The user interface of *WebCT* emerged as a barrier:

“Even though I have done the courses, the occasions when I actually design a new page are few and far between. Consequently, when it comes around to doing it again – let’s say after a break of 6 months – I will have forgotten the little “tricks” that are an everyday issue for the regular programmers/designers”. This means that *WebCT* is not sufficiently user friendly. If one takes into account the four E-model (Collis *et al.*, 2000) then the *ease of use* critical success factor is lacking. The importance of ease of use in adoption is also emphasised in Section 2.6.2 (Davis, 1989, Rogers, 1995). The *ease of use* factor is a recurring theme in the analysis.

One lecturer felt that the turn around time to get study guides on *WebCT* takes too long. In other words the project time line, or the particular part of the time line is experienced as laborious. This aspect relates to the notions of *Relative advantage* and *Compatibility* provided by Rogers (1989) and indicates that *WebCT* is not perceived to be better than the practice it supersedes, that it does not fit the particular lecturer’s needs.

Training of students and student attitudes

Variation in level of computing competence of students is a problem. This aspect could be grouped with the theme of **computer literacy of students** that emerged from the focus group interview in 1999.

“Students do not participate regularly in the process – they are just concerned with the submission of assignments”. From a change management perspective it could indicate that students have to shift to a different paradigm, i.e. from passive learning to active learning. Another lecturer repeated this concern “Reluctance among students to optimally utilise the possibilities of *WebCT*”. It is interesting that the same lecturer posed that their reluctance could be ascribed to e-mail, because e-mail is so much easier to use. It resonates with the critical success factor of “ease of use” mentioned by Davis (1989) and Collis *et al.* (2000). One lecturer points out that “Students tend to communicate outside *WebCT* because it takes longer to log into *WebCT* than to use e-mail or send an SMS”. Yet another states “Some students never use *WebCT*”.

A recommendation was made that more training and experiential learning should take place before students will really start using the system.

WebCT

One lecturer stated that “*WebCT* is rigid in terms of down loading student information, calculation of marks, handling groups”. It is similar to the theme of ***WebCT***, that emerged

from the focus group interview in 1999 i.e. that it is not easy to use. It is a concern that will hopefully be addressed by the latest version 3.8 of *WebCT*. If this is not the case it could prevent the *early majority* from adopting *WebCT* and as a consequence diffusion will not be successful.

One lecturer indicated that “I do not experience specific problems”. This means that what Collis *et al.* (2000) refer to as *Engagement* was successful.

Another lecturer mentioned that discussion and chat functions are rarely used because “direct e-mail is easier and better”. In terms of diffusion it could be problematic that another technology, i.e. e-mail is in effect hindering adoption of *WebCT*. It will be important to address the user interface of *WebCT* to ensure diffusion among the *early majority*. The following statements build on the theme of a lack of user friendliness:

“Uploading and downloading of assignments is a laboursome process”.

“The way in which one has to open sequences of messages is laboursome”.

WebCT integration with legacy systems

“Integration of registering students on the student administration system (mainframe) is not in sync with registering students on *WebCT*. Students often have to start working in *WebCT* before they have paid and have been formally registered at the University – we should look at more flexible business rules”. This is a business rule issue that poses a financial risk to the University if it is not followed, but which has been discussed with Finance in an attempt to resolve the frustration of students and staff.

Change management

On a positive note, two lecturers noted respectively that “Initial resistance should be resisted because it is a natural response to change” and “the demand from students is greater than the capacity of academics to supply”.

Resources

A noteworthy comment was that the “Biggest constraint is people, not technology”. It possibly indicates that the lack of user friendliness of *WebCT* could be overcome by enthusiasm. It possibly indicates that the factor of *Engagement* weighs more than the factor of *Ease of use* where diffusion is concerned. Another lecturer mentioned that departments with limited staff struggle to put in sufficient time to go through the process of redesigning and in some cases designing content from scratch. He suggested the contracting of

postgraduate students for content expertise/design. This statement reflects a lack of *Compatibility*.

One lecturer emphasised time constraints in the sense that there are too many student discussions to respond to: “I need a tutor or assistant to take responsibility for the online part of a flexilearning programme – I can’t manage the assessment and feedback”. This statement reflects a lack of *Relative advantage* and *Compatibility*.

What is important to take cognisance of is that some lecturers experience limited resources in terms of content expertise and typical activities of a lecturer, i.e. assessment and feedback. Hence it could indicate that technology and instructional design and development support is adequate, but additional academic support is required.

Educational model and learning facilitation

A lecturer noted that the use of “*WebCT* by both parties [lecturers and students] is required, otherwise it reduces to little more than a document delivery system”. A concern and yet another example of a technology interfering with the diffusion of an innovation is the following statement: “CD’s enhance convenience, but students ignore *WebCT* once they have the CD”. One should consider all the pros and cons when determining the selection of technologies used in a course – particularly the way it is used. A benefit of the CD is that it lowers frustration levels of students who experience access problems. Yet it causes serious damage to the strategic focus on quality flexible learning. The fact that students ignore *WebCT* once they have the CD means that they then forfeit rich communication and possible high level learning interactions via *WebCT*.

A statement of “It is difficult to focus if one offers *WebCT* courses and regular lectures in other courses” points either to the lack of a consolidated educational model or strategy, or to the fact that diffusion has not reached early majority level. In other words some of the courses that the lecturer offers do not make use of *WebCT* yet.

A positive comment was that “Online discussions in *WebCT* add value to learning”. Also that it facilitates “group work, discussions, case studies and simulations”. Another appreciates the fact that it expedites feedback to students, “answering as quickly as possible”.

When asked for what activities they use *WebCT* the following educational model emerged:

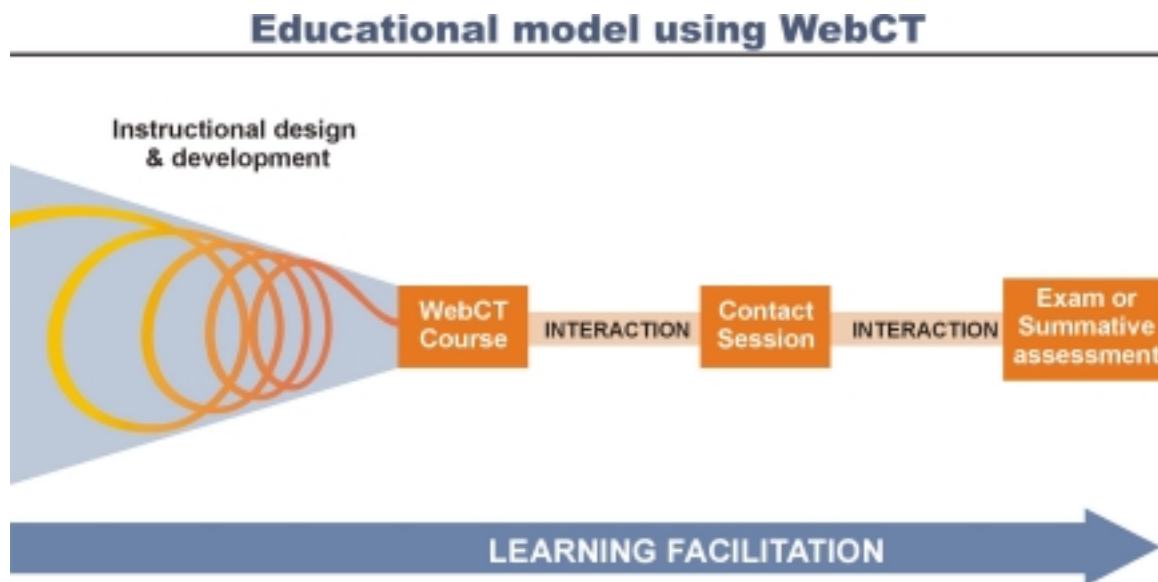


Figure 4.15 Prevalent model used for *WebCT* supported courses

The spiral depicts the educational model followed by the lecturer, Telematic Learning and Education Innovation and Academic Information Services to create a course. Once it is activated, certain lecturers provide activities that learners have to complete before the first face-to-face contact session. Interactions take place during this time via *WebCT*, telephone, e-mail, fax and cell phone.

The contact session is used for particular activities as reported on in the following section. Thereafter interactions take place again, but seemingly less than between the activation of the course and the first contact session. Finally, a contact session is used for examination purposes. This model varies based on a specific programme or course. In some courses regular contact sessions are held on a weekly basis. In others, only two contact sessions are held a year.

The following provides an overview of activities before students come to contact sessions:

Before contact sessions:

Students have to do preparation on topics. "Students have to achieve assigned tasks for which content is not available on the site, but in various electronic databases".

Students have to complete group assignment reports.

Students are trained on the use of *WebCT*.

Listserv communication takes place (Outside *WebCT*).

Practise runs and information sessions are held by the lecturer regarding assignments. Group assignments and information are given. Multiple choice tests and case study preparation prepare students.

The descriptions below indicate that *WebCT* is used to prepare students before they come to contact sessions. This is done in various ways, as discussed below.

Minimum requirements

Providing the minimum requirements of outcomes, schedule, assignments, references and assessment criteria prepare students and gives them a mental model of everything that is expected of them. "Students are guided in doing their assignments and additional information is posted on the Web for their use and follow-up. They are also expected to communicate with each other on assignments and other learning material".

Course content

Content in the form of case studies, *Power Point* slides or lecture notes are provided. "Case studies are provided and they are asked to analyse and synthesise using skills acquired by performing certain reading/review tasks". "Notes and power point slides".

Links to other web sites

Links are often available to important sites. "Links to internet resources, asynchronous communication".

Self assessment

In some instances students have to complete self-assessment activities before coming to contact sessions. "Self evaluation and feedback".

Other descriptions of activities before contact sessions include the following:

"Students are given an article written by a world expert (with permission), which is not quite up to date. They are then asked to update/improve it and the expert becomes an external evaluator of the product".

Problem solving and discussion

“Facilitate problem solving through online discussions and debates”.

“I communicate a least three times a week with my students and provide a recording of a discussion between myself and Prof Britz online for them to listen to”.

40% (16) of respondents indicated that they use *WebCT* as a content delivery tool only”.

Contact sessions:

The researcher attempted to quantify the percentage of lecturers who use contact sessions for specific activities:

lectures (90%) (36), group assignments (60%) (24), group presentations (13%) (5), simulations (7%) (3), practicals (13%) (5), discussions (20%) (8), case study analysis, guest speakers (7%) (3), feedback on assignments (17%) (7) evaluating online discussions (7%) (3), class tests (53%) (21).

Figure 4.16 is a graphic representation of the descriptive statistics above.

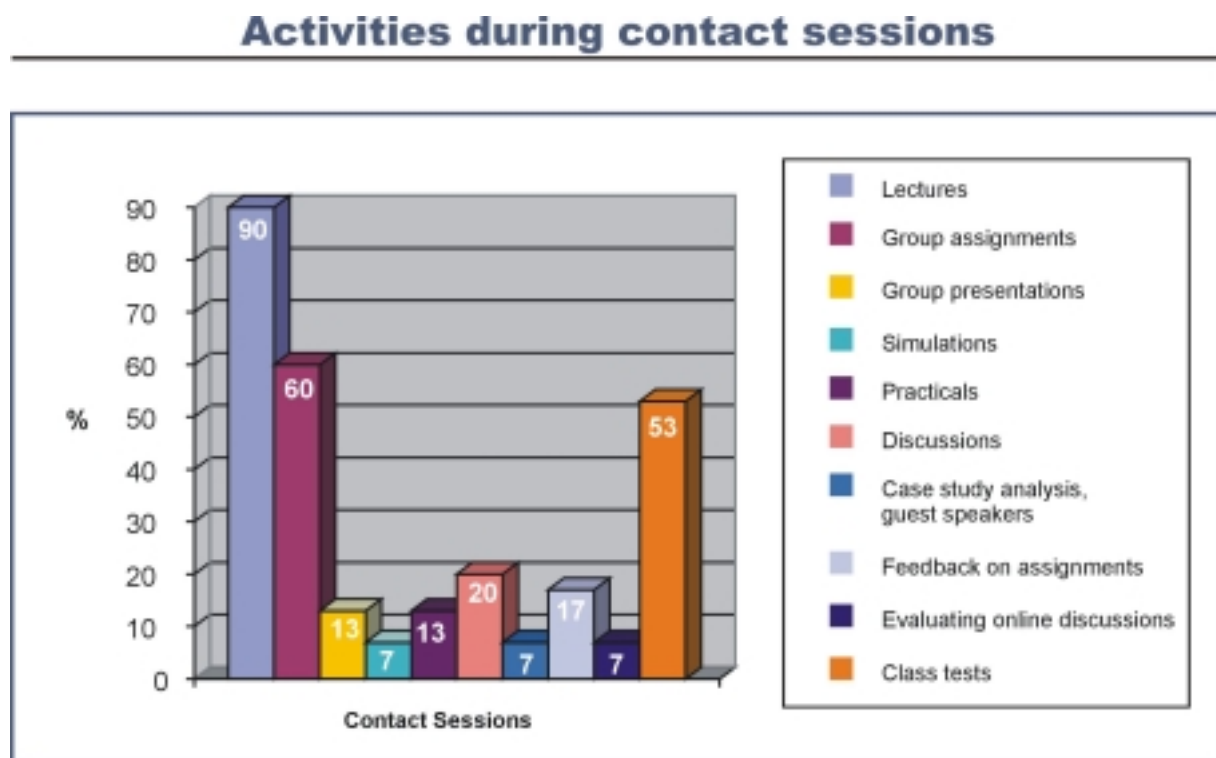


Figure 4.16 Learning and teaching activities during contact or block sessions

What is clear from the statistics is that an objectivist/behavioural model prevails in spite of the introduction of a web-supported model. As shown, 90% of lecturers use contact sessions to lecture. Interestingly a percentage of 60% lecturers use contact sessions for group assignments – which indicates a relatively high level of cooperative learning. It must be noted that the statistics are not mutually exclusive in that the same lecturer could have indicated that she makes use of contact sessions to give lectures and to facilitate group work. It seems that assessment, i.e. *Class tests* scores 53% which possibly indicates that contact sessions remain the preferred opportunity for formal assessment. The percentages of other activities are not significant enough to interpret.

The following section analyzes what kinds of activities lecturers engage in after contact sessions.

After contact sessions:

Students are given group assignments to complete and have to start with examination preparation. Some lecturers give students a research report to complete. Others do nothing: “None”.

The section below quantifies respondents answers.

Peer assessment

10% (4) of respondents use peer (student) evaluation as formal assessment, which is significant and contributes to the strong presence of cooperative learning in the educational model.

Usage of *WebCT* interaction/communication functions:

90 % (36) of respondents believe that interactions between them and students between block/contact sessions is important. This is significant because it indicates realisation of the need for learning facilitation and communication.

The percentage use of various functionalities of *WebCT* are provided below.

Bulletin board: 20 % (8)

Chat: 7% (3)

Messaging: 40% (16)

Multiple choice: 13% (5)

Case studies: 60% (24)

Although *messaging* is 40%, it is outweighed by *case studies*. In terms of a constructivist model the case studies point to a significant level of problem solving present in the educational model. Yet the communication component of constructivist learning is quite low. It should be mentioned that communication between students and lecturers takes place via e-mail as well, thus it would not be a valid inference to conclude that too little communication takes place in *WebCT*-supported courses.

Usage of WebCt Interaction/ communication functions

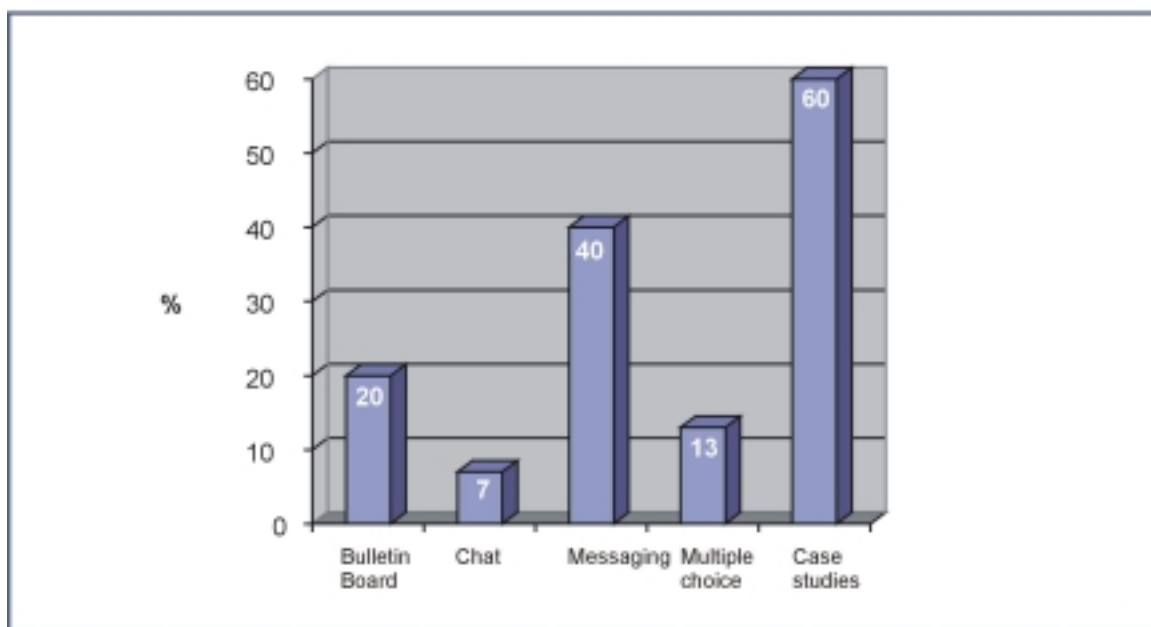


Figure 4.17 Frequency of communication facilities used in *WebCT*

Lecturers were asked about the turnaround time of feedback on assignments. The reason is that effective feedback (timely, constructive, positive) contributes to effective learning (Section 2.3.10)

Turnaround time of feedback on assignments:

One week: 33% (13)

Two weeks: 33% (13)

Three weeks: 13% (5)

Four weeks: 7% (3)

One month: 7%(3)

Two months: 3% (1)

Marked as not applicable: 3% (1)

The turn around time is acceptable if one considers that 66% of lecturers provide feedback within one or two weeks. Two weeks could be considered too slow for a web environment. To return an assignment after a month or longer leaves too wide a gap between the student's engagement with the knowledge constructs and the time when feedback is given.

Turnaround time of feedback on assignments

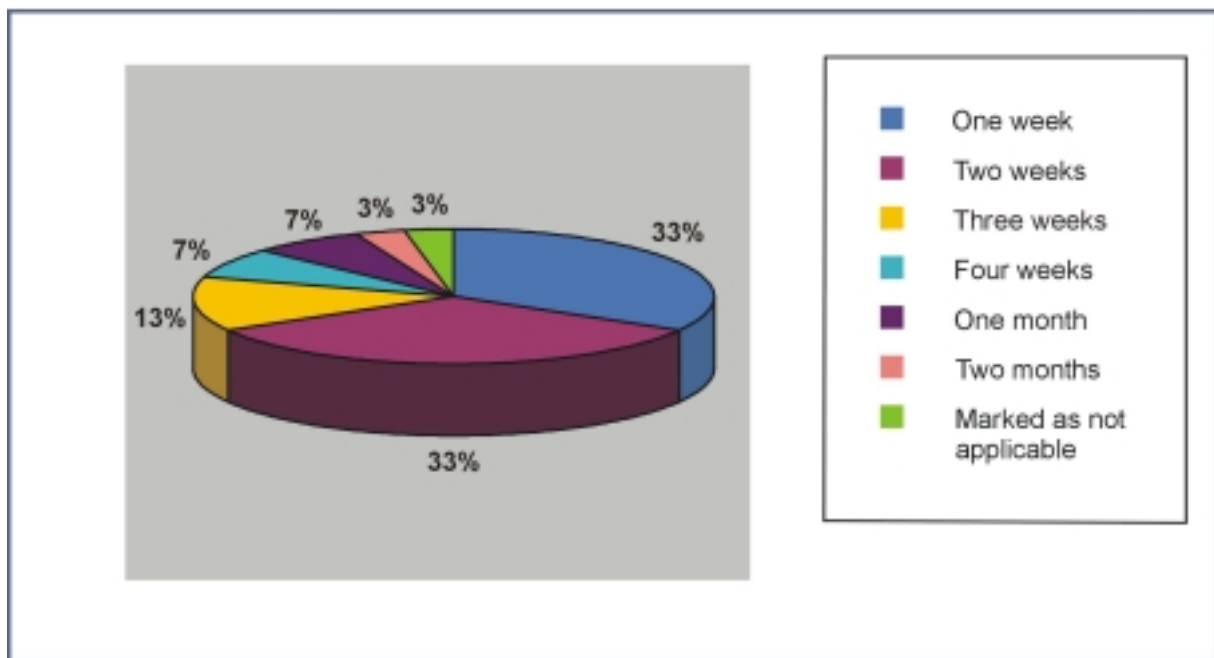


Figure 4.18 Turn around time of assignments

Other themes that emerged from the respondents' answers are discussed below.

Knowledge creation

Some feel there is a lack of knowledge and skills of lecturers and students. This is a concern that could be addressed by means of innovative training and, at best, increased knowledge sharing among lecturers and their peers and among students. This is echoed by two other statements: "Lecturers don't share experiences of what works and what doesn't".

"Lecturers should be trained to use various interactivity options".

The researcher used characteristics of a web lecturer listed by Bonk & Wisner (2000:11) in Question 18.

The important characteristics of a lecturer as perceived by respondents are given in Table 4.12.

Important characteristics of a lecturer from a lecturer's perspective

Characteristic	Mean	Std Dev	Rating (1 as most important and 12 as least important)
Enthusiasm	3.2	2.4	1
Responsive	3.7	2.2	2
Expertise	4.9	3.2	3
Flexible	5.1	2.4	4
Clarity	5.3	2.8	5
Positive	5.7	3.4	6
Web-smart	5.9	3.6	7
Empathy	7.7	3.6	8
Patience	7.8	3.3	9
Caring	7.9	2.4	10
Friendly	8.2	2.6	11
Cultural responsiveness	9.8	2.9	12

Table 4.12 Rating by lecturers of important characteristics of a web lecturer

The rating indicates that the majority of lecturers regard *Enthusiasm* as the most important characteristic of a web lecturer, followed by *Responsiveness* and *Expertise*. The latter relates to subject expertise.

The results of the question about the most appropriate roles of the lecturer in a web environment indicate that those of *Facilitator*, *Mentor*, *Provocateur*, *Observer* and *Participant* were marked most often.

Section 4.15.8 provides results of individual interviews with the virtual campus project team.

4.15.8 Interviews with virtual campus project team

Individual interviews were held with members of the virtual campus project team. An open interview structure was followed, in other words no agenda was used with specific questions. The project team officially disbanded towards the end of 2000. Smaller groupings of members continue to meet frequently to further deploy and sustain projects that have been implemented. The original team consisted of 25 members, of which 20 were core members, including four project managers and the researcher. Two members have left the University and three members initially attended and then left. Taking the above into account, the population is 19. A convenience sample of 17 was chosen, which yields a representation of 95%.

The emerging patterns and themes that emerged from the interviews are as follows:

Knowledge creation and organisational learning

Interviewees indicated that the virtual campus led to new knowledge and that “Knowledge creation speeded up as time passed” and “Problem solving and knowledge creation took place in the project team”.

One interviewee felt that the “Blueprint helped for alignment, but can never be too specific because of the impact of the human factor”. The Blueprint refers to the original project charter and tasks. The majority of respondents said that the virtual campus project team meetings highlighted commonalities that stakeholders were not aware of and that it broadened the institutional knowledge base. It was also valuable to promote horizontal, cross functional collaboration. A positive and important comment was that “Communication networks that were created still continue and were sustainable”. Three members from Academic Information Services mentioned that full text articles and online sources that resulted from the virtual campus enriched the offering to students and led to knowledge creation amongst librarians.

Competitive advantage

All interviewees thought that the virtual campus adds to the competitive advantage of the University of Pretoria and that it led to significant changes at the University.

One interviewee regarded it as a “Necessary and appropriate project”.

One interviewee described it as a “Lead project within the university”.

Several pointed out that the virtual campus was an international leader in 1999 in terms of the scale of integrated products and services via the Internet.

Change management

A benefit pointed out by several interviewees was that the virtual campus aligned various departments and that it made a start to breaking down silo-based culture.

It made a difference organisation wide and gave impetus to further institution-wide initiatives like the Client Service Centre – a project that the scope of this thesis does not allow to describe. Several interviewees pointed out that it was beneficial to drive the virtual campus at operational level because it would not have succeeded on senior managerial level. It acted as catalyst and created a competitive environment – leading to healthy competition amongst departments. Unfortunately the competitive environment resulted in unnecessary duplication in one instance. The duplication resulted in distrust among certain team members and confused users because over a period of a year two similar systems were created on which they were trained by different parties. In terms of change management it was driven holistically, but not enough was communicated to the University of Pretoria at large – more demos and information sessions would have influenced the adoption rate positively. Responsibilities for certain tasks have settled within various departments but more resources are necessary to maintain momentum. A concern was expressed that executive management have lost the cross-functional view of the virtual campus now that its various components have settled into the line responsibility of departments.

Constraints

Four interviewees commented on the fact that the pressure was high and the time scale short. Further that members had to produce results on top of a regular work load. It was also pointed out by a member from the IT department that the technology architecture was not ready at the time. Further that the interim development served the purpose well, but that it was necessary to migrate the virtual campus to a new technology architecture.

Project management

Interviewees indicated that the project team was representative of stakeholders and the formal reporting was effective.

Small cross-functional groups worked well together and the project team served a very good function of coordinating cross-cutting tasks. It also provided information and facilitated communication well. The project had a significant outcome with a remarkably low budget.

One member felt that it could have worked even better if strategic decisions were separated from operational tasks. Another pointed out that it worked well because the operational level made decisions quickly without delaying implementation by bureaucratic procedures. The operational level was more in touch of what could be done and there was sufficient strategic guidance from the researcher. Moreover, several middle managers served on the team which ensured communication to their senior managers.

Several members pointed out that the aggressive energy and push of the researcher was necessary to overcome lethargy and to accomplish the deliverables in time.

The project team disbanded at the right time (after three years) since which time smaller groups continue to meet on a regular basis. All interviewees indicated that the planning and project management was good.

Innovation

Some interviewees felt that the 'underground' strategy combined with top-down support worked well. In terms of innovation it is considered a good decision at the time to create a more integrated administration system and to link it with *WebCT* as it was the first successful attempt to integrate student services. Three members indicated that the virtual campus project team accelerated innovation at Academic Information Services (library).

All interviewees felt that the growth in adoption rate of products and services is significant. The spiral/iterative or incremental development worked well in that the *WebCT* pilot projects served as success factors for further deployment. It was pointed out, however, that a chasm still exists between administration staff and academic staff. In terms of success rate most of the original objectives have been reached, but others have failed, such as online registration.

Critical success factors VC:

Interviewees provided the following critical success factors of the virtual campus project:

- The vision and drive of the researcher.
- The support from executive management.
- The *Sponsor* (Director: Telematic Learning and Education Innovation) understood the university well (being the former Registrar).
- The fact that it was driven mostly at tactical and operational level.
- The incremental innovation strategy worked well to reduce risk, to allow for mobility regarding changes in technology architecture and to adapt, based on experience.

Critical success factors *WebCT*:

In terms of the *WebCT* component of the virtual campus, interviewees provided the following critical success factors:

- “Diffusion has to reach a point where needs are created and where dependency on the use of the web is such that you can’t do without it (dominant design on ‘S’-curve)”.
- The attitude, example and drive of the academic project leader of the pilot projects: MEM and MPM.
- Academic project leaders must know how to manage diffusion.
- The ability to create an enabling context and culture in students.
- User-friendliness of the system used.
- Support of Telematic Learning and Education Innovation.

Suggestions:

Some members made suggestions for the way forward:

- Training by experienced lecturers/champions as opposed to training only by telematic staff.
- More marketing is needed.
- Seize opportunities that have been created, such as international collaboration.
- If no support is given in matrix management, for example in an interdisciplinary programme – substitute resources at a cost y contracting in external resources.
- More lecturers should be appointed on contract and a core pool of academics should remain on permanent basis to sustain the research pool.
- More research is required about the needs of lecturers.

An interpretation of the themes follows.

4.15.8.1 Interpretation**Knowledge creation**

A significant finding is that knowledge creation speeded up as time passed. This adds a new dimension to knowledge creation theory. It indicates that *time* is a factor of acceleration of

knowledge creation when small teams learn together. The longer the team work together, the faster they create knowledge. This could possibly be ascribed to a similar mental model that develops among team members. The similar mental model probably aligns thinking and accelerates implementation as less justification and negotiation is required. It could also be contributed to collaborative knowledge that grows exponentially as time passes.

Mental model

Emerging knowledge about *innovation strategy* and *knowledge creation* is that a blueprint or project charter facilitates knowledge creation by creating a mental model of what the outcome of the innovation should look like and strategies of how to get there. As pointed out by one of the interviewees – a blueprint cannot be completely accurate where innovation is concerned. The reason is that it has never been done before and one can only attempt to give general thrusts of what the deliverables should be. In the case of the virtual campus, the foreseen deliverables were very specific. It could be argued that specific deliverables limit creativity. Yet the researcher is of the opinion that the specific deliverables assisted to make the mental model of team members more concrete. During the innovation process team members used their own creativity and tacit knowledge to reach the deliverables. It is posed that in order to create a blueprint, the *intrapreneur* or *innovator* requires an ability to first combine explicit knowledge in the organisation, i.e. the models of *combination* and making tacit knowledge explicit i.e. *externalisation* (described in Section 2.5.1) are used before the design of deliverables can take place. During the design phase the innovator needs to be creative enough to make the vision concrete. This is done by imagining the foreseen outcomes (such as new products and services) and working backwards to map them onto existing knowledge. Through this process of problem solving it is possible to provide specific strategies and deliverables.

Competitive advantage

If sufficient working relationships develop in a matrix project team the likelihood of sustainable innovation increases. In this case the team achieved enough synergy to embed new institutional processes that are sustainable and that are continuously improved upon. The virtual campus project was therefore successful in converting human capital into new products and services – regarded in Section 2.5 by Quinn *et al.* (1992:181), Tapscott (1996:43) and Von Krogh (1998:133-136) as one of the biggest competitive advantages of an organisation. Furthermore, it has led to organisational learning. Products and services have been improved through better knowledge and understanding (Fiol & Lyles, 1985); the range of potential behaviours of employees have changed (Huber, 1991); and new mental models

have been created (Stata, 1989). It also positioned the university as an international leader in virtual education as early as 1999.

Change management

Change management took place, discussed in Section 2.6, in that business processes were redesigned to utilise the benefit of a new technology – the Internet (Conner, 1998:100). Business processes were also redesigned around the needs of customers – students. The virtual campus is an example of an organisation that has been re-architected (Nadler & Tushman, 1995), in terms of technology architecture, business processes, the educational model and administrative services. The recognition of the impact of technology on the higher education landscape and the changing needs of customers was acted upon rapidly enough to reposition the institution and make it more competitive. It indicates that the University of Pretoria is a nimble institution, in other words it is sufficiently mobile to respond to change. In itself this is a competitive advantage, considering how large the institution is.

A significant finding is that a predominantly bottom-up change management strategy was successful in a cross-cutting project. The remark that it would not have been successful, had it been driven at senior managerial level, is interpreted by the researcher as an indication that power bases are stronger on a senior level and hence more resistance is experienced if a horizontal, institution wide project is attempted at that level. In a certain sense the senior management level (Directors and Deans) was by-passed. The reason why this statement is made is because the project was supported by the top level of management, i.e. the Vice-Chancellor in person in the role of *Protector*, and decisions were made and implemented on a middle managerial and operational level.

Competition resulted from the project, which led to an accelerated pace of knowledge creation and innovation. On the down side, duplication occurred that resulted in confusion among users. The duplication can be ascribed to a lack of ownership experienced by the particular team members. It only occurred in one Department though, which indicates that the relevant Director and team members probably resisted the change to such an extent that the competition changed from healthy inter-departmental competition to destructive competition that actually harms the institution, as discussed in Section 2.6 (Crego & Schiffrin, 1995:69).

Support from top management emerged as another critical success factor. However, the researcher finds it necessary to emphasise the fact that it was not formal support in the sense that almost no decisions were taken by top management regarding the virtual campus.

Neither was it propagated publically by the Vice-Chancellor. The advantage of this strategy was that people felt less threatened and as a result less resistance was experienced. Yet the project team was allowed enough scope and power to make decisions and implement major changes. Top management support, or rather the support of the Vice-Chancellor was implicit but adequate – the fact that the status report served at the Strategic Technology Committee, with presentation by the Vice-Chancellor indicated a sufficient level of support. As project leader the researcher found it frustrating at the time that it was never included in the strategic plan of the university as a strategic focus. Then again, a very formal launch was held and university publications reported on the virtual campus. Furthermore, the researcher was given several opportunities to give information sessions to which the entire university was invited. These took place at so - called Telematic forums and Marketing forums. Both are regular forums to which every staff member receives an invitation by e-mail and by letter (hard copy). In hindsight, it could have contributed to a lack of ownership because the researcher resided in the Department of Telematic Learning and Education Innovation and all the presentations on the virtual campus were done under the auspices of this department. Hence the question arises whether a more independent identity should have been created for the virtual campus project team – being a cross-divisional team.

A comment about a continued chasm between academic staff and administrative staff reflect not only upon the virtual campus project, but also on the culture of the university.

Marketing

The point about the lack of adequate marketing and information sessions is important for future innovations. It reveals that there can never be enough discussions, information sessions, demos and marketing campaigns when one deals with organisational innovation.

Resources for sustainability

An important concern that has emerged is the possibility that the vision is becoming fragmented again now that new products and services have been embedded in specific departments. Also that an integrated or consolidated strategy is required to inform top management of the links between budgetary requests by individual departments to sustain the innovation of the virtual campus.

An interesting suggestion is that resources – specifically lecturing staff – should be contracted if a lack of support is experienced in a matrix management project. Many postgraduate programmes are managed in matrix fashion because they are interdisciplinary.

Both the MEM and MPM are interdisciplinary programmes and consist of courses offered by different departments and even different faculties. A further recommendation is to contract in more lecturers and to keep a core of permanent lecturers to focus on research. This could lead to better performance. If a lecturer is contracted in to offer a *WebCT*-supported course, he or she will be contractually bound to use it effectively and successfully. Unfortunately many lecturers are permanent staff members and are reluctant to change their teaching model.

Project management

The short time span was experienced by team members as a constraint, but the researcher is of the opinion that it created the sense of urgency and tension that was necessary to mobilise people and maintain momentum.

From a project management perspective, the team functioned successfully and was critical in coordinating a wide spectrum of tasks.

Innovation strategy

The results of the interviews support the researcher's view of the incremental or evolutionary strategy that was followed. Yet it caused radical changes to the university's way of doing business – especially in terms of services but also in terms of products. Additionally, that it was a sound decision to focus on the knowledge champions in terms of representation on the project team, and not the senior managerial level. The decision to integrate *WebCT* with existing administration systems was visionary. This is confirmed by a global trend, most visible in the USA, of implementing web-enabled *ERP* systems that integrate processes – including integration with course management solutions like *WebCT* and *Blackboard* as described in Section 3.2.

The spiral innovation process echoes the organisational knowledge creation spiral of Nonaka and Takeuchi (1995:73), depicted in Section 2.5.2. Another successful strategy was to choose pilot projects for the diffusion of *WebCT*.

Champions

As indicated by the critical success factors that emerged from the interviews, the role of the project leader is crucial to ensure successful innovation. This is also true for change management and project management.

The project champion plays a crucial role in terms of innovation – in this instance the characteristics of the academic project leader is probably more important than the project manager at Telematic Learning and Education Innovation. The reason is that the academic project leader is the change agent who must be credible enough to bring about radical change in the way lecturers teach. If the academic project leader is not enthusiastic and serious about driving the change and does not set an example for faculty, the project will in all likelihood fail. It is also necessary that they understand innovation and how to manage diffusion. In the case of the pilot projects, the particular project leader was Professor Antonie de Klerk - Head of Department of Technology and Engineering Management. Apart from choosing the MEM and MPM programmes based on the subject field and the profile of postgraduate students, these programmes were chosen because of Professor de Klerk's knowledge and understanding of technology innovation and personal characteristics of being a strong and visionary leader.

Important recommendations that emerged are that champion lecturers should also be used to train prospective *WebCT* lecturers. The reason is that lecturers share professional experience— attributes that contribute to credibility and respect. This strategy could help to address the phase of *Persuasion* (Rogers, 1995). From a psychological perspective it would be easier to follow the example of someone in a similar profession where change is concerned, as opposed to being led by a person who does not practice web-supported teaching as a profession.

Diffusion

In terms of *WebCT* a significant finding is that the innovators, and especially the early adopters have to endure long enough until they reach a point of dependency of the new technology. It is at this point that diffusion has reached a level where users feel comfortable enough to become creative in using the new technology. A significant factor is that of creating an enabling context and culture in students. It is reminiscent of the recommendation by Wlodkowski (1999:11) that self-directed strategies in teaching should be negotiated with learners and not simply mandated (Section 2.3.6). A means of doing this is to provide clarity about the new educational model and what it entails in marketing material and to discuss the model with students at the first point of contact – preferably this should be face-to-face, but it could also be facilitated via a listserv or bulletin board.

A factor that emerged from the questionnaire for lecturers as well as the interviews is the user friendliness of the system. *WebCT* is not currently user friendly in the sense that its

interface is not as intuitive as for example *Microsoft Word for Windows (MS Word)*, a dominant word processing package used by university staff. Yet enthusiastic lecturers make use of *WebCT* in spite of the lack of ease of use.

Finally, the support of Telematic Learning and Education Innovation confirms literature (Bates, 2000; Rogers, 1995; Pistorius, 2000) that successful diffusion is dependent on sufficient institutional support.

Opportunity

Opportunities for international collaboration in *WebCT*-supported programmes has yet to reach a level of significance. Benefits of international collaboration include cost saving, exposure to international experts and knowledge creation.

A significant request is to conduct more research on the needs of lecturers – an aspect that is included in Chapter Five with regards to recommended further research.

Section 4.15.9 reports on the findings of a questionnaire (Annexure I) that was administered to a sample of students who follow *WebCT*-supported programmes.

4.15.9 Questionnaire for *WebCT* students

The purpose of this section is to explore the learning environment of students following *WebCT*-supported programmes. A decision was made not to focus on *WebCT* only, as it would then disregard the flexible educational model and would not provide a holistic view.

As explained in Chapter One, a descriptive and interpretive case study entails that the researcher analyzes, interprets and theorises about the phenomenon against the backdrop of a theoretical framework. It is once again important to emphasise the systems perspective, in that both the researcher and respondents are subjective and create meaning in the expression of their world view by means of language. Also, language is used to construct the meaning co-constructed by the researcher and the respondents.

The research procedures followed in this section will subsequently be described.

4.15.9.1 Validity and reliability

Reliability and validity are salient in qualitative research. As mentioned in Section 1.5.8, reliability relates to how items are developed for constructs and whether the items are dependable and consistent. Furthermore, reliability means that information provided by items does not vary as a result of the characteristics of the indicator itself (Neuman, 1994).

Another type of reliability is concerned with equivalence reliability, in which multiple indicators (several items in a questionnaire measure the same construct) are used. The reliability of the constructs was determined by the Cronbach alpha coefficient that is used when more than two different scores are possible for each item (Owen & Taljaard, 1996:66). The Cronbach alpha coefficient measures the internal consistency of the items. It is done by adding all the variances of respondents' scores for each item. High intercorrelations of items on a questionnaire indicate that similar attributes are measured, and therefore the coefficient will be high. In cases of error or items that measure different attributes, the reliability coefficient will be low. According to Owen & Taljaard (1996:70) a Cronbach Alpha of 0,6 and higher indicates a high level of accuracy with which the instrument measures specific constructs. The Cronbach alpha coefficient for the various constructs is as follows:

Theme or construct	Cronbach alpha
1 Deep information processing	0.8
2 Constructivist elements	0.7
3 Interaction	0.9
4 Intrinsic motivation	0.6
5 Effective feedback	0.8
6 Learner – centred assessment	0.5

Table 4.13 Result of Cronbach Alpha test

The results show that the item constructs are reliable – in that they measure the constructs in a reliable way, except for construct 6, which has a Cronbach Alpha coefficient of 0.5. This means that construct 6 has a lower, but adequate level of measuring learner-centred assessment in a reliable way.

4.15.9.2 Validity

According to Johns (1996) validity is an index of the extent to which a measure truly reflects what it is supposed to measure.

In this questionnaire, the items, or questions are developed based on the work of experts in the field of learning. Their work is discussed in Chapter Two. The researcher poses that the construct validity of the indicators is high because of the fact that the work of experts is used.

4.15.9.3 Description of statistical analysis

The SAS Software package, version 8 (SAS Institute Inc., 1999) was used for data processing. The MicroCAT™ Testing System (1993) was used for an item analysis, including statistical properties such as the item mean, the item variance and the item-scale correlation. Other basic descriptive statistics were calculated, such as frequencies, averages and standard deviations by means of ITEMAN version 3.5 (Assessment Systems Corporation, 1993).

4.15.9.4 Population

The population consists of all programmes that have been supported by *WebCT* for one year and longer (64).

4.15.9.5 Sampling procedure

Purposeful sampling took place by selecting the two flag ship programmes that were the pilot projects for *WebCT*. These are the Masters in Engineering Management (MEM) and the Masters in Project Management (MPM) programmes. Both were redesigned from a distance model with paper-based support and two contact sessions to a model using *WebCT* in 1998. Both programmes enrol approximately 50 students who used to complete the degree over a three year period. Since 2001 students complete the degree over a two year period. Both first year and second year students for 2002 were included in the sample. The first year MBA students of 2002 were also selected, because the MBA shares certain courses with the abovementioned programmes. Furthermore, the MBA was developed in 2000, a year later than the previous programmes – providing a difference in maturity of the programme.

4.15.9.6 Differences between groups

To determine differences between independent groups, the analysis of variance (ANOVA) is used. The ANOVA test indicates that there is no significant difference (<0.05) between the results of the MEM, MPM and MBA groups. Neither is there a significant difference between the first and second years in these MEM and MPM groups.

4.15.9.7 Sample size

MEM first years	48
MEM second years	20
MPM first years	41
MPM second years	13
MBA first years (modular)	42
Total:	174

A total of 163 students responded, making the response rate 94%.

4.15.9.8 Instrument

A questionnaire was developed, consisting of 82 questions. The questionnaire was explained to each group of students before they completed it and the researcher was also available for questions whilst the respondents completed the questionnaire.

The theoretical basis for the selection of the questionnaire items was a thematic analysis. The questions are based on the extensive literature study conducted in Chapter Two and theoretical aspects in Chapter Three. Certain constructs emerged around which the researcher formulated the questions. The constructs are listed below.

- a. Deep information processing.
- b. Constructivist elements.
- c. Interaction.
- d. Intrinsic motivation.
- e. Effective feedback.
- f. Learner – centred assessment.
- g. Role of the lecturer.

Each section indicates the theory that was used to construct the questions that constitute a specific theme. Examples of how these themes manifest in the sample courses are shown.

Section A: Deep processing of information

This construct is based primarily on the work of Henri (1992:73) which is discussed in Section 2.3.2 on *Cognitivism*.

The questions test whether students engage in the following cognitive strategies in their learning environment:

Linking facts, ideas and notions in order to interpret, infer, propose and judge.

Offering new elements of information.

Generating new data from information collected by the use of hypotheses and inferences.

Proposing one or more solutions with short- medium or long-term justification.

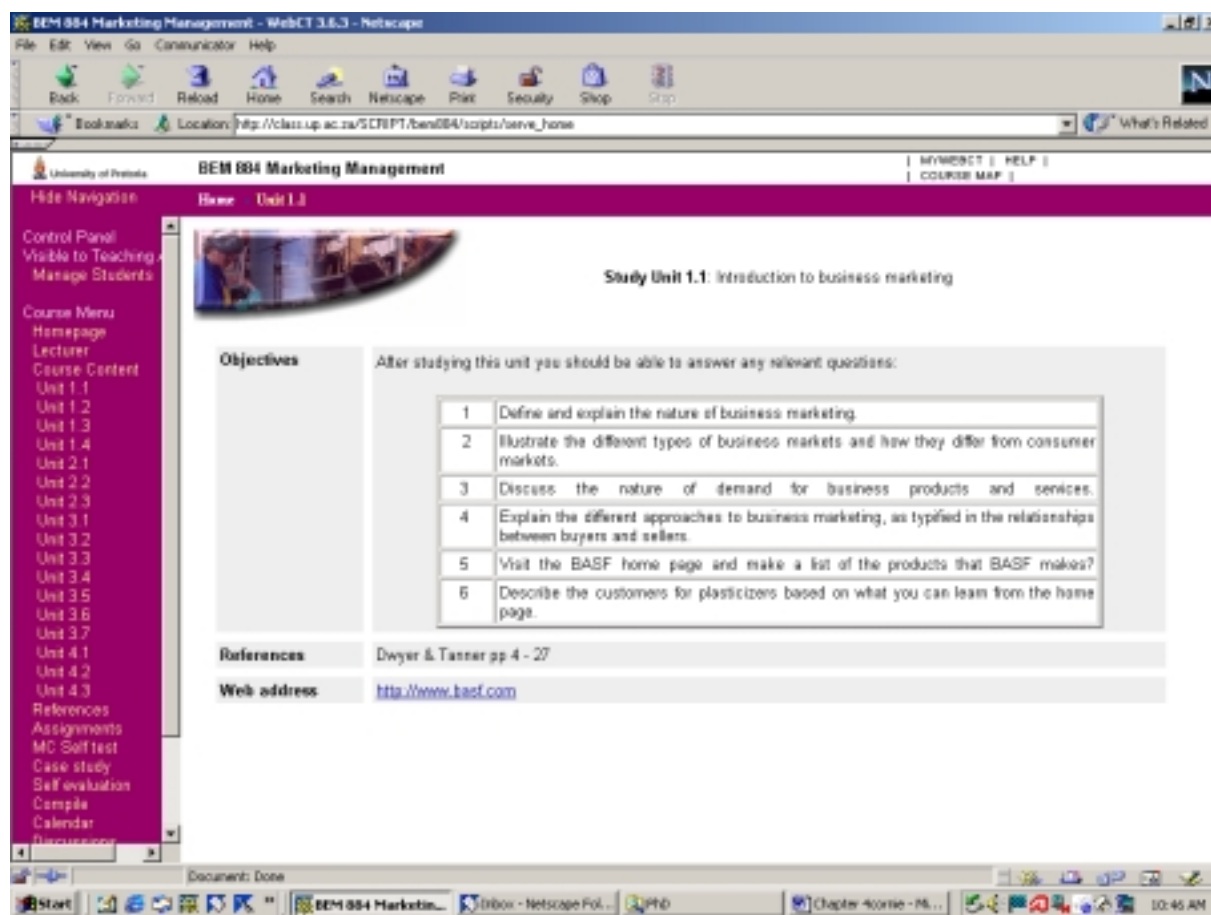
Setting out the advantages and disadvantages of a situation or solution.

Providing proof or supporting examples.

Making judgments supported by justification.

Perceiving a problem within a larger perspective.

Developing intervention strategies within a wider framework.



Screen capture 4.12 Outcomes in Marketing Management

These outcomes of Unit 1.1 are on a lower cognitive level of Bloom's taxonomy.

Questions 1 – 6 in the questionnaire (Annexure I) tests the construct of Deep processing of information). The table indicates the frequency (number of students) and percentage of students who rated the theme of Deep Information Processing on the Likert scale.

Likert	Frequency	Percent
1	1	0.6
1.6	5	3.0
1.8	2	1.2
2	5	3.0
2.2	4	2.4
2.4	7	4.2
2.6	42	25.7
2.8	18	11.0
3	21	12.8
3.2	22	13.5

3.4	9	5.5
3.6	18	11.0
3.8	4	2.4
4	5	3.0

Table 4.14 Frequency distribution of deep information processing

The frequency distribution indicates that deep processing of information takes place often in the learning experience for 45% of respondents (cumulative score of 3 – 3.8 on Likert). It takes place always for only 3% of respondents.

The total of 45% is low, considering that it is a postgraduate group.

Section B: Constructivist elements

This construct is based on Section 2.3.4, particularly the synthesis of constructivism by Bonk & Wisner (2000:6). Questions correspond to the following characteristics of constructivist learning:

Construction of meaning and knowledge that builds on prior knowledge.

Personal interpretation.

Meta skills.

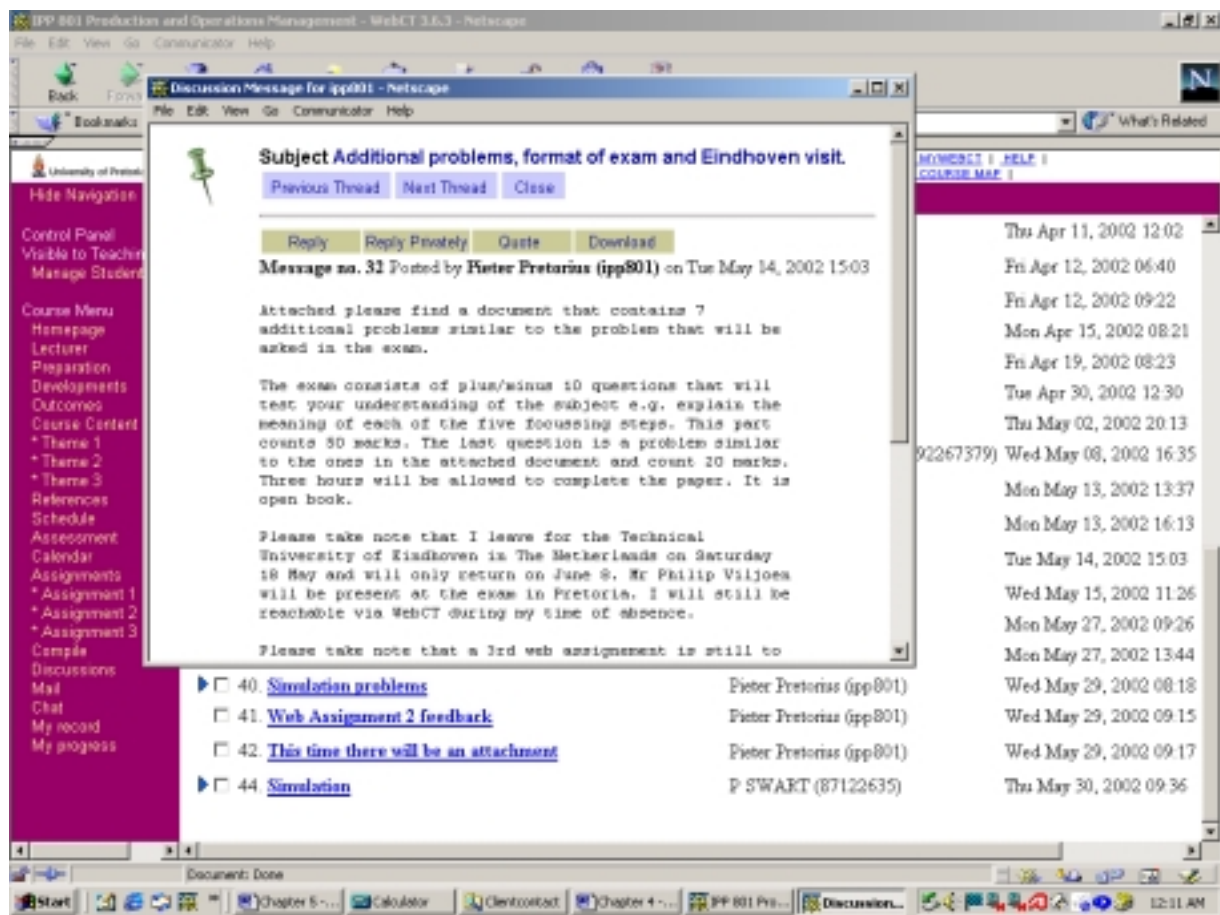
Active learning process.

Learning is collaborative – allowing for multiple perspectives.

Knowledge is situated in real life.

Assessment should be integrated with the task.

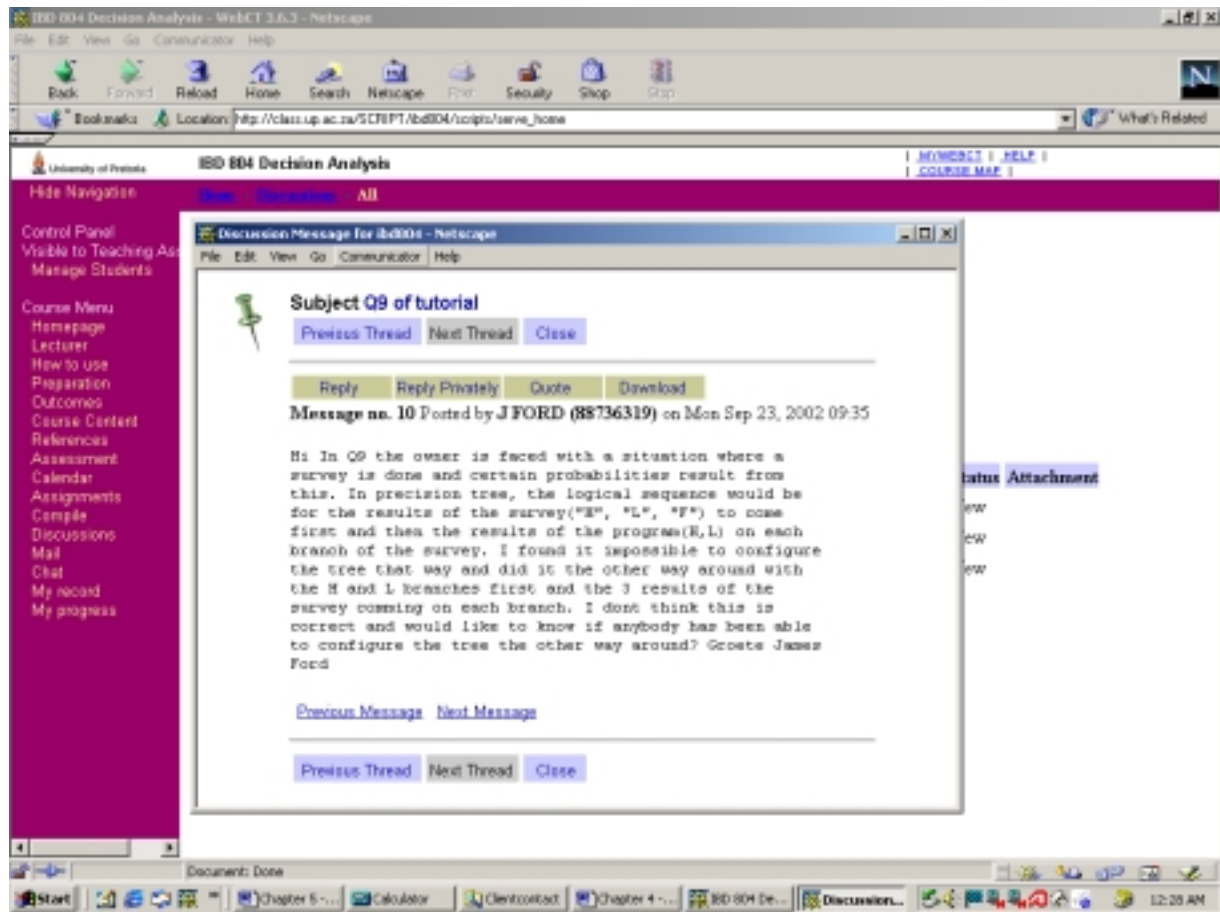
(High participation, transfer skills)



Screen capture 4.13 Arrangements for the exam and problem solving in Production and Operations Management

Screen capture 4.13 shows guidance regarding examination and also that the lecturer will be available via *WebCT* even though he will be overseas. The latter is a motivational strategy (Wlodkowski, 1999:294-297) and is an example of *concretely indicating cooperative intentions to help adults learn*.

It shows that *problem solving* forms a significant part of assessment in the course, which denotes cognitive and constructivist elements. An encouraging element is that the exam is open book – which means that it is not behavioural (rote learning) in spite of being an exam.



Screen capture 4.14 Group interaction in Decision Analysis

This message signifies a high level of group interaction and discussion. The particular learner states a problem he encountered in trying to answer a question. He explains how he tried to solve the problem, before asking assistance and clarification from his peers.

Returning to the quality of online discussions, this message reveals a question related to a case study and how the learner tries to solve the problem by negotiating meaning and testing whether his assumption is correct. It is a good example of spontaneous cooperative learning and learning on a high level.

The screenshot shows a WebCT interface for the course 'ISD 804 Decision Analysis'. The left sidebar contains a navigation menu with options like 'Home', 'Assignments', 'Control Panel', 'Course Menu', 'References', 'Calendar', 'Assignments', 'Complex', 'Discussions', 'Mail', 'Chat', 'My record', and 'My progress'. The main content area is titled 'Assignments' and contains the following information:

Assignment 1 Do the following problems and submit at **13h00 on August 14** (first class day of this course). Late submissions will unfortunately not be accepted since we will work through the solutions in class.

Problem 1 Case Study: Da Pont and Chlorofluorocarbons (Clemen & Reilly p15)

Problem 2 Questions and Problems 2.5 (Clemen & Reilly p37)

Problem 3 Toxicab (see notes page, slide 2-26)

Problem 4 To the best of our knowledge, with probability 0,8 AI is guilty of the crime for which he is about to be tried. Bo and CI, each of whom knows whether or not AI is guilty, have been called to testify. Bo is a friend of AI's and will tell the truth if AI is innocent but will lie with probability 0,2 if AI is guilty. Ci hates everybody but the judge and will tell the truth if AI is guilty but will lie with probability 0,3 if AI is innocent. Given this model of the situation:

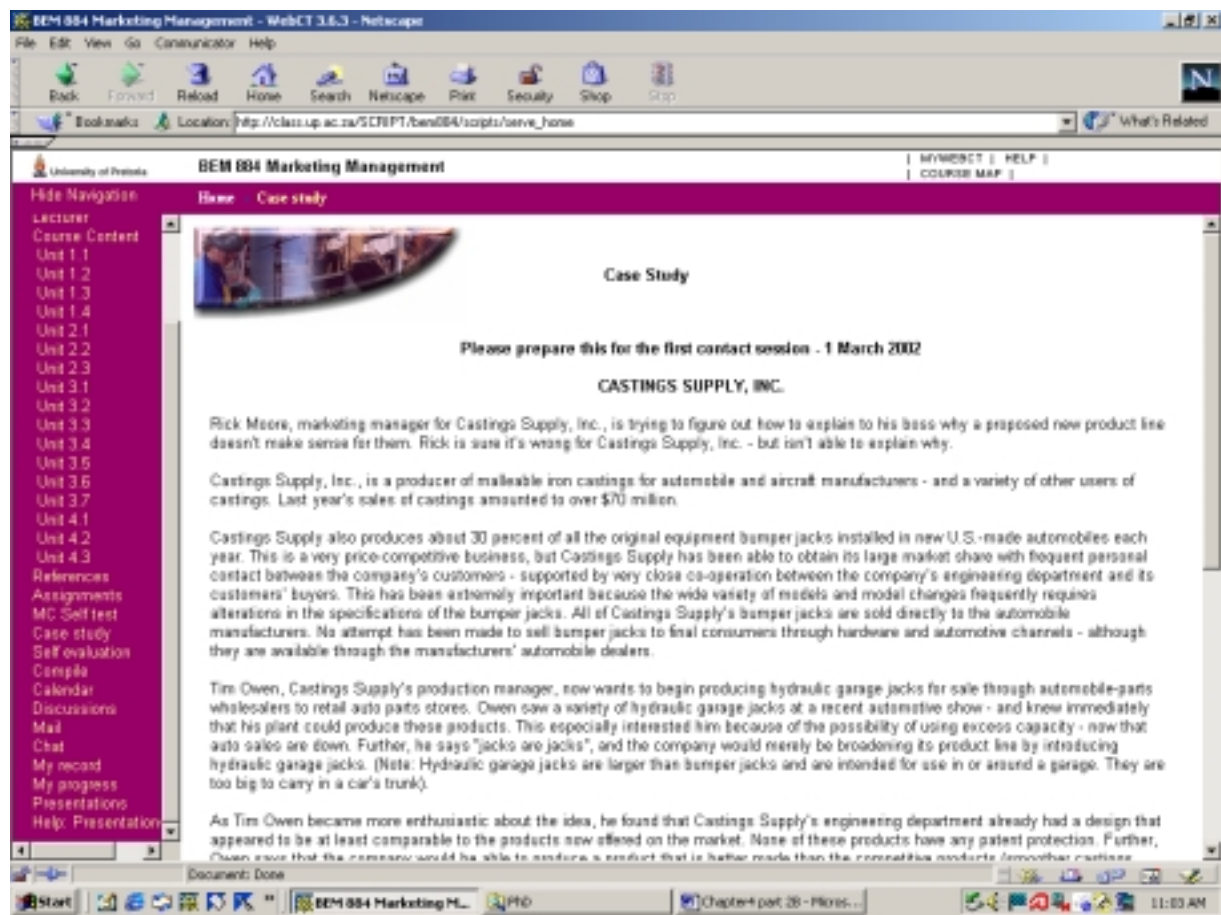
- Determine the probability that the witnesses give conflicting testimony.
- Which witness is more likely to commit perjury?
- What is the conditional probability that AI is innocent, given that Bo and Ci gave conflicting testimony?

Problem 5 The cost of designing tooling for the manufacture of a new product is uncertain. Some new technology and equipment is involved, introducing more uncertainty than usual. After careful consideration of the work involved, the production engineering department has submitted the following estimate to the project team:

Probability	Hours
0,1	300
0,1	400
0,4	550

Screen capture 4.15 Assignment in Decision Analysis

What is significant about this screen capture is that it illustrates the educational model described in Figure 4.15. Students are provided with problems in *WebCT* that they have to complete before they come to the second contact session. They are instructed that late submissions will not be accepted because the contact session will deal with the solutions to the problems. A case study is also given, which reflects constructivism.



Screen capture 4.16 Case study in Marketing Management

The prevalence of case studies in these courses is positive because it provides real life situations that learners must solve. Wlodkowski (1999: 294-297) states that the use of case studies enhance meaning and aids motivation.

Questions 10 – 18, 49 – 52, 58, 59, 67, 70 in the questionnaire address this construct.

The table indicates the frequency (number of students) and percentage of students who rated the theme of Constructivist elements on the Likert scale.

Likert	Frequency	Percentage
1.6	1	0.6
2	1	0.6
2.2	22	13.5
2.4	18	11.0
2.6	20	12.2
2.8	43	26.3
3	29	17.7

3.2	11	6.7
3.4	10	6.0
3.6	4	2.5
3.8	4	2.5

Table 4.15 Frequency distribution of constructivist elements

The frequency distribution indicates that constructivist elements are present often (cumulative 3 – 3.8 on Likert scale) in the learning experience of 36% of respondents.

The percentage of 36% is low, but indicates that constructivist elements are present in their learning environment.

Section C: Interaction

This construct is based on Section 2.3.10 and uses specifically the work of Curtis & Lawson (1999) and Oliver & Macloughlin (1996) in the questions:

Interaction consists of the following:

Receiving help.

Exchanging information.

Explaining and elaborating on information.

Sharing knowledge with others.

Challenging others' contributions.

Advocating increased effort and perseverance among peers.

Engaging in group skills.

Monitoring the efforts of others.

Oliver & Macloughlin (1996)

Kinds of interactions:

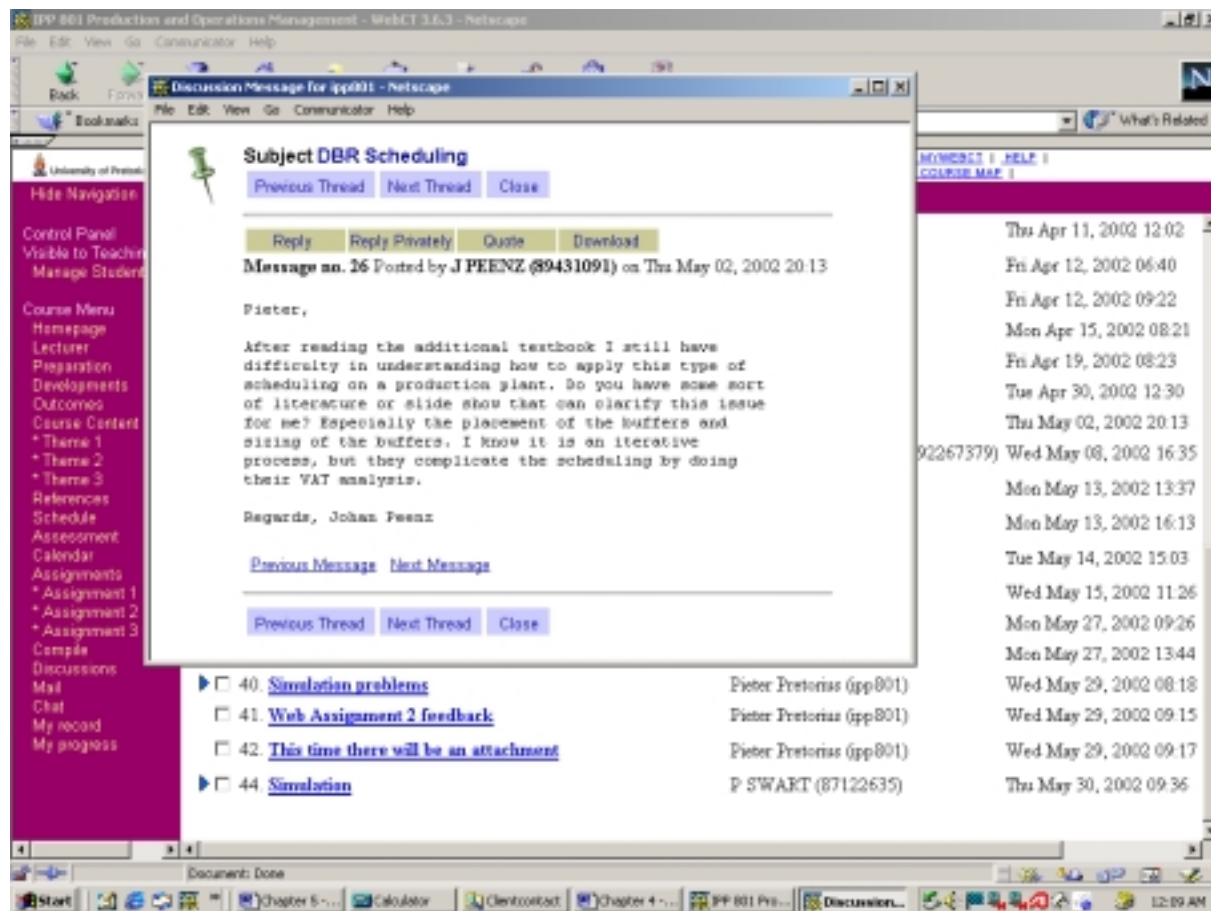
Social interaction.

Procedural interaction – dialogue between learner and lecturer.

Expository interaction – answering questions.

Explanatory interaction – using the learners reactions to explain new information.

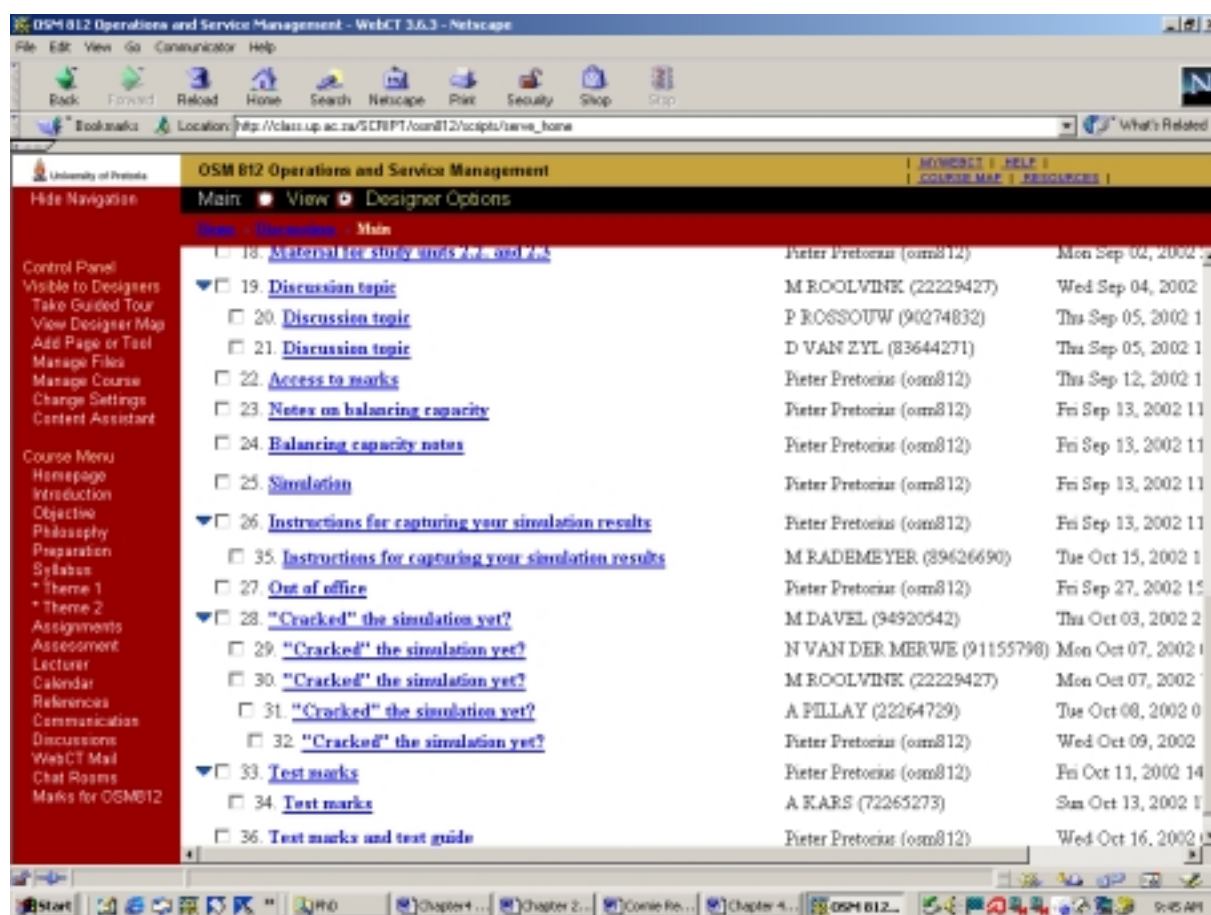
Cognitive interaction – giving a constructive answer to learners so that they reconsider their own ideas.



Screen capture 4.17 High level interaction in Production and Operations Management

This screen capture shows dialogue between the lecturer and student regarding a problem posed in an assignment.

From a learning theory perspective this type of interaction is conducive to effective learning in adults and reminiscent of the argument by Pea and Gomez (1992:5) that a learning conversation takes place when “both parties [lecturer and learner] clarify messages, test for understanding, compare and contrast with previous understandings” as discussed in Section 2.3.6. Discussions that are facilitated by technology should take place on this level in order to facilitate learning. As discussed in Section 2.3.10 some studies indicate that online discussions remain on the level of information sharing and comparing, as opposed to knowledge negotiation, construction, testing and application (Kanuka & Anderson, 1998; Bonk & Wisher, 2000). The fact that this course is singled out possibly signifies that this is one of the few courses where this level of communication takes place via *WebCT*.



Screen capture 4.18 Discussion in Operations and Service Management

This screen capture shows the frequency of discussions in Operations and Service Management. Note the combination of both administrative and subject-related topics. The allusion to “cracking a case” reflects a positive attitude of learners towards solving the simulation and also shows that they, or at least the particular individual, view it as a challenge.

Questions 19 – 48, 76 – 81 in the questionnaire address this construct.

The table indicates the frequency (number of students) and percentage of students who rated the theme of Interaction on the Likert scale.

Likert	Frequency	Percent
1.4	2	1.2
1.6	2	1.2
1.8	8	4.9
2	14	8.6

2.2	11	6.7
2.4	17	10.4
2.6	22	13.5
2.8	22	13.5
3	28	17.1
3.2	18	11.0
3.4	10	6.1
3.6	9	5.5

Table 4.16 Frequency distribution of interactions

The frequency distribution indicates that interactions take place often (cumulative Likert 3 – 3.6) for 40% of respondents.

The fact that only 40% of respondents experience interaction often in their learning environment is a concern. Especially in light of the importance of interaction between the lecturer and students in a web-supported environment this result could be considered too low.

Section D: Intrinsic motivation

This construct is based on the work by Fleming & Levie (1993:6) and Wlodkowski (1992:12), discussed in Section 2.3.5. Intrinsic motivation is enhanced by:

Variation.

Curiosity.

Relevance.

Challenge.

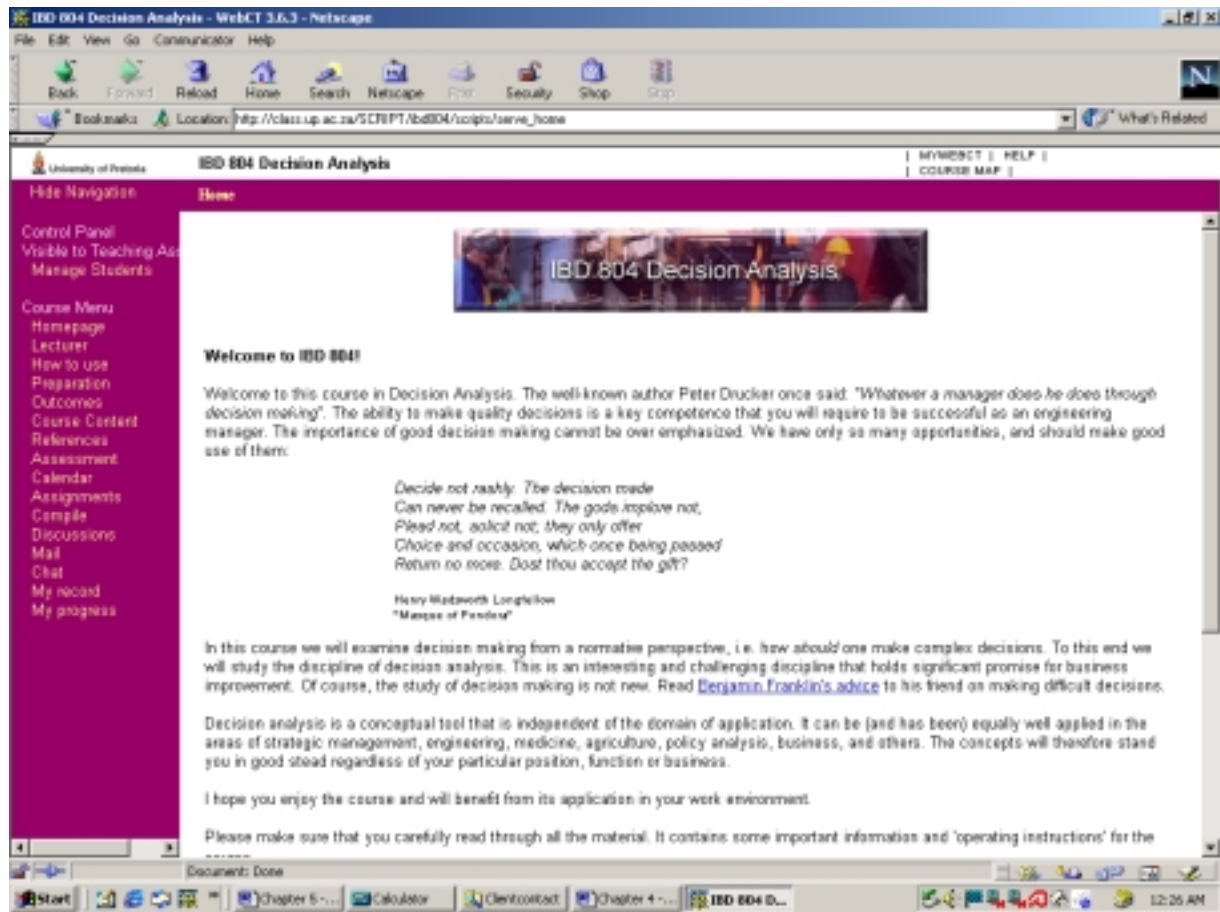
Control.

Success.

Choice.

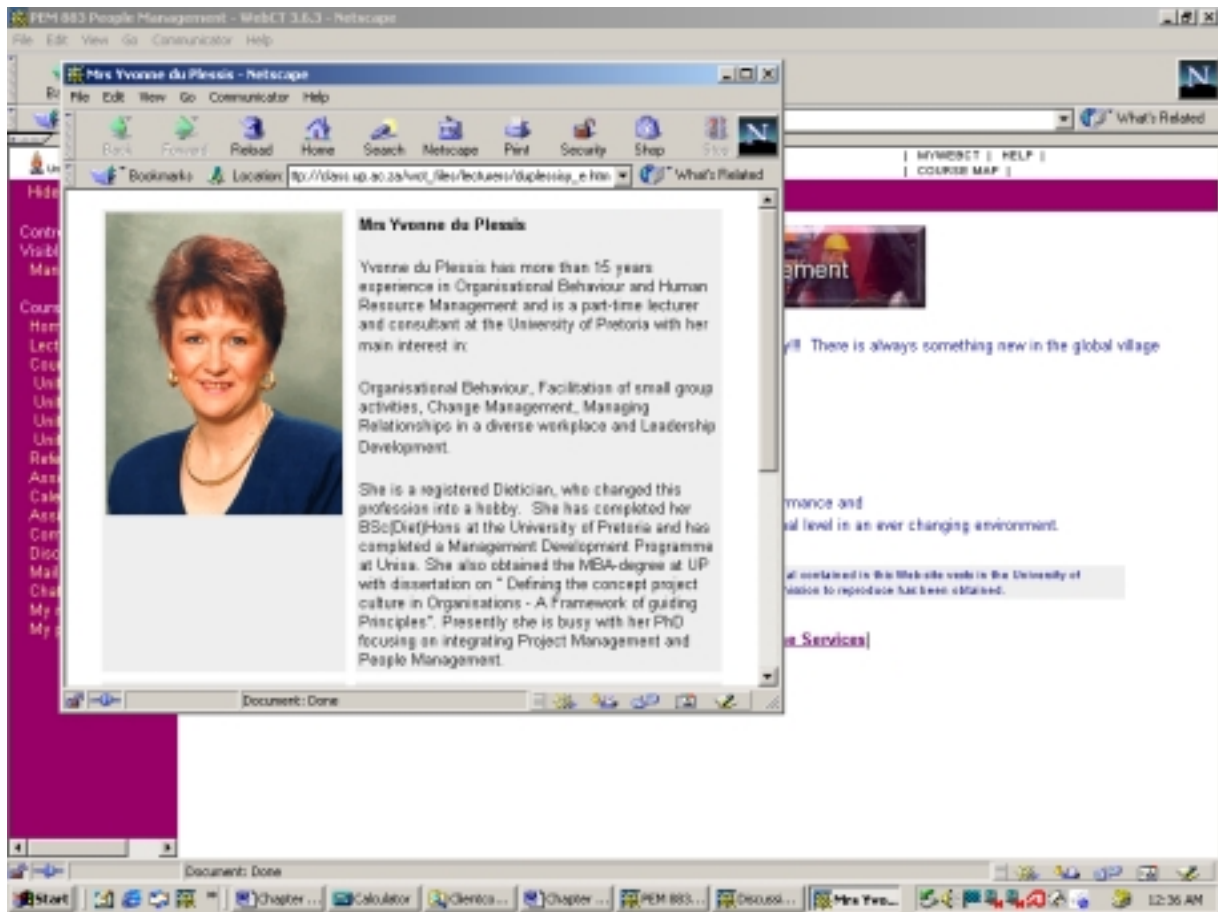
Value.

Enjoyment.



Screen capture 4.19 Welcome note in Decision Analysis

The Welcome note in Decision Analysis is a good example of how students can be introduced to a *WebCT* course. It pulls the learner into the subject field by citing a global expert on leadership – Peter Drucker, and proceeds to give an appropriate quote that reflects on the importance of decision making. The tone is enthusiastic and a sense of camaraderie is created by referring to ‘we’. It is further personalised and expresses the wish that the learner will benefit from the application of the knowledge in their work environments. It epitomizes two of the motivational strategies provided by Wlodkowski (1999: 294-297), i.e. “Allow for introductions” and “Emphasise the human purpose of what is being learned and its relationship to the learners’ personal lives and contemporary situations”.



Screen capture 4.20 The lecturer of People Management

This is an example of information about the lecturer that is provided on *WebCT*. Lecturers are encouraged to provide their photographs, because it assists in personalising a course. An abbreviated resume aids confidence in the competence of the lecturer.

The screenshot shows a web browser window displaying the 'BEM 884 Marketing Management' page. The browser's address bar shows the URL: http://class.up.ac.za/SCRIPT/bem884/scripts/serve_home. The page has a purple header and a navigation menu on the left. The main content area is divided into two sections: 'Criteria' and 'Weight allocation'.

Criteria Table:

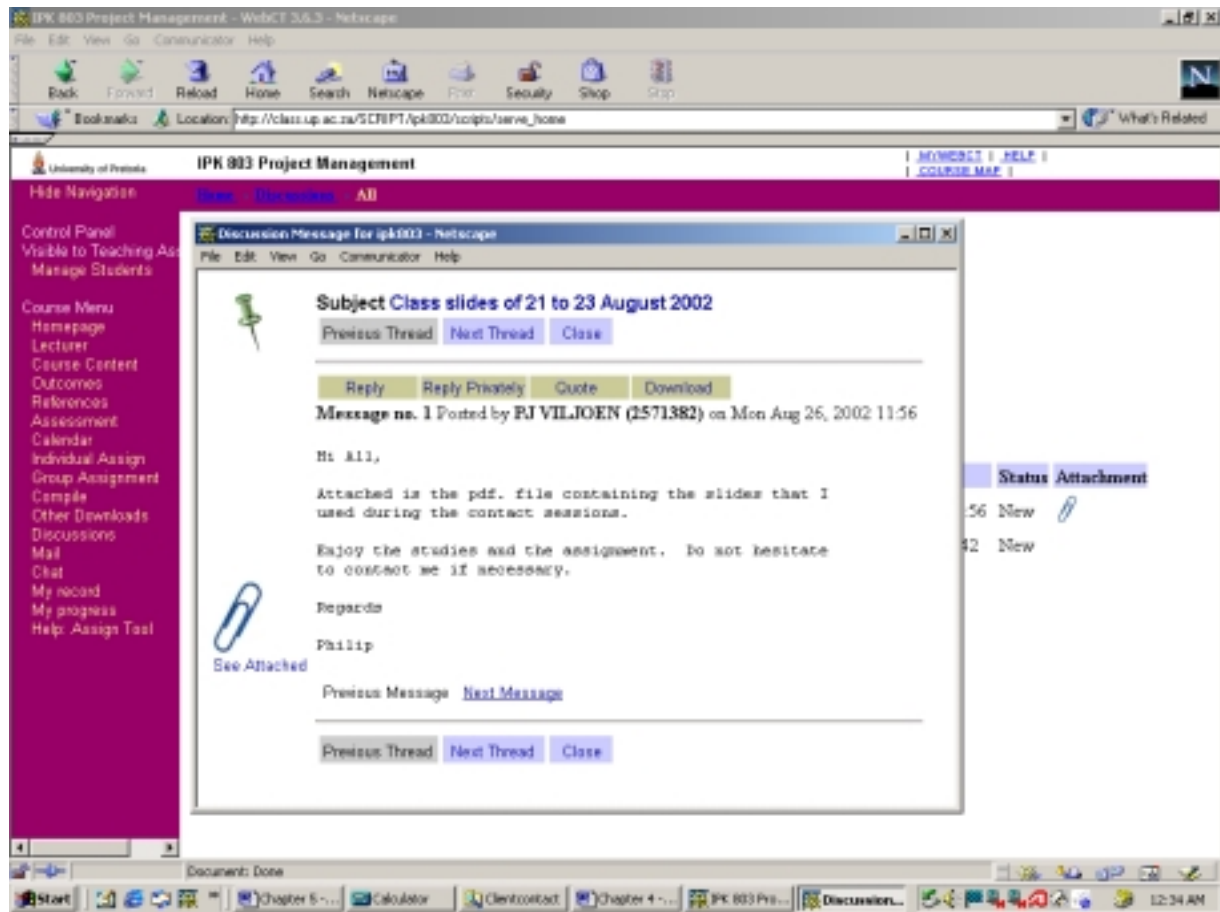
Criteria	Relative weight
1. Content	
Application of marketing theory	15
Creativity	10
Integration of concepts, models and strategy	20
Insight into the problem	15
Total for Content	60
2. Structure	
Introduction / Problem statement	5
Reasoning	10
Conclusions & recommendations	5
Total for Structure	20
3. Technical Aspects	
Table of Contents	5
Language & Grammar	5
Headings and numbering	5
Literature referencing	5
Total for Technical Aspects	20
Grand total	100

Weight allocation Table:

Criteria	Weight (%)
Assignment 1	50
Examination	50
Total	100

Screen capture 4.21 Assessment criteria for an assignment in Marketing Management

The assessment criteria are clear, which is conducive to learner control and motivation.



Screen capture 4.22 Power Point Slides in Project Management

What is interesting about this screen capture is that the lecturer provides the students with slides that were presented during a contact session. A different model would have entailed providing the slides beforehand in *WebCT*, and discussing questions about them during the contact session. As this is one of the courses that was singled out by first year MEM students it is noticeable that the lecturer is enthusiastic, encouraging and supportive. The motivational strategy of “Encourage the learner” (Wlodkowski, 1999: 294-297) is apparent.

The screenshot shows a web browser window displaying the course outline for BEM 884 Marketing Management. The browser's address bar shows the URL: http://class.up.ac.za/SCRIPT/bem884/scripts/serve_home. The page title is "BEM 884 Marketing Management".

On the left side, there is a "Hide Navigation" menu with the following items: Lecturer, Course Content, Unit 1.1, Unit 1.2, Unit 1.3, Unit 1.4, Unit 2.1, Unit 2.2, Unit 2.3, Unit 3.1, Unit 3.2, Unit 3.3, Unit 3.4, Unit 3.5, Unit 3.6, Unit 3.7, Unit 4.1, Unit 4.2, Unit 4.3, References, Assignments, MC Self test, Case study, Self evaluation, Conqis, Calendar, Discussions, Mail, Chat, My record, My progress, Presentations, and Help: Presentation.

The main content area is titled "BEM 884 Marketing Management" and includes a search bar with the text "2.3 Weaving marketing into the fabric of the firm". Below this, there are two main sections:

Part 3: Business Marketing Programming
Aim: Part 3 prepares you to develop programs that serve the customer and attain organisational objectives.

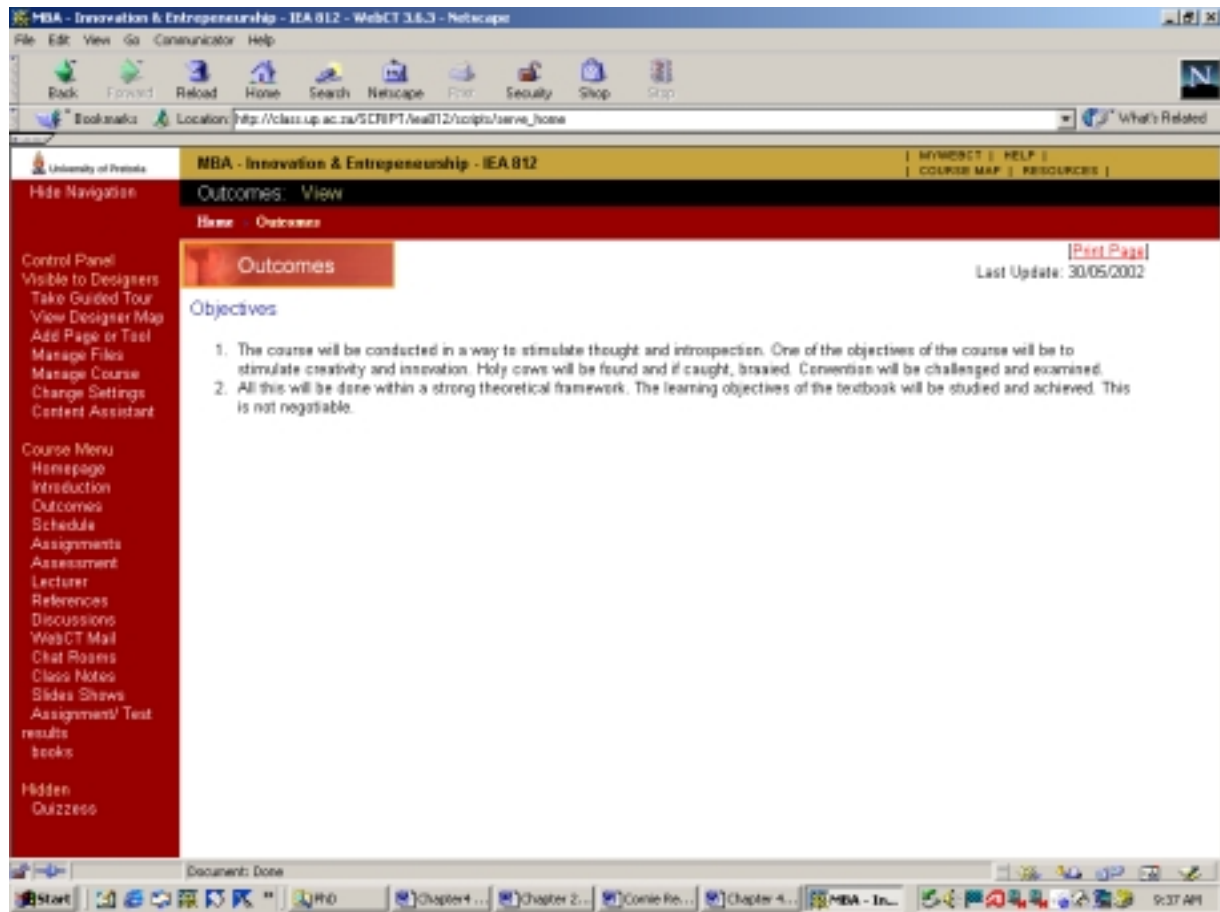
Unit	Description
3.1	Developing and managing products
3.2	Business marketing channels
3.3	Integrated marketing communication (IMC)
3.4	Communicating with the market
3.5	IMC: The One-to-One Media
3.6	Sales and sales management
3.7	Pricing and negotiating value

Part 4: Investing for value in customers and yourself
Aim: Part 4 tells you more about what business marketing is by looking at the essentials of business marketing with a new level of sophistication.

Unit	Description
4.1	Evaluating marketing efforts
4.2	Customer retention and maximisation
4.3	The future of business marketing

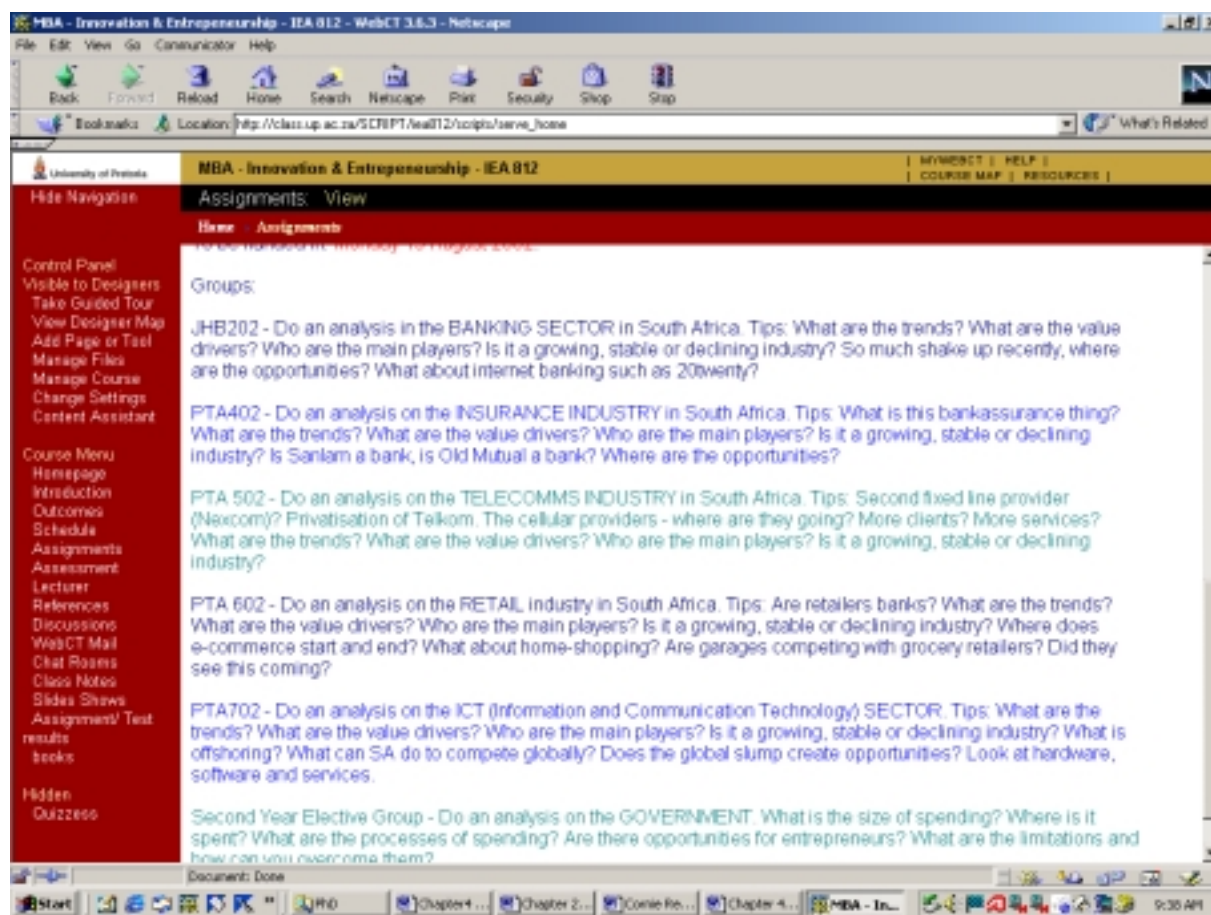
Screen capture 4.23 Course outline in Marketing Management

The fact that the course outline is available before the course starts provides learners with a mental model of the course. It facilitates effective learning by enabling individuals to work through the material at their own pace, in conjunction with structured time lines in a course. It could be considered a linear design model.



Screen capture 4.24 Outcomes of Innovation and Entrepreneurship

The outcomes in Innovation and Entrepreneurship presented with humour – an important motivational strategy (Wlodkowski, 1999: 294-297).



Screen capture 4.25 Group assignment in Innovation and Entrepreneurship

The assignments shown in Innovation and Entrepreneurship are meaningful because they relate learners to adult interests and use critical questions to stimulate learner engagement and challenge (Wlodkowski, 1999: 294-297).

Questions 53 – 57, 68, 69, 73 (barriers – external factors), 74 address this construct.

The table indicates the frequency (number of students) and percentage of students who rated the theme of Intrinsic motivation on the Likert scale.

Likert	Frequency	Percentage
1.8	1	0.6
2	2	1.2
2.2	10	6.1
2.4	9	5.7
2.6	31	19.1
2.8	42	25.9
3	25	15.4

3.2	26	16.1
3.4	7	4.3
3.6	9	5.6

Table 4.17 Frequency distribution of intrinsic motivation

The frequency distribution indicates that 39% of respondents (Likert 3 – 3.6) are often intrinsically motivated. This result is low, because it indicates that more than half of respondents are not often intrinsically motivated.

Question 73 was an open ended question that requested students to list the barriers that they experienced. The two main themes are that lecturers do not use *WebCT* and that they do not give prompt feedback.

Section E: Effective feedback

This construct is based on the work of Wlodkowski (1999:244-249) who states the following about effective feedback, as discussed in Section 2.3.10.

Effective feedback is informational rather than controlling.

Provides evidence of the learner's effect relative to the learner's intent.

Is specific and constructive.

Can be quantitative.

Is prompt.

Is frequent.

Is positive.

Is related to impact criteria.

Is usually personal and differential.

Questions 60-66, 82 address this construct.

The table indicates the frequency (number of students) and percentage of students who rated the theme of Effective feedback on the Likert scale.

Likert	Frequency	Percentage
1	3	1.8
1.2	7	4.3
1.4	2	1.2

1.6	14	8.6
1.8	18	11.1
2	15	9.2
2.2	28	17.2
2.4	11	6.7
2.6	31	19.1
2.8	18	11.1
3	4	2.4
3.2	6	3.7
3.4	1	0.6
3.6	3	1.8
3.8	1	0.6

Table 4.18 Frequency distribution of effective feedback

The frequency distribution indicates that only 9% of respondents experienced that they receive effective feedback often (cumulative of Likert 3 – 3.8). Compared to the other constructs, this result is extremely low. It means that 91% of students in these postgraduate programmes do not experience effective feedback often.

Section F: Learner – centred assessment

This construct is based on the work of Brown & Duguid (1996:10) who define learner-centred assessment as follows in Section 2.3.7:

Continuous learner and course assessment is used to analyse teaching.

Learner performance is observed by others versus only private assessment by the instructor.

Learners help define the questions rather than instructors simply handing out facts.

The screenshot displays a web browser window with the URL http://class.up.ac.za/SCIT/P1/app801/scripts/serve_home. The page title is 'IPP 801 Production and Operations Management' and it is part of the University of Pretoria's WebCT system. The main content area is titled 'Assessment' and contains the following information:

Evaluation policy
This course will be examined by means of tests, individual and group assignments, continuous web evaluation and an examination. The continuous web evaluation will consist of short assignments and/or multiple choice assessments on material prepared according to the self study schedule. Notification of these evaluations will be communicated via the WebCT Communication facility. The exam will have as its primary focus the management aspects (Syllabus themes 2 and 3) and will test facts, concepts, and problems, as well as application to business situations. It will be an open book exam but you will not be allowed to use computer notebooks or any electronic device other than a calculator.

Grading policy

Syllabus theme	Type of evaluation	Weight (%)
1	Continuous web evaluation	5%
	Closed book test	15%
2	Continuous web evaluation	5%
	Individual assignment (Individual XY problems)	10%
	Group assignment (The Goal principles)	20%
3	Continuous web evaluation	5%
	Group assignment (Applications)	40%
Progress mark		100%

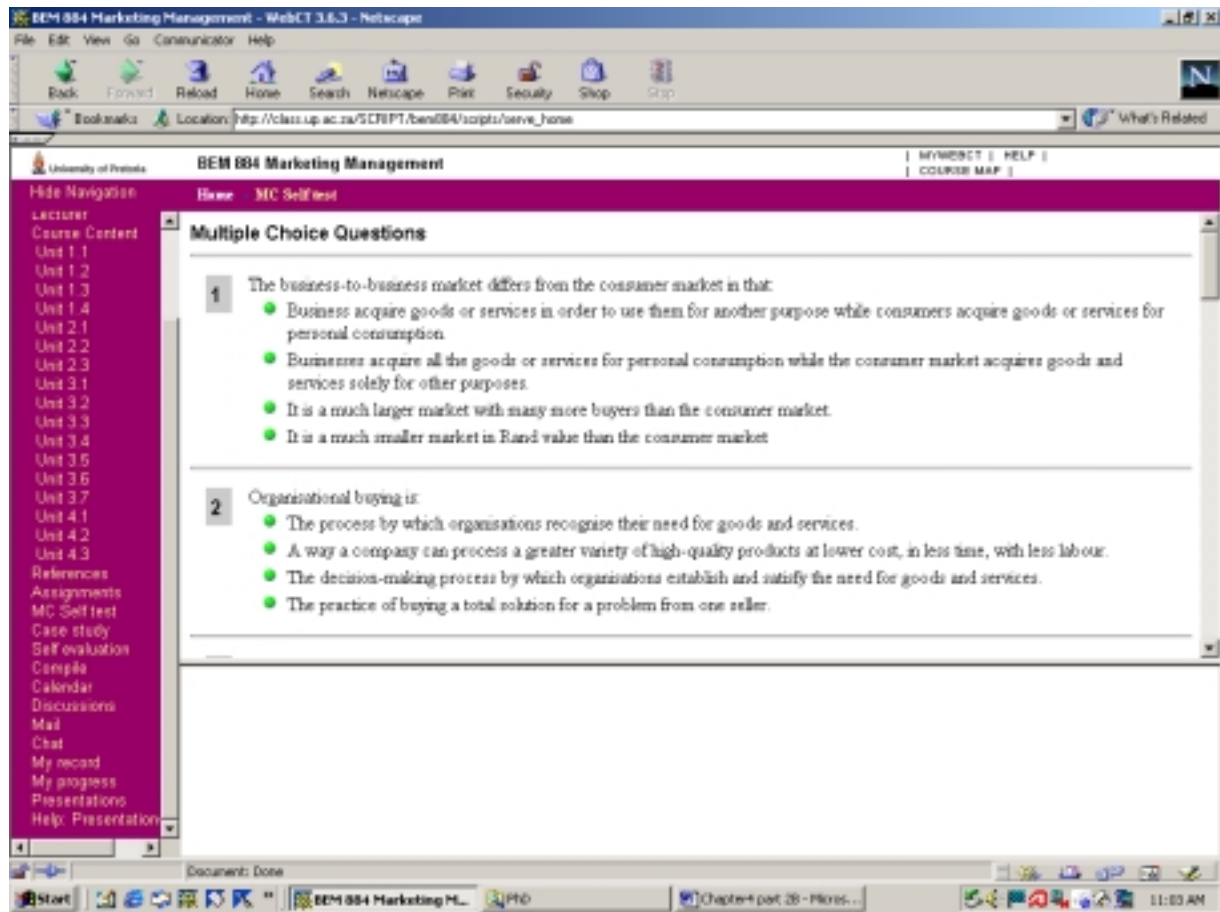
Final mark = (Progress mark + Exam mark) / 2

Late handing in of Assignments handed in after the due date will carry a 10% penalty per calendar day late unless arranged with the

Screen capture 4.26 Evaluation outline in Production and Operations Management

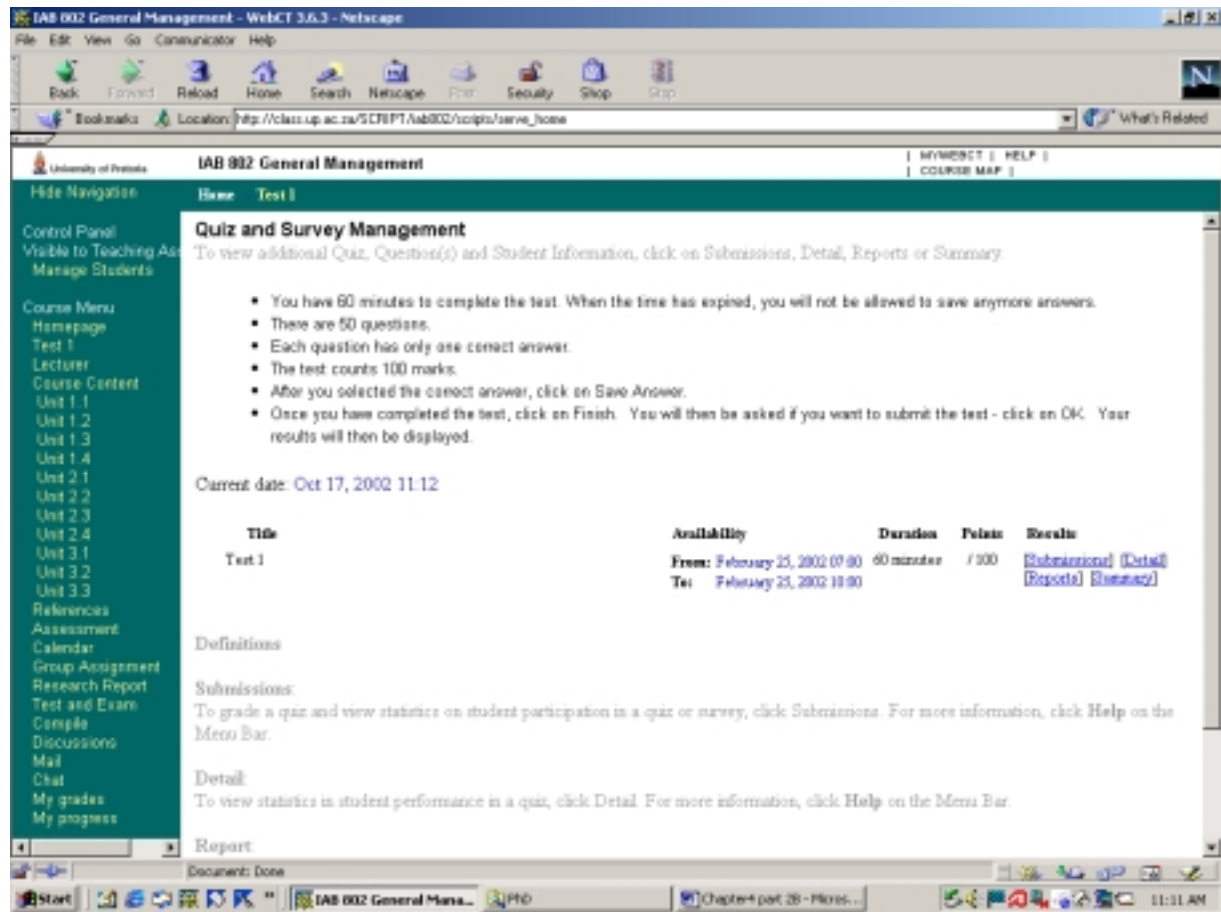
This screen capture illustrates the evaluation in the course. It is significant that a wide variety of assessment methods are used, which includes continuous assessment and individual and group assessment. Both signify a learner centred approach, as described in Section 2.3.9.

It is a motivational strategy to clearly identify learning outcomes and to make assessment, tasks and criteria known to learners (Wlodkowski, 1999: 294-297).



Screen capture 4.27 Quiz in Marketing Management

The *WebCT* quiz tool is useful for continuous self-assessment. It is reminiscent of a motivational strategy provided by Wlodkowski (1999: 294-297) "Use self-assessment methods to improve learning and to provide learners with the opportunity to construct relevant insights and connections.



Screen capture 4.28 Quiz in General Management

Questions 7, 8, 9, 71, 72, 75

Likert	Frequency	Percentage
1.4	1	0.6
1.6	4	2.4
1.8	3	1.8
2	11	6.7
2.2	12	7.3
2.4	16	9.8
2.6	46	28.2
2.8	14	8.5
3	23	14.1
3.2	13	7.9
3.4	14	8.5
3.6	4	2.4
3.8	1	0.6
4	1	0.6

Table 4.19 Frequency distribution of learner-centred assessment

As reported in Section 4.15.9.1 on *validity* and *reliability* the Cronbach Alpha test indicates a lower level of accuracy in terms of reliability for this construct. The frequency distribution indicates that 34% of respondents experience learner-centred assessment often (Likert 3 – 3.8). One could interpret this result that the perception of the majority of students is that assessment is not learner centred.

Figure 4.19 provides an overview of the percentage per theme.

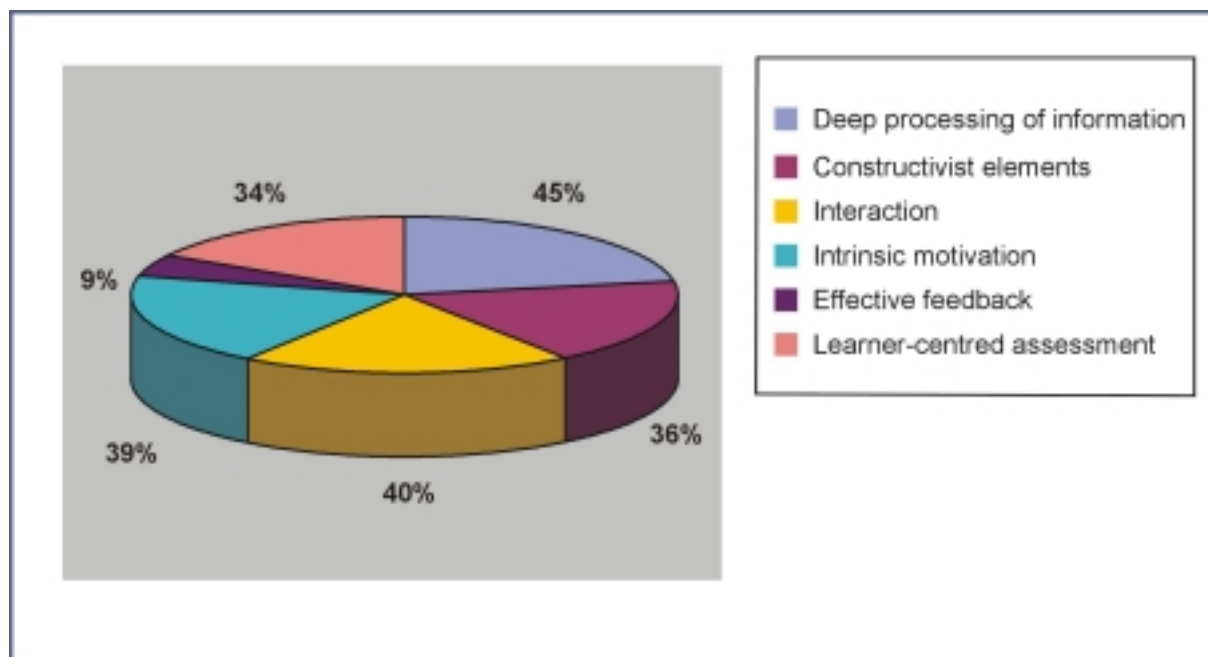


Figure 4.19 Percentage (*often* on Likert scale) per theme

What can be deduced from the findings is that cognitive and constructivist elements are present in the programmes, and manifest lower than 50%. Of significance is that Effective Feedback is so low. It is reason for concern because interaction is not very high either, which means that learners do not have adequate interaction with lecturers apart from the two two- week long contact sessions per year. This conclusion is based on the fact that the questionnaire dealt with the learning environment in totality and not only on the use of *WebCT*.

The mean score for the six constructs are as follows:

Variable	N	Mean	Std Dev
Deep information processing	163	2.9	0.5
Constructivist	163	2.8	0.4

elements			
Interaction	163	2.7	0.5
Intrinsic motivation	162	2.9	0.4
Effective feedback	162	2.3	0.6
Learner – centred assessment	163	2.7	0.5

Table 4.20 Mean score per theme

The *means test* indicates that all six constructs fall on average on ‘sometimes’ on the Likert scale, or between ‘sometimes’ and ‘often’; which is not very conclusive. *Effective feedback* scores the lowest and differs considerably from the results of the other constructs.

An analysis of selected individual items is subsequently made. Only the largest percentage in terms of frequency is indicated.

Deep information processing

Item	Question	Frequency distribution
V1	I link facts, ideas and notions in order to interpret, infer, propose and judge	Often 47%
V2	I contribute new elements of information	Often 44%
V3	I create new knowledge	Sometimes 45%
V4	I propose solutions supported by justification	Often 48%
V5	I make judgments supported by justification	Often 57%
V6	I propose advantages and disadvantages of a situation or solution	Often 56%

Table 4.21 Individual items of Deep Information Processing

It is noticeable that V3 on the creation of new knowledge had the highest frequency on the Likert scale of *sometimes*, indicating that respondents are possibly less sure of their creating knowledge than other questions related to deep information processing. The fact that 57% often *make judgments supported by justification* indicates a satisfying level of *evaluation* in the learning environment. Problem solving, on the other hand, as indicated by V4, is lower at 48%.

Constructivist elements

Item	Question	Frequency distribution
V10	I take an active role in learning.	Always 42%
V11	I take a pro-active role in learning.	Often 38%
V12	I cannot complete a cooperative/group assignment without the contribution of others in the group.	Sometimes 35%
V13	I remain accountable for a group assignment.	Always 50%
V14	Everyone shares leadership in a group assignment.	Often 45%
V15	Everyone shares responsibility in a group assignment.	Always 42%
V16	The group is involved in processing its effectiveness.	Often 35%
V17	The lecturer observes during group assignments.	Sometimes 35%
V18	The lecturer intervenes during group assignments.	Not at all 55%
V49	The learning outcomes in my courses build on my prior knowledge	Often 42%
V50	I can apply what I learn to my work environment.	Often 49%
V51	The assessment criteria allows for multiple perspectives.	Often 46%
V52	The role of the lecturer is to help students learn about the real world.	Often 43%
V58	Learning takes place with other people.	Often 53%
V59	I prefer learning alone.	Often 55%
V67	What I apply has visible consequences.	Sometimes 44%
V70	The assignments are situated in real-life situations, like case studies.	Often 43%

Table 4.22 Individual items of Constructivist elements

Some of the item results require closer scrutiny due to their significance. Only 42% of respondents take an active role in learning (V10). The fact that 50% of respondents feel that they always remain accountable for a group assignment is positive. More than half of respondents (55%) indicated that they *prefer learning alone* often (V59) and almost half (53%) indicated that *learning takes place with other people* (V58). The relevance of their studies to their work environment (V67 *What I apply has visible consequences*, and V70 *The assignments are situated in real-life situations, like case studies*) is quite low at 44% (*sometimes*) and 43% (*often*). It is reason for concern that only 42% of respondents feel that their learning outcomes build on their prior knowledge (V49). It could be ascribed to the interdisciplinary natures of particularly the MPM and the MBA, yet no significant difference was found amongst these groups and the MEM, which is focused on engineers.

Co-operative learning

In an attempt to establish whether true co-operative learning occurs, the items constituting the construct of **Constructivist elements** were screened for those items that reflect the true characteristics of co-operative learning (Section 2.3.10).

Important items are V12, V13, V14, V15, V16, V17 and V18

Item	Question	Frequency distribution
V12	I cannot complete a cooperative/group assignment without the contribution of others in the group.	Sometimes 35%
V13	I remain accountable for a group assignment.	Always 50%
V14	Everyone shares leadership in a group assignment.	Often 45%
V15	Everyone shares responsibility in a group assignment.	Always 42%
V16	The group is involved in processing its effectiveness.	Often 35%
V17	The lecturer observes during group assignments.	Sometimes 35%
V18	The lecturer intervenes during group assignments.	Not at all 55%

Table 4.23 Individual items measuring extent of true co-operative learning

From this analysis it can be said that less than half of respondents experience a significant amount of true co-operative learning. What is interesting is that such a large percentage indicate that lecturers do not intervene during group assignments.

Interaction

Item	Question	Frequency distribution
V19	Social interaction takes place with other learners.	Often 44%
V20	Dialogue with the lecturer takes place often via e-mail.	Sometimes 61%
V21	Dialogue with the lecturer takes place often via WebCT discussion tools.	Not at all 42%
V22	Dialogue with the lecturer takes place often during block sessions (face-to-face).	Always 56%
V23	The lecturer answers our questions.	Always 52%
V24	We answer the lecturers' questions.	Often 48%
V25	My reaction/answer to a question is used by the lecturer to explain new information.	Sometimes 41%
V26	The lecturers' answers to my questions encourage me	Often 47%

	to reconsider my ideas.	
V27	The interactions between block sessions lead to increased learning	Always 40%
V28	The interactions between block sessions lead to increased participation.	Always 32%
V29	The interactions between block sessions develop communication with the lecturer.	Not at all 29%
V30	The interactions between block sessions develop communication with fellow learners.	Always 34%
V31	The interactions between block sessions enhance elaboration	Often 40%
V32	The interactions between block sessions enhance retention.	Often 33%
V33	The interactions between block sessions support self-regulation	Often 39%
V34	The interactions between block sessions support self-directed learning.	Often 38%
V35	The interactions between block sessions increase my motivation.	Always 36%
V36	The interactions between block sessions facilitate negotiation of understanding.	Often 34%
V37	The interactions between block sessions facilitate team building.	Always 32%
V38	The interactions between block sessions facilitate discovery.	Often 36%
V39	The interactions between block sessions facilitate exploration.	Often 37%
V40	The interactions between block sessions facilitate clarification of understanding.	Often 35%
V41	The interactions between block sessions take place on a level of information sharing.	Often 45%
V42	The interactions between block sessions take place on a level of information comparing.	Often 44%

V43	The interactions between block sessions take place on a level of knowledge negotiation.	Often 35%
V44	The interactions between block sessions take place on a level of knowledge construction.	Sometimes 35%
V45	The interactions between block sessions take place on a level of knowledge testing.	Sometimes 32%
V46	The interactions between block sessions take place on a level of knowledge application.	Sometimes 35%
V47	The interactions between block sessions aid clarification of my ideas.	Often 40%
V48	The interactions between block sessions aid clarification of my ideas and the ideas of others.	Often 38%
V76	I exchange resources with fellow learners.	Often 47%
V77	I exchange information with fellow learners.	Often 52%
V78	I challenge others contributions.	Often 48%
V79	I share knowledge with others.	Sometimes 59%
V80	I monitor the efforts of others.	Sometimes 53%
V81	I engage in group skills.	Often 52%

Table 4.24 Individual items of Interaction

Returning to Section 2.3.10, Oliver & Macloughlin talk about *procedural interaction* which in this instance is experienced always by 56% of students as V22 indicates.

Expository interaction is indicated by V23 and V24, namely *always* 52% and *often* 48%.

Explanatory interaction is indicated by V25 as *sometimes* 41%.

Cognitive interaction is indicated by V26 as *often* 47%.

Hence *procedural interaction* (dialogue between learner and lecturer) is experienced more than other types of interactions.

V44 – V46 are significant in that all relate to knowledge (construction, testing, application) and respondents indicated that they experience it sometimes (34% average), which could be considered low for a postgraduate programme.

Intrinsic motivation

Item	Question	Frequency distribution
V53	The assignments are too easy to solve.	Not at all 57%
V54	The assignments are too difficult to solve.	Often 58%
V55	What I study makes me more competent.	Often 48%
V56	My studies help me to be successful.	Often 46%
V57	I am responsible for learning to take place.	Always 67%
V68	The assignments in my courses foster curiosity.	Often 50%
V69	The lecturer fosters curiosity in the subject matter.	Sometimes 45%
V74	I feel I have control over the learning experience in terms of when, how and where I learn.	Often 38%

Table 4.25 Individual items of Intrinsic motivation

Items in Table 4.25 indicate that learners take responsibility for their learning (V57) and that on average less than half of the respondents are intrinsically motivated. It is disconcerting to look at the result of V74 in which only 38% indicated that they *often* feel in control of the learning environment.

Effective feedback

Item	Question	Frequency distribution
V60	Feedback in my courses is prompt.	Sometimes 51%
V61	Feedback in my courses is frequent.	Sometimes 44%
V62	Feedback in my courses is positive.	Often 46%
V63	Feedback in my courses is personalised.	Sometimes 44%
V64	Feedback in my courses relates to assessment criteria.	Sometimes 42%
V65	Feedback in my courses is specific.	Often 30%
V66	Feedback in my courses is constructive.	Often 44%
V82	I receive help and feedback timeously.	Sometimes 50%

Table 4.26 Individual items of Effective feedback

These items indicate that less than half of respondents experience effective feedback sometimes or often. 51% of respondents experience effective feedback *sometimes*. As indicated earlier in this section, only 9% of respondents experience effective feedback *often*.

Learner – centred assessment

Item	Question	Frequency distribution
V7	Continuous assessment takes place in my courses.	Often 37%
V8	My performance is observed by others versus only private assessment by the lecturer.	Sometimes 35%
V9	I help define the questions in the assignments.	Not at all 60%
V71	Assessment is varied (multiple choice, group assignments, individual assignments, exams).	Always 37%
V72	Assessment is appropriate for the specific courses I take.	Often 52%
V75	The assessment criteria are clear.	Often 42%

Table 4.27 Individual items of Learner centred assessment

A significant result in Table 4.27 is that the majority of respondents (60%) do not help define questions in assignments. This correlates with V11 in which only 38% of respondents indicated that they often take a pro-active role in learning. Yet this construct proved not to have a high level of reliability and the researcher would consequently be hesitant to interpret these results.

The fact that multiple methods of assessment are used in the courses offered in MEM, MPM and MBA is a positive finding. It appears that few courses demonstrate high level learning discussions. A recommendation would be to provide lecturers with strategies to plan, order and execute interactions and discussions so that it is structured as opposed to haphazard. In addition to encouraging learners to engage in discussions, lecturers should use specific strategies to elicit discussion.

The following section reports on the perceived important characteristics of a web lecturer.

Important characteristics of a *WebCT* lecturer from a student perspective

Characteristic	Mean	Std Dev	Rating (1 as most important and 12 as least important)
Expertise	3.2	3.0	1
Clarity	3.8	2.7	2
Responsive	4.6	2.8	3
Enthusiasm	4.9	3.0	4

Positive	5.1	2.3	5
Flexible	6.9	2.5	6
Friendly	7.2	2.6	7
Patience	7.5	2.6	8
Web-smart	7.6	3.6	9
Empathy	8.2	2.9	10
Caring	8.2	2.8	10
Cultural responsiveness	9.7	2.8	11

Table 4.28 Rating of important characteristics of a Web lecturer from a student perspective

The results in Table 4.28 indicate that students rated the characteristic of *Expertise* as the highest, followed by *Clarity* and *Responsiveness*. It is significant that both *Expertise* and *Responsiveness* correlate with the top three characteristics identified by lecturers. The fact that students rate *Expertise* as the most important characteristic could indicate that they still regard competency in the subject field as the most important characteristic, regardless of mode of instruction. The implication of choosing *Clarity* as the second most important characteristic could imply a need for more structure due to the mode of instruction. This also pertains to choosing *Responsiveness* – implying a need for responsiveness, possibly because of the mode of instruction. It is interesting that the characteristics of *Caring* and *Enthusiasm* rate so low, compared to lecturers who rate *Enthusiasm* as the most important characteristic. This could indicate that this particular grouping of respondents with a profile of engineers and managers are task oriented and more concerned about effectiveness and efficiency than affective and motivational aspects of their studies.

The results of the question on the role of the lecturer indicate that roles of *Facilitator*, *Mentor*, *Mediator*, *Co-learner*, *Provocateur* and *Assistant* were considered to be the most appropriate roles for students.

These roles share a strong common theme of supporter – indicating that respondents have a need for a lecturer in a supporting role. The ones that correlate with the most appropriate roles as perceived by lecturers are those of *Facilitator*, *Mentor* and *Provocateur*.

4.15.10 Examples of specific courses

Students could indicate below each question which course/s the answer applies to. Project Management, Decision Analysis, General Management and People Management had the highest frequency among first year MEM students. In the second year MEM students, 14 students mentioned that Production and Operations Management (IPP 803) is a course in which the lecturer observes during group assignments and in which dialogue with the lecturer takes place via the *WebCT* discussion tools. The courses with the highest frequency in terms of being examples of their statements were Decision Analysis, Marketing Management, Production, Operations Management and Project Management. Four respondents in the first year MPM group listed Technology Management, Project Management, Marketing Management, Production and Operations Management, Quality Management, Human Resource Management and Organisational Behaviour as courses to which their statements apply. A total of 19 respondents indicated that their statements pertain to all the courses. In the second year MPM group 7 respondents indicated that their statements pertain to all courses. Systems Engineering, General Management and Project Management Practises were singled out by four respondents. In the first year MBA group, 11 students listed Entrepreneurship and Innovation, Operations and Service Management, Human Resources Management, Decision and Risk Management and Marketing Management. A total of 15 respondents indicated that their responses include all courses.

In Section 4.16 the virtual campus is compared to the benchmarking document provided in Chapter Three.

4.16 Benchmarking

Symbols used:

- ✓ The benchmark is in place.
- ✗ The benchmark is not in place.
- ☒ The benchmark is in process.
- ! The benchmark is a concern.

Benchmarks

Institutional support

1. A documented technology plan that includes electronic security measures (i.e., password protection, encryption, back-up systems) is in place and operational to ensure both quality

Benchmarks

standards and the integrity and validity of information. ☒

2. The reliability of the technology delivery system is as failsafe as possible. ☒
3. A centralized system provides support for building and maintaining the electronic education infrastructure. ✓

Course Development

4. Guidelines regarding minimum standards are used for course development; design and delivery, while learning outcomes – not the availability of existing technology – determine the technology being used to deliver course content. ✓
5. Instructional materials are reviewed periodically to ensure they meet program standards. ✓
6. Courses are designed to require students to engage themselves in analysis, synthesis and evaluation as part of their course and program requirements. ✓

Teaching/Learning

7. Student interaction with faculty and other students is an essential characteristic and is facilitated through a variety of ways, including voice-mail and/or e-mail. ✓
8. Feedback to student assignments and questions is constructive and provided in a timely manner. !
9. Students are instructed in the proper methods of effective research, including assessment of the validity of resources. ✓

Course structure

10. Before starting an online program, students are advised about the program to determine:
 - If they possess the self-motivation and commitment to learn via electronic education and!
 - If they have access to the minimal technology required by the course design. ✓
11. Students are provided with supplemental course information that outlines course objectives, concepts and ideas and learning outcomes for each course are summarized in a clearly written, straightforward statement. ✓
12. Students have access to sufficient library resources that may include a “virtual library” accessible through the World Wide Web. ✓
13. Faculty and students agree upon expectations regarding times for student assignment completion and faculty response. !

Student Support

14. Students receive information about programs, including admission requirements, tuition and fees, books and supplies, technical and proctoring requirements, and student support services. ✓
15. Students are provided with hands-on training and information to aid them in securing material through electronic databases, interlibrary loans, government archives, news services and other sources. ✓
16. Throughout the duration of the course/program, students have access to technical assistance, including detailed instructions regarding the electronic media used, practice sessions prior to the beginning of the course and convenient access to technical support staff. ✓

Benchmarks

17. Questions directed to student service personnel are answered accurately and quickly, with a structured system in place to address student complaints. ☒

Faculty Support

18. Technical assistance in course development is available to faculty who are encouraged to use it. ✓
19. Faculty members are assisted in the transition from classroom teaching to online instruction and are assessed during the process. ✓
20. Instructor training and assistance, including peer mentoring, continues through the progression of the online course. !
21. Faculty members are provided with written resources to deal with issues arising from student use of electronically accessed data. ✓

Evaluation and Assessment

22. The program's educational effectiveness and teaching/learning process is assessed through an evaluation process that uses several methods and applies specific standards. ✗
23. Data on enrolment, costs, and successful/innovative uses of technology are used to evaluate program effectiveness. ✗
24. Intended learning outcomes are reviewed regularly to ensure clarity, utility and appropriateness. ☒

Table 5.27 Benchmark application to virtual campus

In light of lessons learnt and feedback from clients (students, faculty and support departments) the virtual campus will be upgraded in 2003. In terms of the characteristics of a customer driven organisation (Section 2.8), particularly pertaining to the virtual campus products and services, the researcher would rate the university as follows:

We spend time meeting customers and listening to their problems.

We benchmark competitor's products and seek 'best of class' solutions.

We continuously improve and refine service offerings according to market feedback if resources allow.

We meet customer requirements for customisation where it can be done profitably.

We study customer needs and wants.

We measure company image and customer satisfaction continuously.

We influence all employees in the organisation to be customer-centred.

Section 4.17 provides an overview of the migration and upgrading of the virtual campus.

4.17 Migration of the virtual campus

A project to migrate and upgrade the virtual campus has commenced with the following specifications that were drafted by the new virtual campus project team:

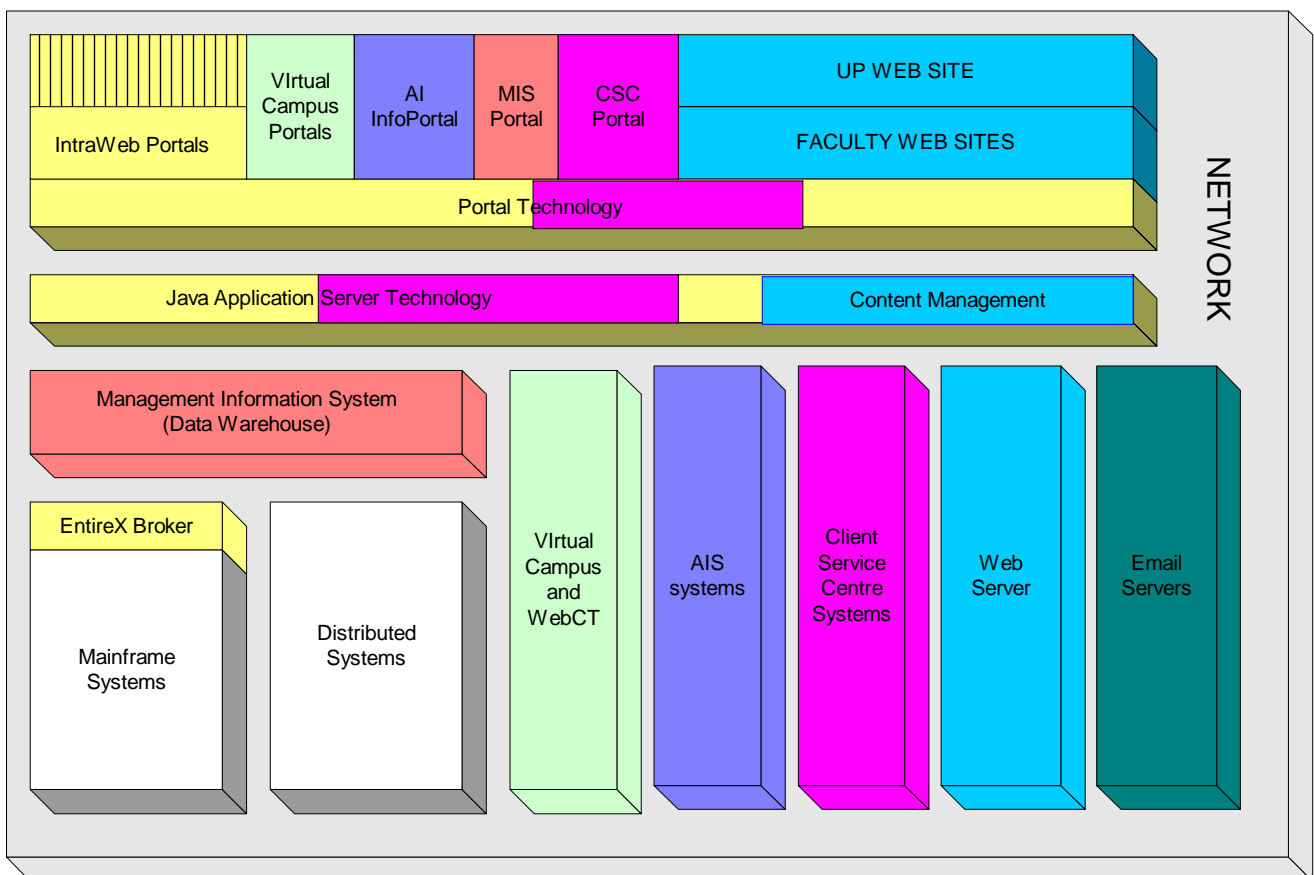
Functionality	Description	Comment
Logging in	Allows a user to log in to the virtual campus	This must be replaced by the sign mechanism in the UPPortal.
Online application	Allows a student to apply online.	A number of changes to the current functionality are necessary. These concern streamlining the process and ensuring that the web based and paper based application processes are as similar as possible
Online payment	Allow students to make payments online.	It is anticipated that the volume of online payments will continue to increase. This needs to be better integrated with back office allocation of money received.
Contact information	Allows students and lecturers to update contact details.	This is not currently passed to the mainframe, but kept in a separate database. In future, this information must be updated on the mainframe.
Messaging and discussions	Allows lecturers and students to send messages to each other. Also allows for open discussions.	A generic way of handling these needs to be developed. Business decisions will have to be made with respect to where this is implemented, who will be allowed to post messages etc.
Registered courses	Allow students to see a summary of the active <i>WebCT</i> and other modules that they are registered for.	
Results	Allows students to view their exam results	Needs to be extended to include test results as well.
Calendar	Displays diary information	Need to look at how this relates to event publishing. Lecturers need to be able to input course specific dates.
Opinion polls	Allow students to give their opinions on various topics	Need to decide whether this should still be included or not.
Help	Provides help on a number of virtual campus issues.	A greater variety of help is needed for lecturers
Academic record	Shows student their full academic record.	
Downloads and uploads	Allow students to download various programs and information.	Need to look at how information from the mainframe can be uploaded e.g. student marks.
Class lists	Allows lecturer to see class lists.	Needs to be integrated with the functionality available in the web based student administration system.
<i>WebCT</i>	Links to <i>WebCT</i>	
Search	Allow lecturers to search for information pertaining to a specific student.	This needs to be extended to include all the information currently available via the web based student information system. Lecturers however should not be allowed access to account related information.

Table 4.29 Migration and upgrading of the virtual campus

The new virtual campus architecture will form part of an organisation wide deployment of a Java-based portal for the university.

Diagram 4.5 shows how the virtual campus will fit into the new technology architecture.

Diagram 4.5 Proposed new architecture of the virtual campus (illustrated as part of portal project)
(IT Department, University of Pretoria)



Chapter 5 Conclusion

This thesis has investigated the creation and evolution of the virtual campus in terms of its components of *process*, *product* and *service* innovation.

Chapter Five closes the study by addressing the following aspects of the thesis:

- A reflection of what has been achieved.
- A review of the research questions of the thesis and their answers.
- An overview of the relevance of the study.
- A list of recommendations for future research.

Figure 5.1 illustrates how Chapter Five fits into the structure of this thesis.

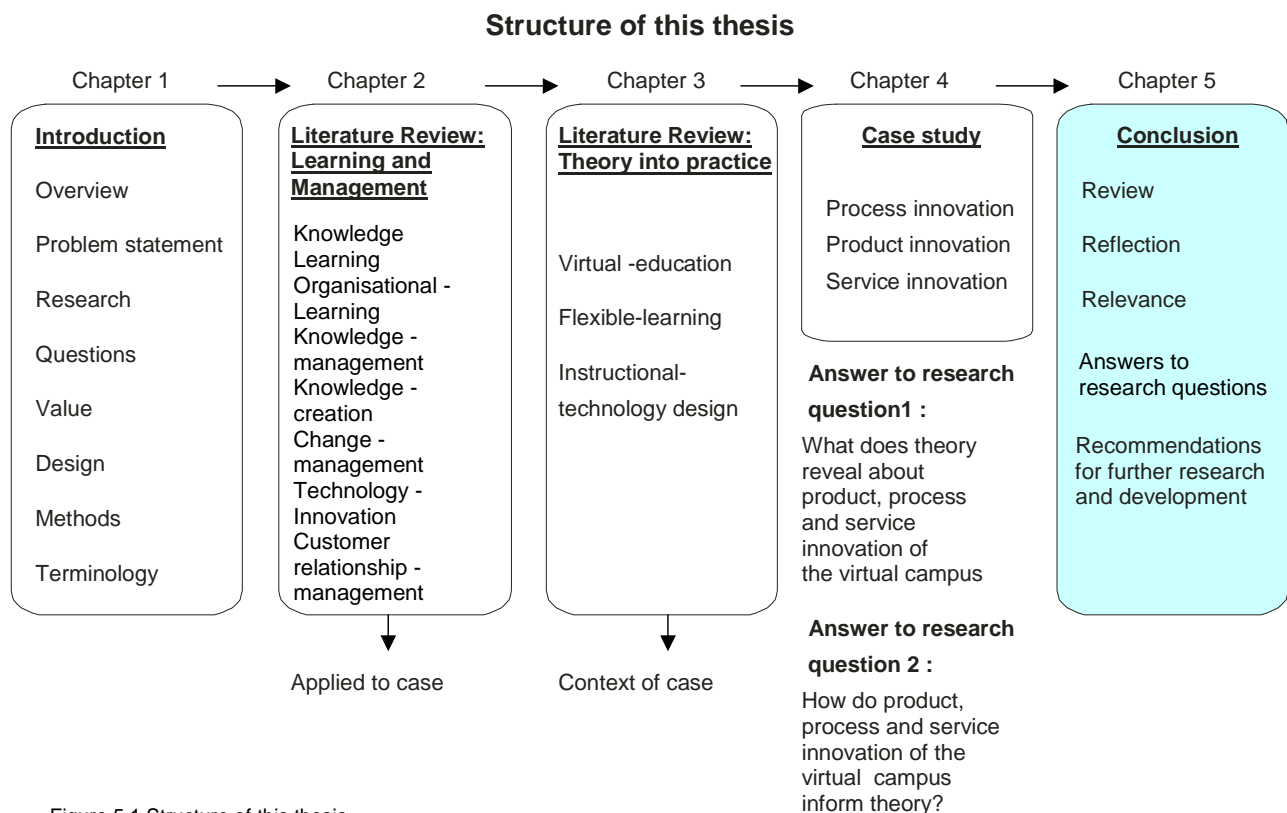


Figure 5.1 Structure of this thesis

5.1 Reflection

The virtual campus of the University of Pretoria is analyzed from multiple perspectives. *Knowledge, learning, organizational learning, knowledge creation, knowledge management, change management, technology innovation and customer relationship management* are drawn upon to better understand the innovation components of the virtual campus, namely, *process, product and service* innovation.

These theories were selected because they interface with one another and inform educational innovation. Technology innovation as a field of study is not adequate to investigate the various components of the virtual campus as an educational innovation.

Theory in Chapter Two is applied to the different components of *process, product and service* innovation in order to describe and interpret educational innovation. Interpretation is aided by examples from Theory in Practice, discussed in Chapter Three, and certain aspects discussed in Chapter Three are also applied in Chapter Four. Chapter Three illustrates how the different theories manifest in Practice, particularly in terms of the current higher education landscape and the impact of technology on higher education. It also provides the context for the case in Chapter Four.

Virtual education and flexible learning have become competitive strategies for universities. In turn, technology innovation requires universities to draw on knowledge about the use of technology in the learning process as well as institutional change management and organizational learning strategies. Knowledge creation strategies, project management and change management emerged as key to educational innovation management. Hence both learning and management theory augment technology innovation theory to facilitate educational innovation.

The complexity of the virtual campus is illuminated by the various theories. They all provide useful strategies that can be applied in educational innovation and inform on the different aspects that require attention in managing educational innovation.

An analysis of the diffusion of new products and services of the virtual campus of the University of Pretoria confirms the 'S' – curve maturation and signifies that especially

services need to be revisited in order to remain competitive, because they are reaching a plateau.

Processes that were used to create the new products and services are analyzed and processes that support and sustain the new products and services are described.

If one considers the initial objectives of the virtual campus project team, the online yearbook and degree audit, as well as online registration, are outstanding deliverables. In addition, complete online assessment and accreditation of courses have not manifested. Small components of courses utilize online assessment, but summative assessment continues to take place by means of examination. Continuous formal assessment such as assignments and collaborative research reports make use of *WebCT* as a tool to facilitate assessment. The researcher is of the opinion that this 'middle road' that has emerged signifies best practice within the context of the educational model that has been established at the University. Accreditation is an aspect that was not explored in this thesis, but courses that are web-supported follow the same accreditation processes as contact courses.

The scope of the thesis does not allow for in-depth analysis of the role that performance management and incentives play in the new learning environment. It does, however indicate that enthusiasm and passion for excellence are better predictors of success than monetary rewards.

The virtual campus has focused mainly on students and could be augmented to add more services for faculty. Another student service could include e-recruitment, which will facilitate career placement of students and possibly strengthen ties with Alumni, Business and Industry. The virtual campus could be expanded to incorporate other aspects of the university such as the personnel and purchasing systems. It should move in the direction of a virtual university in order to remain competitive.

One of the findings of this study is that the virtual campus should be marketed more effectively. Observations about the research questions are made in Section 5.2. Although answers are given these should not be construed as absolute findings.

5.2 Research questions and answers

The research in this thesis makes two main contributions as it answers the research questions of Chapter One.

<i>Research question 1 (Chapter Four)</i>	
What does theory reveal about process, product and service innovation of the virtual campus?	
<i>Method</i>	
Investigation of the creation and evolution of the virtual campus in terms of theory.	
<i>Goal</i>	<i>Data collection methods</i>
<i>Action</i> (Using theory and practice to investigate the manifestation of its elements in the case study)	<i>Qualitative methods:</i> <ul style="list-style-type: none"> • Application of theory, interpretation of interviews, questionnaires, document analysis of non-technical literature and overview of courses.
	<i>Quantitative methods:</i> Collection of quantitative survey data and descriptive statistical analysis. <ul style="list-style-type: none"> • Adoption rate of services. • Adoption rate of products. • Aspects of web-supported courses.
<i>Research question 2 (Chapter Four)</i>	
How do process, product, and service innovation of the virtual campus inform theory?	
<i>Method</i>	
Building more knowledge about innovation management and theories discussed in Chapter Two.	

<i>Goal</i>	<i>Data collection methods</i>
Development and interpretive	<p><i>Inductive methods and qualitative methods:</i></p> <p>Examination of theories and practice being applied in practice, and induction of ways to implement them.</p> <p>Qualitative inquiry into how the theoretical elements function in different aspects of innovation.</p> <p>Qualitative inquiry of how the findings of the case study contribute to knowledge about innovation in higher education.</p> <p>Motivation: The interpretive design is characterised by subjectivity and the study of individual experience. In this study the theoretical approach is further informed by practice, tending to become grounded theory.</p>

5.2.1 Response to research question one

Chapter Four describes and interprets *process*, *product* and *service* innovation of the virtual campus through the application of various theories discussed in Chapter Two. Both qualitative and quantitative research methods are used to investigate the virtual campus innovations.

Research question 1 (Chapter Four)

What does theory reveal about *process*, *product* and *service* innovation of the virtual campus?

1.3.1.1 Having selected theoretical and practical elements to comprise the literature survey in Chapter Two and Chapter Three, in what ways, and to what extent, are they found to be implemented and manifested in the creation and evolution of the virtual

campus in terms of *process*, *product*, and *service* innovation and the management thereof.

5.2.1.1 Research questions and answers regarding product innovation

- What is the prevalent educational model that is followed in web-supported courses?

Educational model

The prevalent educational model is typified by flexible learning. Contact sessions with students are reduced and augmented by the use of *WebCT* and in some cases other technologies such as e-mail and CDROM. Contact sessions are used predominantly for lectures and assessment purposes.

Encouraging lecturers to build in self-preparation before the first contact session by means of a quiz, group presentation, report or case study can strengthen the emerging prevalent educational model using *WebCT*. The fact that this seems to be a model that is manifesting is encouraging, provided that contact sessions are not used for lectures. Unfortunately the lecture prevails as the preferred activity during contact sessions for the majority of lecturers. This means that a completely learner-centred model has not been adopted and could indicate superficial adjustments that appear to be learner-centred, but are in fact not. It is recommended that contact sessions be used for collaborative assignments and discussions.

- Does behaviourist or constructivist instructional design principles manifest in the web-supported courses?

Elements of behaviourist, cognitivist and constructivist principles are present in these learning environments (MEM, MPM and MBA).

- Is the diffusion of *WebCT* as the solution to support web-supported courses successful?

Slower rate of product innovation diffusion and higher rate of service innovation diffusion

Descriptive statistics indicate that both product and service innovations have followed the 'S'-curve adoption pattern.

Although the diffusion of *WebCT* is following the 'S'-curve, it is uncertain whether the chasm between the innovators and early adopters will be overcome, or for that matter the chasm between the early adopters and the early majority. The support of Telematic Learning and Education Innovation will assist diffusion. Probably the most critical success factor will be a strategy to ensure that communication takes place via *WebCT* and that discussions take place on a high level of learning. The strategy will have to ensure that lecturers take ownership of the new learning environment. A possible explanation for the wider diffusion of service innovation is that product innovation in a higher education institution is more complex because of the nature of learning. Product innovation requires radical innovation and considerable change in the way learners and lecturers engage in the learning environment.

The fact that *WebCT* has become the market leader in South Africa shows that its diffusion has been successful – not only at the University of Pretoria, but throughout the country.

Instructional design and development

There is a danger in relying on instructional designers instead of being actively involved in the new learning paradigm. Reluctance of lecturers to become involved will eventually result in *WebCT* becoming an information site for learners. A possible solution could be to allocate more support to faculty members in the form of tutors, such as graduate assistants. Tasks could range from facilitating discussions, i.e. scaffolding online discussions, to assistance with administrative and technical work.

- Does effective learning take place in web-supported courses?

The lack of effective feedback in the sample of *WebCT*-supported programmes needs to be addressed. The perceptions of the sample of 174 students indicate that other aspects of effective learning, i.e. deep information processing, constructivist elements, interaction, intrinsic motivation and learner-centred assessment are present, but not significantly so.

- How does the use of the web in teaching and learning impact the role of the lecturer?

The use of the web requires a stronger focus on preparation and on making tacit knowledge explicit knowledge. Feedback and responsiveness become more important than in a contact situation. Apart from acquiring technical skills, skillful planning and management are required to facilitate web-supported courses because it could be more time consuming otherwise. This study indicates that knowledge creation regarding the new learning environment among lecturers is not optimal.

5.2.1.2 Research questions and answers regarding process innovation

- Which processes were used to create new products and services and in what way do the theories of knowledge creation, knowledge management, organizational learning, change management, technology innovation and customer relationship management manifest in these processes?

Knowledge creation as an innovation management strategy

The importance of knowledge creation in educational innovation emerged as an important finding. Organizational innovation requires sufficient understanding of how to make tacit knowledge explicit and how to globalize new knowledge to sustain change. Knowledge enabling steps and conditions that are conducive to knowledge creation should be incorporated in change management plans. Knowledge creation accelerates as time passes. New mental models were created in the course of innovation.

Choosing an innovation strategy that fits the culture of the institution

Equally important is a focus on the culture of the institution and to choose an appropriate innovation strategy accordingly. A radical strategy was chosen, as the virtual campus impacted significantly on the product and service offering of the university and, as a result on institutional processes, structures and infrastructure. It also impacted on consumer behaviour – i.e. the way in which students access information, do transactions and engage with their learning environment. It was combined with a mostly bottom-up strategy and visible top down support. Elements of a middle-up-down strategy were present. An incremental process was followed regarding the implementation of *WebCT* and the subsequent development of the virtual campus technology architecture. The virtual campus is in line with the principles of customer relationship management and could be considered as the first attempt to move in the direction of a consumer-oriented model at the University of Pretoria.

- How do the processes look that sustain the new products and services?

The processes are illustrated in Chapter Four.

5.2.1.3 Research questions and answers regarding service innovation

- Is the diffusion of web-based services successful?

Services of the virtual campus have been diffused on a wide scale. As a result of a captured market, saturation or complete diffusion is imminent; hence additional functionalities are required to remain competitive. Service innovation does not require major changes in terms of the actions of users. Additionally, the ease of use of Student Online Services probably also contributes to its wide diffusion. Yet additional functionality should be developed because the virtual campus is dated and needs to incorporate a wider range of self-services via the web for students to remain interested. From an institutional perspective the web-enablement of more services will lead to a bigger cost saving in the long term.

5.2.1.4 General research question regarding the virtual campus

- Do the new products and services of the virtual campus make the University of Pretoria more competitive?

The virtual campus makes the University of Pretoria more competitive because it has improved the accessibility, flexibility and quality of products and services. Self-service has led to cost savings for the institution and has released time that personnel can use for more complex tasks. The virtual campus assists with knowledge management in terms of making information available when it is required and in terms of courses in *WebCT* that contain intellectual property that is explicit. It has improved the corporate image of the University by placing it at the forefront of virtual education in South Africa, and initially as a global leader in concept and function. It proves that the University of Pretoria is sufficiently mobile to respond to external forces and is able to make tacit knowledge explicit in order to create new products and services. Both are competitive advantages.

5.2.2 Response to research question two

Research question two was answered by exploring how theoretical elements in Chapter Two function in various aspects of innovation.

Research question 2 (Chapter Four)

How do process, product, and service innovation of the virtual campus inform theory?

1.3.2.1 How do the findings about *process, product and service innovation* of the virtual campus inform knowledge about the theories discussed in Chapter Two?

5.2.2.1 Research questions and answers regarding product innovation

- How does the prevalent educational model used for web-supported courses inform about behaviourist and constructivist instructional design approaches?

The fact that both approaches manifest in the sample of web-supported courses could indicate that a combination of behaviourist and constructivist approaches is appropriate, rather than using one or the other. Both are on a spectrum and could be relevant, depending on the outcomes of a specific course.

- How do the perceptions of learners and lecturers inform the role of the lecturer in a web-supported environment?

Role of the web lecturer

An interesting finding is that students regard the characteristic of *Expertise* as the most important characteristic of a web lecturer, followed by *Clarity* and *Responsiveness*. It is significant that both *Expertise* and *Responsiveness* correlate with the top three characteristics identified by lecturers. The fact that students rate *Expertise* as the most important characteristic possibly indicates that they still regard competency in the subject field as the most important characteristic, regardless of mode of instruction. The implication of choosing *Clarity* as the second most important characteristic could imply a need for more structure due to the mode of instruction. This also pertains to choosing *Responsiveness* – implying a need for responsiveness, possibly because of the mode of instruction. It is interesting that the characteristics of *Caring* and *Enthusiasm* rate so low, compared to lecturers who rate *Enthusiasm* as the most important characteristic. This could indicate that this particular grouping of respondents (with a profile of engineers and managers) are task oriented and more concerned about effectiveness and efficiency than affective and motivational aspects of their studies. The findings indicate that the majority of lecturers regard *Enthusiasm* as the most important characteristic of a web lecturer, followed by *Responsiveness* and *Expertise*. The latter relates to subject expertise and not web expertise.

The results of the question on the role of the lecturer indicate that roles of *Facilitator*, *Mentor*, *Mediator*, *Co-learner*, *Provocateur* and *Assistant* were considered to be the most appropriate roles for students. These roles share a strong common theme of supporter – indicating that respondents have a need for a lecturer in a supporting role. On the other hand, lecturers marked those of *Facilitator*, *Mentor*, *Provocateur*, *Observer* and *Participant* most often.

The ones that correlate in terms of both students and lecturers are the roles of *Facilitator*, *Mentor* and *Provocateur*. Hence the roles required of a web lecturer that are deemed important enlist facilitation skills, mentoring skills and encouraging critical thinking skills in students.

- How does the diffusion of the new web-supported courses inform technology innovation theory?

Both product and service innovation mirror and therefore confirm the 'S'-curve.

5.2.2.2 Research questions and answers regarding process innovation

- How do the processes that were used to create new products and services inform the theories of *knowledge creation*, *change management* and *technology innovation*?

Innovation and knowledge creation

- Innovation on an organizational level requires an understanding of knowledge creation strategies.
- Knowledge creation leads to new processes that are embedded in the institution.
- Knowledge creation in team-based innovation accelerates as time passes.

Innovation and project management

- Project management is necessary to implement product and service innovation.

Innovation and change management

- Innovation on an organizational level has to account for change management strategies that suit the context and culture of the institution.

Radical innovation in a large organization

- Radical innovation is possible in a large organization, provided that appropriate strategies are chosen. Knowledge champions are key to cross-cutting, institution wide innovation projects.

No need for additional time

- Additional resources and time are often not available and not necessary. There is enough 'white space' that people create for themselves.

Unrealistic time scales are effective to overcome inertia

- Momentum is maintained through almost unrealistic time scales.

Incremental strategy for IT architecture

- Incremental technology architecture development lowers risk and allows for greater mobility if technology changes.

Enthusiasm overrides other barriers to innovation adoption

- Enthusiasm can override barriers to innovation adoption (such as a lack of ease of use and a lack of *perceived usefulness*).

Account for other technologies that could threaten the innovation

- An innovation strategy should account for other technologies that could threaten the adoption of the innovation. In the case of the use of *WebCT* at the University of Pretoria it is *e-mail* and *CDROM*.
- How do the processes that have been embedded to support and sustain new products and processes inform virtual education?

Design web materials in *PDF*

- It is best to design web materials in *PDF* format because most learners continue to print their online materials.

Web technology allows for rapid development

- Web technology enables cost effective customer process reengineering by integrating processes on the front end so that customers (students) have seamless access to relevant information, courses and transactions.

Provide electronic information sources

- The integration of electronic information sources in web-supported courses significantly improves quality and access.

Project management

Project management is key to quality instructional design and development and is conducive to a professional corporate image.

5.2.2.3 Research questions and answers regarding service innovation

- How does the diffusion of the new web-based services inform technology innovation theory?

The diffusion of the web-based services of the virtual campus confirms the 'S'-curve growth pattern. An incremental technology development strategy combined with a radical institutional strategy can be successful on an institutional scale, as is shown in the case of the virtual campus.

5.2.2.4 General research question regarding the virtual campus

- Which critical success factors are important to consider in educational innovation?

The answer to this question came in the form of revealing how the different theories manifested in the innovation components of the virtual campus. Hence the fields of *knowledge, learning, organizational learning, knowledge creation, knowledge management, change management, technology innovation and customer relationship management* can all be used in educational innovation. An understanding of the way in which *process, product* and *service* innovation interact is key to successful educational innovation. The different steps that are important in *process* innovation are to scan the environment and formulate an appropriate strategy, accompanied by a plan in which risks are identified. A vision needs to be created and a team consisting of knowledge champions and other key players. An incremental process of *learning by doing*, i.e. adapting products and services based on monitoring execution and feedback, assists in retaining a market focus. Knowledge enabling steps and conditions for knowledge creation contribute to market adoption.

5.2.3 Strengths and weaknesses of the thesis

- The researcher's proximity to the case aids interpretation. Tacit knowledge illuminates findings gained by means of qualitative and quantitative methods. At the same time it poses a threat to the reliability of the research. The researcher attempted to increase reliability by means of the following strategies:
- Member checks - taking data and tentative interpretations back to colleagues from whom they were derived, and asking them if they are plausible.

- Long-term observation – close involvement as project leader of the virtual campus since March 1998 to date.
- Clarifying the researcher's biases, assumptions, worldview and theoretical orientation at the outset of the study.

The study is encompassing and aims to provide a holistic view of the virtual campus. It investigates one educational innovation model that has proven to be successful. The Literature reviews in Chapter Two and Chapter Three consist of theories that were generated in other countries. The fact that these theories are applied to a South African context could be considered a weakness of this study. Limited theories have been generated in a South African context. The researcher is of the opinion that the theories that are discussed and applied can be generalized to a South African context.

This study is not an attempt to answer one specific aspect of educational innovation in detail. Rather, it is broad in focus, and strives to contribute to knowledge about various aspects of educational innovation. Therefore the case of the virtual campus informs about both learning and management aspects of educational innovation. The scope of the study does not allow the researcher to investigate both learning and management aspects in - depth. The findings should be considered as research findings on a macro, and more strategic level. A possible limitation is the fact that samples of 40 lecturers and 174 students respectively (who participate in web-supported courses) are used. However this study focused on learning, management and technology aspects of the virtual campus and therefore these samples are regarded as adequate.

A possible weakness is that the perceptions of students are recorded in the questionnaire. Their perceptions are not necessarily a representation of reality, but a qualitative research approach does not attempt to prove an absolute reality. Another limitation is that the questionnaire for students is very long. In spite of its length, it required a half an hour of students' time. The researcher guided them through the questions. The strength of this thesis lies in its comprehensive view of various aspects of a virtual campus. It provides numerous strategies that can be utilized in educational innovation and adds to the international knowledge base on virtual education. It is also informative in describing strategies to remain competitive. The advantage of a case study is that it is not a theoretical study, but a study that is informed by experience.

5.3 Relevance of this study

Higher Education institutions globally have to remain competitive in the face of rapid changes in technology, the knowledge era, changing demographics of learners and market demands. This research informs higher education leaders, administrators and lecturers on useful fields that can be drawn upon to succeed in innovation. Technology plays a central role in the types of innovation described but although emphasis is given to the relevance of technology innovation theory; this study reveals the importance of incorporating a broader range of strategies in educational innovation.

Higher education institutions that have initiated steps to utilize technology as a competitive advantage could benefit from this study. It is particularly relevant to South African higher education institutions that cannot afford the resources and infrastructure available in the U.S.A. and Northern Europe.

Institutions that have started out on the road of virtual education could find the procedures, processes, structures and infrastructure that have been created in the virtual campus useful. Not as examples to replicate but as ideas to adapt to their institutional culture and resources.

5.4 Recommendations for future research

The virtual campus and its components of *process*, *product* and *service* innovation were selected as the case because of the researcher's close personal involvement, which is a recommendation for qualitative, interpretive analysis.

Directions for further research can be to investigate whether different strategies are used at other higher education institutions in terms of innovation and perhaps to find a correlation between the strategies used and the culture of particular universities.

An area that requires considerable research is the needs of South African learners and lecturers in the flexible learning environment – specifically web-supported learning.

Another research field pertains to the question whether a web-supported learning environment fosters students who are academically more mature.

5.5 Conclusion

Competitiveness is topical and relevant in the higher education sector. This study puts forward a wide range of strategies that can be used in educational innovation. It describes and interprets educational innovation at a South African university – investigating *process*, *product* and *service* innovation. The research can make a contribution to improve current practice at the University of Pretoria, but also to provide ideas to institutions that are now embarking on this route. It contributes to a better understanding of *process*, *product* and *service* innovation components of virtual education and indicates ways of both creating and sustaining these components. Critical success factors are drawn from a wide range of theoretical fields due to the complexity of educational innovation.

The virtual campus is a competitive advantage for the University of Pretoria. Its new products and services are customer focused and provide improved accessibility and flexibility to students. Product innovation has led to a product offering that is in line with a quality flexible educational model, although learning facilitation aspects require attention. Service innovation is reaching a level of complete diffusion and additional services should be web-enabled to remain competitive.

Apart from new products and services, the creation and evolution of the virtual campus has led to new institutional knowledge and it shows that the University of Pretoria can adapt timeously to external factors.

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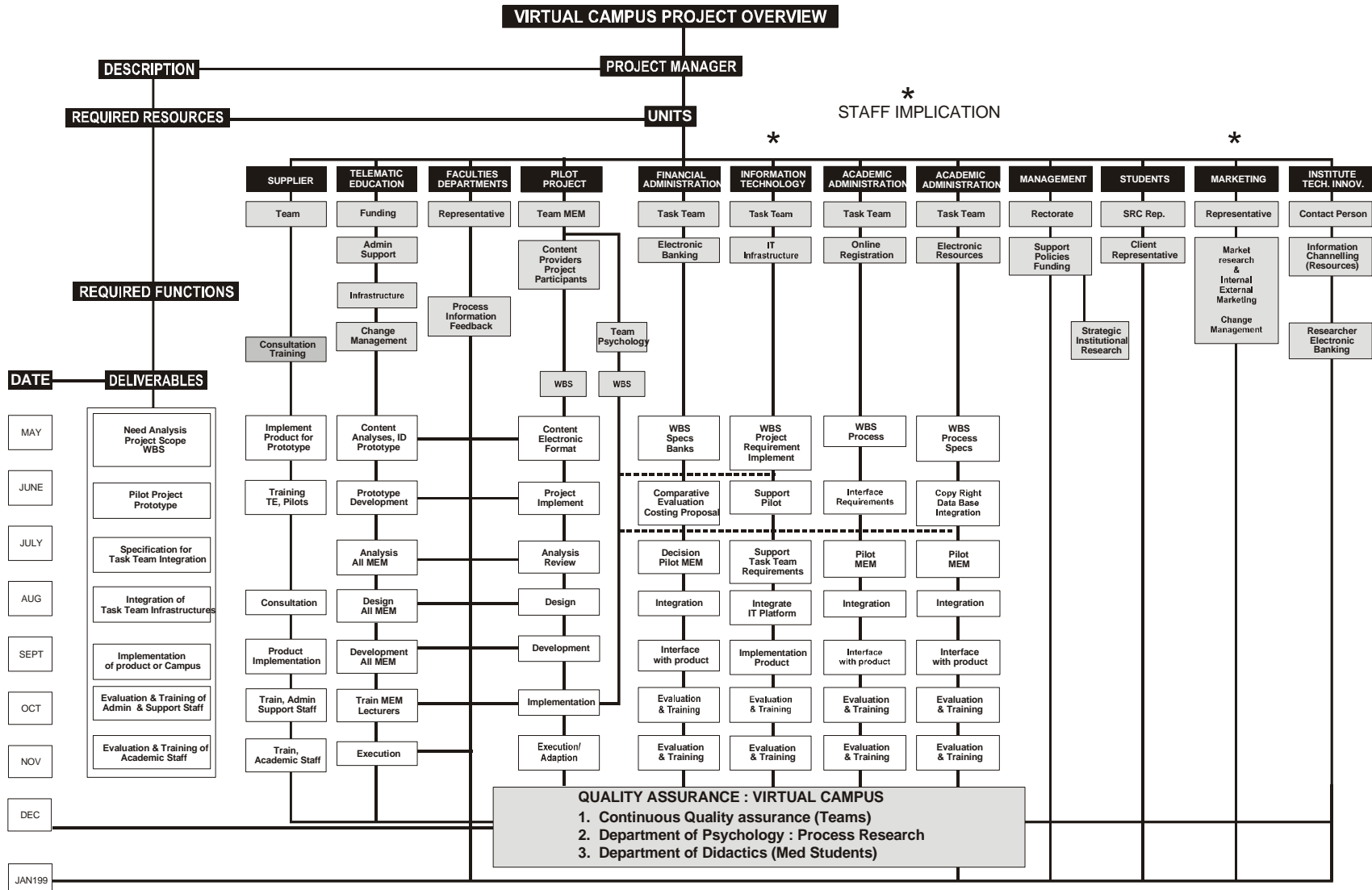
Annexure A

Major motivational condition	Motivational purpose	Motivational strategy
Conclusion (beginning learning activities)	To engender an awareness and feeling of connection among adults	<ol style="list-style-type: none"> 1. Allow for introductions 2. Provide an opportunity for multidimensional sharing 3. Concretely indicate your cooperative intentions to help adults learn 4. Share something of value with your adult learners 5. Use collaborative and cooperative learning 6. Clearly identify the learning objectives and goals for instruction 7. Emphasise the human purpose of what is being learned and its relationship to the learners' personal lives and contemporary situations
	To create a climate of respect among adults	<ol style="list-style-type: none"> 8. Assess learners' current expectations and needs and their previous experience as it relates to your course or training 9. Explicitly introduce important norms and participation guidelines 10. When issuing mandatory assignments or training requirements, give your rationale for these stipulations 11. To the degree authentically possible, reflect the language, perspective, and attitudes of adult learners 12. Introduce the concepts of comfort zones and learning edges to help learners accommodate more intense emotions during episodes of new learning 13. Acknowledge different ways of knowing, different languages, and different levels of knowledge or skill to engender a safe learning environment
Attitude (beginning learning activities)	To build a positive attitude toward the subject	<ol style="list-style-type: none"> 14. Eliminate or minimize any negative conditions that surround the subject 15. Ensure successful learning with mastery learning conditions 16. Positively confront the erroneous beliefs, expectations, and assumption that may underlie a negative learner attitude 17. Use assisted learning to scaffold complex learning
	To develop positive self-concepts for learning	<ol style="list-style-type: none"> 18. Encourage the learner 19. Promote the learner's personal control of the context of learning 20. Help learners accurately attribute their success to their capability, effort and knowledge 21. When learning tasks are suitable to learners' capability, help learners understand that effort and knowledge can overcome their failures
	To establish expectancy for success	<ol style="list-style-type: none"> 22. Make the criteria of assessment as fair and clear as possible 23. Use relevant models to demonstrate expected learning 24. Announce the expected amount of time needed for study and practice for successful learning 25. Use goal-setting methods 26. Use contracting methods

	To create relevant learning experiences	<p>27. Use the five entry points suggested by multiple intelligence research as ways of learning about a topic or concept</p> <p>28. Make the learning activity an irresistible invitation to learn</p> <p>29. Use the K-W-L strategy to introduce new topics and concepts</p> <p>30. Use brain-storming webs to develop and link new information</p>
Meaning (during learning activities)	To maintain learners' attention	<p>31. Provide frequent response opportunities to all learners on an equitable basis.</p> <p>32. Help learners realize their accountability for what they are learning</p> <p>33. Provide variety in personal presentation style, modes of instruction and learning materials</p> <p>34. Introduce, connect and end learning activities attractively and clearly</p> <p>35. Selectively use breaks, physical exercises and energisers</p>
	To invite and evoke learners' interest	<p>36. Relate learning to adult interests, concerns and values</p> <p>37. When possible clearly state or demonstrate the benefits that will result from learning activity</p> <p>38. While instructing, use humour liberally and frequently</p> <p>39. Selectively introduce parapatric emotions</p> <p>40. Selectively use examples, analogies, metaphors, and stories</p> <p>41. Use uncertainty, anticipation and prediction to the degree that learners enjoy them with a sense of security</p>
	To develop engagement and challenge with adult learners	<p>42. Use critical questions to stimulate learner engagement and challenge</p> <p>43. Use relevant problems to facilitate learning</p> <p>44. Use an intriguing problem to make instructional material meaningful</p> <p>45. Use case study methods to enhance meaning</p> <p>46. Use simulations and role-playing to enhance meaning with a more realistic context</p> <p>47. Use invention, artistry, imagination and enactment to render meaning and emotion in learning</p>
Competence (ending learning activities)	To engender competence with assessment	<p>48. Provide effective feedback</p> <p>49. Avoid cultural bias in assessment procedures</p> <p>50. Make assessment tasks and criteria known to learners</p> <p>51. Use authentic performance tasks to enable adults to apply what they are learning to their real lives</p> <p>52. Provide opportunities for adults to demonstrate their learning in ways that reflect their multiple sources of knowing</p> <p>53. When using rubrics make sure they assess the essential features of performance and are fair, valid and sufficiently clear</p> <p>54. Use self-assessment methods to improve learning and to provide learners with the opportunity to construct relevant insights and connections</p>
	To engender competence with communication	<p>55. When necessary use constructive criticism</p> <p>56. Effectively praise and reward learning</p> <p>57. Acknowledge and affirm the learner's responsibility and any significant actions or characteristics that contributed to individual or group learning</p> <p>58. Use incentives to develop and maintain adult motivation in learning activities that are unappealing but personally valued</p> <p>59. When learning has natural consequences help learners to be aware of them and of their impact</p> <p>60. Provide positive closure at the end of significant units of learning</p>

Wlodkowski's summary of motivational strategies (1999:294-297)

Annexure B



Annexure C

1. Deliverables

1.2 Information technology

Task: Provide the required infrastructure for the virtual campus and to assist with the integration of the other task teams' deliverables with the virtual campus. The tasks can be specified as follows:

*Deliverable met / not met

*✓ indicates success

x indicates failure

- Provide the required network capability on campus, to the satellite campuses and investigate what will be required for staff and students accessing the virtual campus from remote locations, other than campus sites. ✓
- Provide and maintain the server for the virtual campus, which will be the integrated interface for teaching, learning and research activities via the web. ✓
- Provide access to this server from the various servers used by departments ✓
- Provide an upgrade plan to provide connectivity for all staff members, which (currently) means a Pentium with a web browser. ✓
- Assist in determining the protocols for the integrated system, i.e. what will be required at the client server side for staff and residential and remote students, security measures that are aligned with best practice internationally. ✓
- Provide a plan on the location of computer centres where students will have access to the virtual campus (only the Extranet and the Internet), whether through network ports provided or through fully equipped centres. ✓
- Assist with the integration of the virtual Academic Information Service and the virtual campus in terms of database access and the protocols involved in accessing full text articles from Ariel and from physically scanned articles, information retrieval. ✓
- Assist Academic Administration in the process of integrating the student administration database (part of Unikom) with the virtual campus to achieve a fully-fledged real time application ✓ and eventually registration x procedure via the Web.
- Assist Academic Administration to develop and maintain a sophisticated Yearbook system on the Web. x

- Assist Financial Administration in determining which Banking institution or electronic commerce company provides the required security protocols for handling online payment via credit card and smart cards and to assist with providing students with their financial records via the virtual campus. ✓
- Assist in the evaluation of the most appropriate virtual campus solution (student management system) for the virtual campus. ✓

Constraints: members have full work loads to account for, lack of expertise where Unikom and web integration is concerned. Unikom is not on schedule and capacity and available time to our mainframe programmers is inadequate. Solution for the latter – liaison with Stellenbosch and Potchefstroom.

1.2 Academic Administration

Task: to integrate the student administration database with the virtual campus on the Web. To provide a more sophisticated and real-time yearbook. The task can be specified as follows:

*Deliverable met / not met

*✓ indicates success

x indicates failure

- Determine the procedure to enable an integrated, uniform, fully-fledged and real-time application via the virtual campus and provide an implementation plan. Investigate the current system and determine whether the current application form is still relevant in light of rapid response and a more streamlined process to ensure a service that captures prospective students and does not result in frustration or loss of interest owing to a laborious, time-consuming process. ✓ How will the system deal with multiple applications across faculties? x
- Provide an updated yearbook and investigate a more sophisticated system that could be linked to requirements, checks and validation procedures as a first-phase implementation of the registration process. This will include the exam timetables and practicals of courses and an interactive courseware selection procedure that provides feedback on particular subject course combinations. The path through the information should be defined. x
- Determine the protocols for full registration via the virtual campus in terms of viability, security, and feasibility: capacity. What kind of expert system will be required to fulfil the needs of individual departments? What are the security issues for remote students, new students and students that are reregistering? x
- Update Unikom and the entry requirements for the year 2000 intake. ✓
- Develop a contingency plan to accommodate telematic projects via the Web that are already being planned. ✓

- Develop a framework of recognition of prior learning in consultation with departments that can be used for articulation purposes. **x**
- Investigate NQF requirements in terms of how courses will be structured as well as existing software that can be used for academic staff to structure their courses appropriately. **x**

Constraints: members have full work loads to account for, lack of expertise where Unikom and web integration is concerned. Unikom is not on schedule and capacity and available time to our mainframe programmers is inadequate. Lack of capacity.

1.3 Academic Information Service

Task: To align the virtual Academic Information Service project with the virtual campus project and to add certain functions and services as part of the virtual campus project. The task can be specified as follows:

*Deliverable met / not met

*✓ indicates success

x indicates failure

- Establish workstations and laboratories in Academic Information Service where students can access the virtual campus. ✓
- Determine and deploy a procedure and infrastructure to integrate electronic information delivery systems (e.g. Ariel) with the virtual campus. ✓
- Determine and deploy a procedure and infrastructure to scan articles and other information such as study guides, exam papers and FAQ (only master copies) required for courses. This includes the protocol involved in the digitising of information and the software required, i.e. is Adobe the most appropriate solution in terms of not being able to edit online information, what are the bandwidth issues and where should OCR be loaded? Should .tif files be converted into .jpeg files and what are the implications for editing online information if it is available in character format? What implications will it have for capacity in terms of infrastructure and staffing? ✓
- Integrate existing databases on the network and integrate them with the virtual campus. ✓
- Determine copyright procedures of all types of course-related information, whether from and internal or external source that will be accessed via the virtual campus. Provide a plan on how copy right for electronic information will be negotiated (for example current negotiations with DALRO) and whether it will be a decentralised function. ✓
- Link the electronic retrieval engine with the virtual campus and provide for an interface for enquiries via the virtual campus that staff and students can access. ✓

- Make recent exam papers available on the virtual campus. ✓
- Assign AIS staff members to Telematic project teams. ✓
- Train staff and students to use abovementioned services. ✓
- Investigate and deploy the use of computer-based training programs. ✓
- Determine budgeting and pricing implications for departments and students of providing/accessing online information such as prescribed books, photocopying costs and copyright costs. ✓
- Who will be responsible to write a plan for knowledge assimilation, administration and delivery at the University? How can we find a mechanism to determine what is available, where it is available and in what format? x
- Link all Academic Information student financial transactions with the online student payment system that Financial Administration will put in place. x

1.4 Financial Administration

- **Task:** Investigate, evaluate and implement online banking and the outsourcing of student payment to a banking institution. Investigate how payment for online courses should be structured and provide student's financial records via the virtual campus. The task can be specified as follows:

*Deliverable met / not met

*✓ indicates success

x indicates failure

- Provide specifications on online banking to banking institutions. ✓
- Evaluate the services provided by banking institutions in terms of online banking, including electronic commerce companies. ✓
- Submit a proposal on the most appropriate banking institution / company, including a comparative evaluation of various solutions and the financial implications, cost saving / benefits of the identified solution. ✓
- Assist Academic Administration to determine how payment for online courses will be structured. ✓

Constraints: Members have full workloads to account for. Policy guidelines from management will be required upon submission of proposal.

1.5 Telematic Education

<p>*Deliverable met / not met *✓ indicates success x indicates failure</p>
<ul style="list-style-type: none"> Telematic Education will provide the infrastructure to design and develop educationally sound courseware for the virtual campus through project-based instructional design processes. The department is also instrumental in conducting continual action research and development in instructional technology and flexible learning. In order to fulfil this support role it is currently in a process of re-engineering to create capacity in terms of expertise and infrastructure relating to web-based courseware design and development. ✓

1.6 Web course management system for the virtual campus

<p>*Deliverable met / not met *✓ indicates success x indicates failure</p>
<ul style="list-style-type: none"> The system will provide an integrated architecture that will be accessible to staff and students – information access will depend on their various roles and authorisation. ✓

1.7 Academic Programme Pilot Project: Master's in Engineering Management

<p>*Deliverable met / not met *✓ indicates success x indicates failure</p>
<ul style="list-style-type: none"> Scheduled to be redesigned and developed in selected web-based learning solution/course management system to be operational 1999. ✓

2. Outstanding Issues

- Formal Change Management plan for the University
- Plan on training implications for administration and academic staff and students – specifically to use the virtual campus interface
- Plan on overall Quality Assurance
- Marketing
- Performance Management

3. Future Prospects

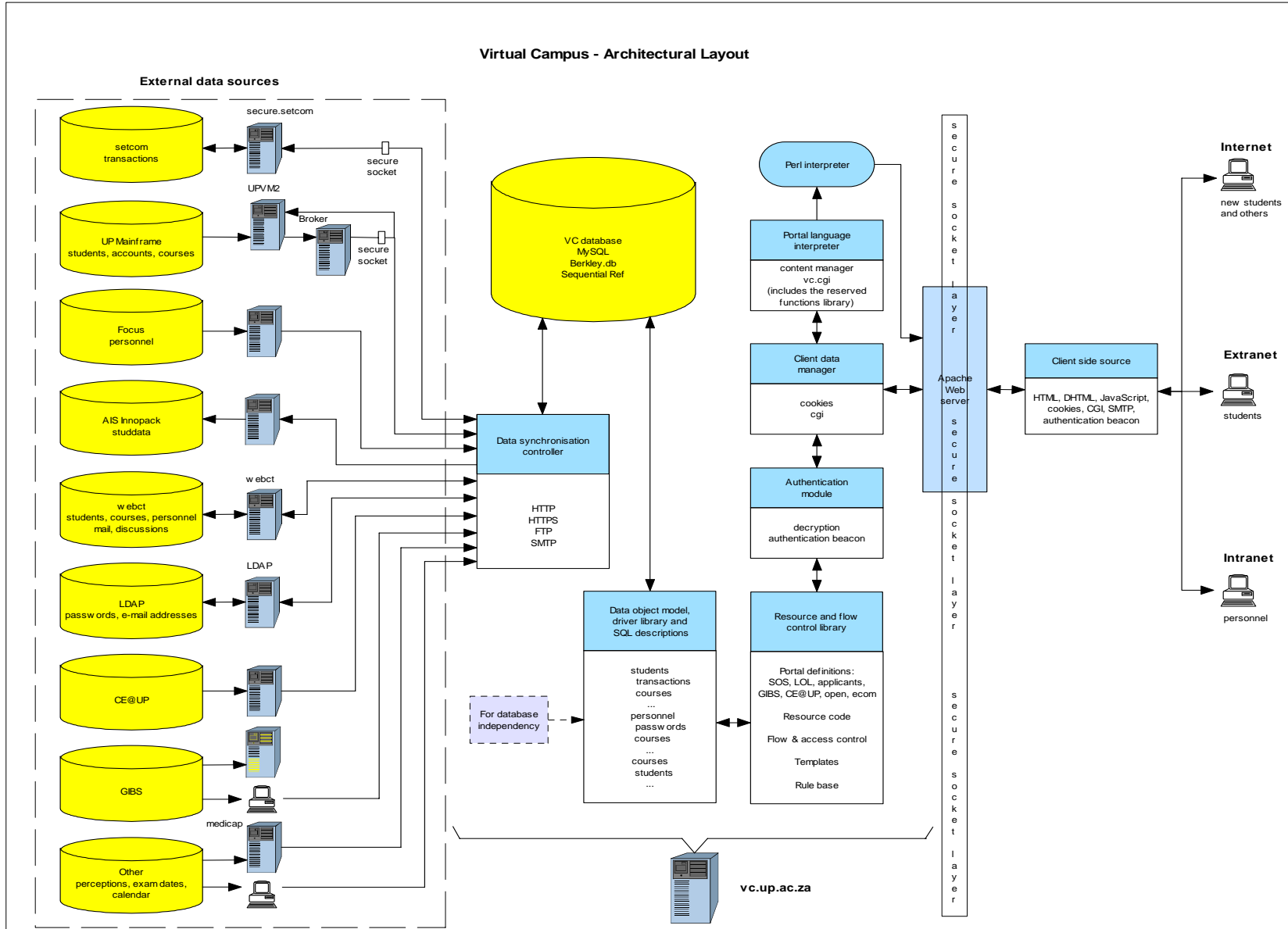
If we are considering partnering with other virtual campuses it will entail the joint use of telecommunication equipment and networks. Pro-active planning on cost sharing would be advised. It will be necessary to develop articulation agreements and procedures and effective mechanisms to assess prior learning and the question of which institution confers a credential in an environment of multiple course providers will need to be resolved (implications of NQF?). There are also policy issues such as the language policy that will have to be re-considered – do we have the capacity to produce information on the virtual campus in both languages?

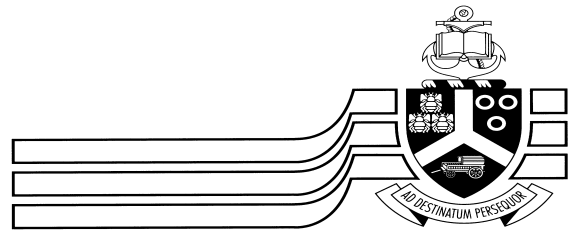
4. Recommendations

If the strategic vision of the University entails a gradual transformation to become a virtual university or have a virtual campus that is integrated with existing practice, additional resources will have to be allocated in terms of funding reallocation, additional human resources or re-engineering of the capacity at the University (re-skilling and infrastructure). Understandably, this can only be done once the implications are clearly delineated. This will be done to a significant extent by the beginning of August 1998. Yet owing to the nature of the field it requires flexibility in terms of funding allocation in a context where it is not always random and cent specific. A long-term financial plan for the whole University is required.

Although a 'grass roots' operational approach is sound with regard to ownership, top-down assistance will also be required in light of the matrix project management being followed which causes a situation whereby processes that will have considerable impact on the institution are either being slighted or delayed on the one hand or done by staff who are not certain to what extent they may spend time on the project and/or stretching their capacity to such a degree that they will not be able to continue producing at the same pace. Support from their line managers is required and a revision on workload will become imperative for the success of this project.

Annexure D





University of Pretoria
Annexure E

Telematic Learning and Education Innovation

Service Level Agreement

Introduction	<p>The Department of Telematic Learning and Education Innovation (TLEI) strives to provide exceptional service to its users in academic departments. In order to meet expectations, it is necessary to reach agreement on the development process and mutual commitments.</p>
Services	<p>In addition to web-based and multimedia course development, the E-education division of TLEI offers graphic, video and photographic services. TLEI recommends that Departments make use of these services to ensure a high standard of quality.</p>
Projects	<p>TLEI can only allocate internal resources to projects where the required project proposal has been approved by the Steering Committee for Telematic Learning and Education Innovation.</p> <p>☞ For details about the submission of project proposals, see http://www.up.ac.za/telematic/intranet/iproject/project.htm</p>
Ownership	<p>The ownership of a Telematic project resides with the Academic Department and therefore the Project Leader is usually the Head of Department or appointed senior lecturer.</p>
Management of seed funds	<p>The seed funds allocated by the Steering Committee to a project are managed by the Project Leader in the academic department.</p> <p>☞ For details see http://www.up.ac.za/telematic/intranet/iproject/vesbest.htm</p>
Project team	<p>For each project approved by the Steering Committee a project team is appointed consisting of the following role players:</p> <ul style="list-style-type: none"> ● Project Leader (Head of Academic Department) ● Project Manager (TLEI) ● Lecturer/s ● Instructional Designer (TLEI) ● Educational adviser (TLEI) ● Information specialist (AIS)

-
- Graphic artist (TLEI)
 - Other support services, if necessary
-

Web Content Development : Web based courses

Study guide

- The final version of the course study guide, complying with our minimum requirements, is the source document for the initial HTML development of web-based courses.

Development time

- Allow **two weeks** for the development of the prototype after the final study guide had been submitted to TLEI. This development period may need to be extended for comprehensive courses including for e.g. a large volume of course content, interactivity, intricate navigation systems and scanned articles.
- If the prototype is intended as a template for further modules, allow **one week per module** after the final version of each study guide has been submitted.
- All development and QA should be scheduled for completion at least one week before the commencement of the course.

Formats

- Do not use styles, underlined text, colours, highlights, track changes, hyperlinks and strange fonts when preparing the study guide.
- Specified fonts : Arial and Times New Roman
- Do not "Save as HTML" in Word.
- Hyperlinks will be added by the web developer.

Instructions to the web developer

- Instructions to the developer should be submitted electronically in a separate document and must not be included in the study guide.

Graphic design

- Graphic work is completed simultaneously with the development of the web pages.
- Evaluation of the prototype includes evaluation of the look and feel and general graphic design.

Services for the account of the Academic Department

- The Academic Department will be invoiced for the following services:
 - Commercial images from an image library
 - Scanning
 - Photography
 - CD reproduction
 - Video shooting and editing
 - Copyright clearance for video / sound clips used by TLEI in developing a product
 - Price lists, which are updated bi-annually, are available from TLEI and Departments are required to familiarise themselves with the current price list.
-

Reproduction of CD-ROMS – Art work for the inlays

- The art work for the front and back inlays of the CD-ROM is discussed at the time of the evaluation of the prototype.
 - The graphic design section of TLEI will submit a concept design.
 - Reproduction of these inlays is outsourced and takes 5 working days after final approval of the design by the project leader.
-

Reproduction of CD-ROMS – duplication of CD-ROMS

- The graphic design section of TLEI will reproduce a maximum of 5 CD-ROMS for demonstration purposes.
 - Reproduction of more than 50 CD-ROMS is outsourced, and takes 4 working days from the time of the placement of the order to final delivery to TLEI.
 - In-house reproduction will take 3 working days once the Project Leader and Instructional Designer are satisfied that all the content is ready for the CD-ROM.
-

Quality Assurance

- Departments submitting video and photographic content which they have produced themselves must ensure that they comply with the standards documents produced by TLEI.
 - The Project Team is responsible for quality assurance of course design and development.
 - All interface design for web courses developed by lecturers themselves is subject to approval by the Project team.
 - The Project Leader is required to participate in the QA sessions and to sign off the QA report when the web course is acceptable.
 - After sign-off, the web course is transferred to the Virtual Campus, for live delivery to students.
 - Once the course is on the Virtual Campus, the content may not be changed during the semester, with the exception of dates and/or small errors.
-

Maintenance

- In the event that more than 6 HTML pages require editing, a reasonable time schedule must be negotiated with the Project Manager.
- Smaller changes to content must be requested electronically in the following format, referring to either the study guide or the actual web page :

Example

Study guide

p.1 – par. 2. Replace “workshop date to be announced” with “Workshop : 15 September 2000”

OR

Web page

Under Workshops : par 2. Replace “workshop date to be announced” with “Workshop : 15 September 2000”

- Handwritten changes will not be accepted.
 - An annual review of the course can be negotiated with the Project Manager.
-

Additional content

-
- A reasonable delivery date should be negotiated with the Project Manager in the event that additional content needs to be added to the study guide.
 - It is the lecturer's responsibility to inform students of additional material/changes via the Discussions Tool.
-

Facilitation of learning

- It is the lecturer's responsibility to facilitate the learning process and to ensure that communication takes place, making use of the communication tools in WebCT.
-

Marks

- It is the responsibility of the lecturer to add and release students' marks in the WebCT course.
-

I hereby agree to the above requirements.

Signed

.....

Date:

.....

Project Leader in Academic Department

Signed

.....

Date:

.....

Project Manager (TLEI)

Roles:

Instructional Designer (TLEI)



There are eight instructional designers at TLEI. Their responsibilities include:

- consult frequently with the lecturer/s
 - report problems to project managers
 - provide guidance and suggestions about the content, strategy and structure of the web based course
 - design, develop and demonstrate the prototype
 - participate in evaluating the prototype
 - design and develop the course
 - ensure that agreed deadlines are met
 - follow quality assurance guidelines
 - carry out ongoing formative evaluation
 - participate in the Quality Assurance team
 - implement changes, edits required after evaluation
 - liaise with systems experts with respect to student registration, uploading course to production system
 - organise and present student orientation sessions
 - load student survey and download results
 - carry out ongoing maintenance of the course according to negotiated delivery times
-

Educational Consultant (TLEI)



Educational consultants are based in the Education Innovation division of TLEI. Their services include:

- collaborate on education philosophy and learning models (macro design)
 - provide assistance with the development of outcomes based curricula in compliance with SAQA requirements
 - guide and support the lecturer in redesigning the content and structure of courses within a flexible learning environment
 - advise on teaching and learning strategies
 - advise on the design and development of assessment strategies and learning activities
 - advise on the design of learning materials that optimise learner interaction and engagement therewith
 - advise on techniques to enhance online communication between learners and facilitator and
-

Information Specialist (AIS)



between learners

- provide relevant resources on teaching and learning theories, techniques and strategies
-

Graphic Artist (TLEI)



Information specialists at the AIS form part of the project team. Their responsibilities include:

- source applicable online resources, such as online journal articles and internet sites
 - scan articles required by the lecturer and provide them to the Instructional Designer in pdf format
 - create web pages for searching and referencing
 - advise on reference techniques (for example, the Augmented Harvard Method)
-

There are four graphic artists at TLEI.

Their responsibilities include:

- consult with the lecturer, instructional designer and project manager
 - ensure that agreed deadlines are met with regard to the development of graphics
 - produce a concept design for the "look and feel" of the online course
 - produce all the necessary graphics, banners, icons for the course
-

Roles of stakeholders (Telematic Learning and Education Innovation, 2000c)

Annexure F

Minimum Requirements: *WebCT* courses (TLEI)

The study guide and the course schedule must be submitted as hard copy and electronically, either on disk or as e-mail attachments to the instructional / *WebCT* designer. Contact details of the lecturer(s) concerned, as well as the course title, course code and description must be included.

- ❖ The **study guide** should be saved as *.rtf (rich text format) in Word.

1. Lecturer(s) details

Minimum:

- Name of lecturer(s)
- Telephone & fax numbers
- E-mail address(es)
- Dates/times during which students may contact the lecturer(s)
OR Link to departmental homepage with the lecturers' information.

Recommended:

- Subject(s) for which the lecturer(s) is/are responsible
- Qualifications

Optional:

- Photo of lecturer(s)
- Research areas
- Titles of conference & journal papers
- Brief CV: Academic and professional experience

2. Schedule / Study Programme

Minimum:

- Overall course schedule (preferably per week) indicating *inter alia*
 - Progress targets for students
 - Dates for assignments
 - Dates for contact sessions
 - Dates for formal tests / examinations (if applicable)

- ❖ The **schedule** should be prepared in Excel and saved as *.csv (comma delimited format) using the layout as illustrated below:

:date	summary	URL	start time(hh:mm)	end time(hh:mm)	detail
:7/2/2000	Assignment 1				Hand in Assignment 1. Chapter 8 : Block codes.
:28/2/2000	Assignment 2				Hand in Assignment 2. Chapter 8 : Convolutional codes and Coded modulation.
:6/3/2000	Lecture Block 1		08:30	17:00	
:7/3/2000	Lecture Block 1		08:30	17:00	
:8/3/2000	Lecture Block 1		08:30	12:00	Class Test 1. Lecture Block 1.
:27/3/2000	Assignment 3.				Hand in Assignment 3. Chapter 7 : Channel capacity and Coding.
:10/4/2000	Assignment 4.				Hand in Assignment 4. Finite Fields and BCH Codes.
:8/5/2000	Lecture Block 2		08:30	17:00	
:9/5/2000	Lecture Block 2. Demo		08:30	17:00	Lab : BCH encoder / decoder demo.
:10/5/2000	Lecture Block 2.		08:30	12:00	Class Test 2. Lecture Block 2.
:5/6/2000	Assignment 5				Hand in Assignment 5. Chapter 2 : Probability and stochastic processes. Chapter 5 : Source
:26/6/2000	Examination Report				Hand in Examination Report.

3. Learning outcomes

Minimum: Specific outcomes for the course / study units as per SAQA

Recommended:

- Capability statement
- Critical / essential outcomes
- How the outcomes will be assessed

4. Content or Content outline

Minimum:

- Content structure according to topic / theme

Recommended:

- Course notes for each topic / theme
- References for each topic / theme
- Links to relevant multi-media presentations
- Self-assessment for each topic / theme
- Peer assessment for each topic / theme

Optional:

- Glossary

5. Evaluation Tools

Minimum:

- List and description of all individual / group assignments
- List and description of other evaluation tools, such as quizzes, self tests, student presentations etc.
- Due dates and submission instructions

6. References

Minimum:

- Complete bibliography

Recommended:

- Links to applicable Web sites
- Pdf documents (for example AIS scanned articles)

7. Assessment Policy

Minimum:

- Assessment criteria, methods and evidence required
- Grading weight factors
- Calculation of semester and year marks

8. Communication Tools

Minimum: List and description of communication opportunities

Recommended:

- Telephone
- E-mail
- Discussions (topics)
- Chat rooms

(Telematic Learning and Education Innovation, 2000c)

Annexure G

SERVICE IN SUPPORT OF TELEMATIC LEARNING AND EDUCATION INNOVATION (TLEI)

INTRODUCTION

Support for information services in telematic teaching requires a close partnership between the AIS, the relevant academic department, TLEI and various other departments within the University (e.g. Informational Technology). External players are also partners in the delivery of services (Dalro, Contents Solutions).

THE DELIVERY OF INFORMATION SERVICES IN SUPPORT OF TLEI.

1. Preliminary arrangements before service delivery.

The nature of the services to be delivered by the AIS in support of telematic teaching is such that it can only be delivered successfully if all the parties concerned agree in advance upon their various responsibilities. The Academic department, the Information Specialist and the designer from TLEI must contract about the following:

- support in identifying information sources
- format in which information must be made available
- number of students involved
- times when services must be available
- aid to students when necessary

2. Pre-packaging of information sources. Pre-packaging implies that copyright clearance must be obtained in advance and that master copies (electronic or in paper format) must be available.

Policy, guidelines and procedures as applicably when making information resources available:

- Launching of project:
 - The lecturer contacts the relevant Information Specialist and representative of TLEI well in advance
 - They act as a team and the project is planned
 - Master copies (best quality available) are made available
- Copyright Clearance

The Academic departments and lecturers take responsibility for:

- The timeous budgeting for copyright as part of the general budgeting process
- The completion of a request for copyright clearance per course/module per registered student. (NB this request is only valid for one module).

- Adhering to the Copyright Act (10 % or 1 chapter or one article)
- The AIS takes responsibility for:
 - Managing the requests for copyright clearance in cooperation with Dalro.
 - Managing quotations and payments of copyright clearance fees to Dalro
- The question of time

A period of at least one month is needed by the AIS to prepare the information. This includes:

- Collection of the material
 - Scanning of material
 - Linking up to UPExplore
 - Design of web pages
- Number of articles:

The following serves as a guideline:

 - 5 articles for undergraduate courses
 - 10 articles for honours courses
 - 15 articles for M/D courses
 - The number of clients involved will determine the format of delivery
- Technical specifications
See "Help" screen at: <http://explore.up.ac.za/screens/help.html>
- Support

Contact the relevant Information Specialist. Particulars are available on the web pages of the courses/modules.

Annexure H

UNIVERSITY OF PRETORIA

WEBCT-SUPPORTED COURSES QUESTIONNAIRE TO LECTURERS

September 2002

1. Do you think the use of WebCT offers more flexibility to students in terms of place, pace and time?
2. Do you support web-based education?
3. Please list and describe constraints that you experience regarding the use of WebCT.
4. Please list your courses and course codes that are offered with WebCT support.
5. How do you facilitate learning in your WebCT supported courses?
6. Do you use WebCT only as a content delivery system?
7. How do you make use of group learning techniques in your WebCT supported courses regarding the following phases?

Before block/contact session	_____

During block/contact session	_____

After block/contact session	_____

8. How do you make use of peer assessment regarding group activities in your WebCT supported courses?
9. Do you use peer evaluation as a formal mark that contributes to the semester marks of students?
10. Please indicate whether you make use of WebCT communication tools (Bulletin Board, Messaging, Chat) to facilitate discussions and indicate which tools you use.
11. Do you make use of the multiple choice testing facility in WebCT?

12. Do you think it is important that interactions between you and students take place between block/contact sessions?

13. What is the average turnaround time of feedback on assignments that you give students?

14. Do you make use of case studies in your WebCT supported courses?

15. Mark with an X what types of activities you use block/contact sessions for:

Lectures	
Class tests	
Group assignments	
Other	(Please describe)

16. What types of interactions take place between you and students between block sessions?

17. If interactions take place between you and students between block sessions, do you make use of WebCT to facilitate interactions?

Role of the lecturer:

Please mark in order of priority (1 – 12) what you consider to be important characteristics of a lecturer who uses WebCT in a course:

<input type="checkbox"/>	Expertise
<input type="checkbox"/>	Empathy
<input type="checkbox"/>	Enthusiasm
<input type="checkbox"/>	Clarity
<input type="checkbox"/>	Cultural responsiveness
<input type="checkbox"/>	Patience
<input type="checkbox"/>	Positive
<input type="checkbox"/>	Friendly
<input type="checkbox"/>	Responsive
<input type="checkbox"/>	Caring
<input type="checkbox"/>	Flexible
<input type="checkbox"/>	Web-smart

Other: _____

Please mark appropriate roles of a lecturer who facilitates web-supported learning:

	Facilitator
	Mediator
	Mentor
	Provocateur (prompts student to think critically and participate)
	Observer
	Participant
	Co-learner
	Assistant
	Community-organiser
	Host
	Other _____

Annexure I

Questionnaire: WebCT – supported programme

Please encircle the relevant programme that you are registered for and indicate your year of study in the right-hand column below.

Programme	Year of study
MEM	
MBA	
MPM	

Please mark the correct column with an X

1. When I learn, I link facts, ideas and notions in order to interpret, infer, propose and judge

1	2	3	4
not at all	sometimes	often	always

2. I contribute new elements of information.

1	2	3	4
not at all	sometimes	often	always

3. I create new knowledge.

1	2	3	4
not at all	sometimes	often	always

4. I propose solutions supported by justification.

1	2	3	4
not at all	sometimes	often	always

5. I make judgements supported by justification.

1	2	3	4
not at all	sometimes	often	always

6. I propose advantages and disadvantages of a situation or solution.

1	2	3	4
not at all	sometimes	often	always

7. Continuous assessment takes place in my courses.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

8. My performance is observed by others versus only private assessment by the lecturer.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

9. I help define the questions in the assignments.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

10. I take an active role in learning.

1	2	3	4
not at all	sometimes	often	always

11. I take a proactive role in learning

1	2	3	4
not at all	sometimes	often	always

12. I cannot complete a cooperative/group assignment without the contribution of others in the group.

1	2	3	4
not at all	sometimes	often	always

13. I remain accountable for a group assignment.

1	2	3	4
not at all	sometimes	often	always

14. Everyone shares leadership in a group assignment.

1	2	3	4
not at all	sometimes	often	always

15. Everyone shares responsibility in a group assignment.

1	2	3	4
not at all	sometimes	often	always

16. The group is involved in processing its effectiveness.

1	2	3	4
not at all	sometimes	often	always

17. The lecturer observes in group assignments.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

18. The lecturer intervenes during group assignments.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

19. Social interaction takes place with other learners.

1	2	3	4
not at all	sometimes	often	always

20. Dialogue with the lecturer takes place via e-mail.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

21. Dialogue with the lecturer takes place via WebCT discussion tools.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

22. Dialogue with the lecturer takes place during block sessions (face-to-face).

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

23. The lecturer answers our questions.

1	2	3	4
not at all	sometimes	often	always

24. We answer the lecturers' questions.

1	2	3	4
not at all	sometimes	often	always

25. My reaction/answer to a question is used by the lecturer to explain new information.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

26. The lecturers' answers to my questions encourage me to reconsider my ideas.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

27. The interactions between block sessions lead to increased learning.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

28. The interactions between block sessions lead to increased participation.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

29. The interactions between block sessions develop communication with the lecturer.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies.

30. The interactions between block sessions develop communication with fellow learners.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

31. The interactions between block sessions enhance elaboration.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

32. The interactions between block sessions enhance retention.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is ***sometimes, often or always***, please list specific courses where this applies

33. The interactions between block sessions support self-regulation.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is ***sometimes, often or always***, please list specific courses where this applies

34. The interactions between block sessions support self-directed learning.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is ***sometimes, often or always***, please list specific courses where this applies

35. The interactions between block sessions increase my motivation.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is ***sometimes, often or always***, please list specific courses where this applies

36. The interactions between block sessions facilitate negotiation of understanding.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is ***sometimes, often or always***, please list specific courses where this applies

37. The interactions between block sessions facilitate team building.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is ***sometimes, often or always***, please list specific courses where this applies

38. The interactions between block sessions facilitate discovery.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

39. The interactions between block sessions facilitate exploration.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

40. The interactions between block sessions facilitate clarification of understanding.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

41. The interactions between block sessions take place on a level of information sharing.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

42. The interactions between block sessions take place on a level of information comparing.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

43. The interactions between block sessions take place on a level of knowledge negotiation.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

44. The interactions between block sessions take place on a level of knowledge , construction (new knowledge).

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

45. The interactions between block sessions take place on a level of knowledge testing.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

46. The interactions between block sessions take place on a level of knowledge application.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

47. Interactions between block sessions aid clarification of my ideas.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

48. Interactions between block sessions aid clarification of my ideas and the ideas of others.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is ***sometimes, often or always***, please list specific courses where this applies

49. The learning outcomes in my courses build on my prior knowledge.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is ***sometimes, often or always***, please list specific courses where this applies

50. I can apply what I learn to my work environment.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is ***sometimes, often or always***, please list specific courses where this applies

51. The assessment criteria allows for multiple perspectives.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is ***sometimes, often or always***, please list specific courses where this applies

52. The role of the lecturer is to help students learn about the real world.

1	2	3	4
not at all	sometimes	often	always

53. The assignments are too easy to solve.

1	2	3	4
not at all	sometimes	often	always

54. The assignments are too difficult to solve.

1	2	3	4
not at all	sometimes	often	always

55. What I study makes me more competent.

1	2	3	4
not at all	sometimes	often	always

56. My studies help me to be successful.

1	2	3	4
not at all	sometimes	often	always

57. I am responsible for learning to take place.

1	2	3	4
not at all	sometimes	often	always

58. Learning takes place with other people.

1	2	3	4
not at all	sometimes	often	always

59. I prefer learning alone.

1	2	3	4
not at all	sometimes	often	always

60. Feedback in my courses is prompt.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

61. Feedback in my courses is frequent.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

62. Feedback in my courses is positive.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

63. Feedback in my courses is personalized.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

64. Feedback in my courses relates to assessment criteria.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

65. Feedback in my courses is specific.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

66. Feedback in my courses is constructive.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

67. What I apply has visible consequences.

1	2	3	4
not at all	sometimes	often	always

68. The assignments in my courses foster curiosity.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

69. The lecturer fosters curiosity in the subject matter.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

70. The assignments are situated in real-life situations, like case studies.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

71. Assessment is varied (multiple choice, group assignments, individual assignments, exams).

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

72. Assessment is appropriate for the specific courses I take.

1	2	3	4
not at all	sometimes	often	always

If your answer to the above is **sometimes, often or always**, please list specific courses where this applies

73. I experience barriers in the learning process.

1	2	3	4
not at all	sometimes	often	always

If the answer to the above is **sometimes, often or always**, please describe them:

74. I feel I have control over the learning experience in terms of when, how and where I learn.

1	2	3	4
not at all	sometimes	often	always

75. The assessment criteria are clear.

1	2	3	4
not at all	sometimes	often	always

76. I exchange resources with fellow learners.

1	2	3	4
not at all	sometimes	often	always

77. I exchange information with fellow learners.

1	2	3	4
not at all	sometimes	often	always

78. I challenge others' contributions.

1	2	3	4
not at all	sometimes	often	always

79. I share knowledge with others.

1	2	3	4
not at all	sometimes	often	always

80. I monitor the efforts of others.

1	2	3	4
not at all	sometimes	often	always

81. I engage in group skills.

1	2	3	4
not at all	sometimes	often	always

82. I receive help and feedback timeously.

1	2	3	4
not at all	sometimes	often	always

Role of the lecturer:

Please mark in order of priority (1 – 12) what you consider to be important characteristics of a lecturer who uses WebCT in a course:

	Expertise
	Empathy
	Enthusiasm
	Clarity
	Cultural responsiveness
	Patience
	Positive
	Friendly
	Responsive
	Caring
	Flexible
	Web-smart

Other: _____

Please mark appropriate roles of a lecturer who facilitates web-supported learning:

	Facilitator
	Mediator
	Mentor
	Provocateur (prompts me to think critically and participate)
	Observer
	Participant
	Co-learner
	Assistant
	Community-organiser
	Host
	Other _____

Annexure J

Samples of WebCT courses

The screenshot shows a Netscape browser window displaying a WebCT course page. The browser's address bar shows the URL: http://chem.up.ac.za/S/CRIP/asy101/scripts/serve_home. The page title is "Introduction to Chemistry - CMY 101".

The page layout includes a navigation menu on the left with the following items:

- Hide Navigation
- Control Panel
 - Visible to Designers
 - Take Guided Tour
 - View Designer Map
 - Add Page or Tool
 - Manage Files
 - Manage Course
 - Change Settings
 - Content Assistant
- Course Menu
 - Homepage
 - Syllabus
 - References
 - Class Notes
 - First Semester
 - Second Sem
 - Assessment
 - Add. Material
 - Lewis Structures
 - Periodic Table
 - Lecturer
 - Discussions
 - WebCT Mail
 - WebCT Chat
 - Video setup
 - Videos

The main content area features a banner for the "Department of Chemistry" with a molecular structure graphic. Below the banner are links for "(Student Online Services)" and "[UP Home]".

The main text on the page includes:

How to use the Study Guide

This Study Guide comprises an organisational component and a study component.

The organisational component

The organisational component explains all the administrative and organisational arrangements regarding the presentation and evaluation of the semester course.

The study component

Your learning activities should occur within the framework of the study component, which is divided as follows:

- **Syllabus themes:** The course comprises different themes. These themes represent a broad division of the learning contents of this year course.
- **Study units:** Each syllabus theme is divided into study units
- **Learning objectives:** A number of learning objectives are supplied. As an absolute minimum, you will be expected to achieve

Introduction to Chemistry - CMY 101 - WebCT 3.6.3 - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Shop Stop

Bookmarks Location: http://chem.up.ac.za/SCRP/chemistry/scripts/home_home What's Related

University of Pretoria

Introduction to Chemistry - CMY 101

MYSUBJECT | HELP | COURSE MAP | RESOURCES |


Hide Navigation

Control Panel
Visible to Designers
Take Guided Tour
View Designer Map
Add Page or Test
Manage Files
Manage Course
Change Settings
Content Assistant

Course Menu
Homepage
Syllabus
References
Class Notes
• First Semester
• Second Sem
Assessment
Add Material
• Lewis Structures
• Periodic Table
Lecturer
Discussions
WebCT Mail
WebCT Chat
Video setup
Videos

• Lewis Structures: View

Home • Lewis Structures



Molecular Geometry, using Lewis Structures, the VSEPR and Valence Bond Theories

These notes should not replace the reading of good text books.
Physical and Chemical properties depend on the geometry of a molecule.
Molecular Geometry (three dimensional structure) depends on the nature of the central atom (with or without d-orbitals): : the bonding electrons and the lone pairs around it.

- Use Lewis structures and the VSEPR theory: Valence Shell Electron Pair Repulsion, bonding electrons and lone pairs (the valence electrons) are placed on a sphere as far apart as possible
- Use Lewis structures and the [Valence bond \(VB\) theory](#): Bonding electrons and lone pairs are accommodated in hybridized orbitals, as far apart as possible in three dimensional space

For Molecular Geometry (Structure): the positions of the atomic nuclei will determine the geometry
BP = Bonding Pairs, LP = Lone Pairs

Electron Pair Geometry: AX₂ (2 BP)

Document: Done

Start Introduction to Chem... RD Chapter 5 - Microsoft Word 9:20 AM

The screenshot shows a Netscape browser window titled "Thermodynamics - MTX 220 - WebCT 3.6.3 - Netscape". The address bar shows the URL: http://class.up.ac.za/SCRIPT/mk220/scripts/serve_home. The browser interface includes a menu bar (File, Edit, View, Go, Communicator, Help) and a toolbar with buttons for Back, Forward, Reload, Home, Search, Netscape, Print, Security, Shop, and Stop. The website header displays "Thermodynamics - MTX 220" and navigation links: Home, View, Designer Options, and a "New" button. A left sidebar contains a "Control Panel" with options like "Take Guided Tour" and "Manage Course", and a "Course Menu" with links to "Homepage", "Afrikaans", "English", "Discussions", "References", and "Marks / Punte". The main content area is titled "MTX220: Thermodynamics / Termodinamika" and features a collage of images including a car, a truck, and a person working with machinery. Below the collage are links for "[Course List] [UP Home]" and "[English] [Afrikaans]". A large "WELCOME / WELKOM" message is displayed, followed by "Welcome to Thermodynamics MTX220" and a note: "Please click on the button for English if you want to see the Study Guide with all relevant information." The browser's status bar at the bottom shows "Return to previous document in history list" and the taskbar includes icons for Start, Internet Explorer, and other applications.

Engineering Physics - FSK 126 - WebCT 3.6.3 - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Shop Stop

Bookmarks Location: http://class.up.ac.za/SCRIPT/fsk126/scripts/serve_home

University of Pretoria

Engineering Physics - FSK 126

M-Media Problems View

Home » M-Media Problems

Multimedia Interaktiewe Probleme

Multimedia Interactive Problems

Hierdie interaktiewe probleme moet op jou hardeskyf gestoor word. Daar is 3 leers nodig om die multimedia te loop.
NB: jy moet die hoofstuk hieronder ook aflaai as jy die probleme daarin wil doen. Die 3 leers is:

- [ILW95.exe](#) Media Loader (EXE Program, 1,6Mb)
- [ILW.exe](#) Menu File (selfextracting Zip, DXR file, 915kb)
- [global.exe](#) Global File (selfextracting Zip, CXT file, 798Kb)

Kort? [HULP / HELP](#) Need?

These interactive problems must be saved on your harddisk. There are three files needed to run the interactive multimedia. **NB: you will have to download the chapter below as well if you want to do the problems within the chapter.**

When you have downloaded all the files as well as the chapter(s) for FSK 126 Click on ILW95.exe to run the program. It may ask you for Global.cxt. Just Select "all files" and click on the Global.cxt file and OK.

NB - if you select a chapter you have not downloaded yet, the program will freeze and you will have to press the "ctrl" "alt" "delete" keys on your keyboard at the same time to close the program. Download the chapter and click on [ILW95.exe](#) again.

Chapters 1 - 19 Chapters 20 - 38

Other Chapters - This Colour FSK 126 Files - This Colour

Control Panel
Visible to Designers
Take Guided Tour
View Designer Map
Add Page or Tool
Manage Files
Manage Course
Change Settings
Content Assistant

Course Menu
Homepage
Discussion Board
Study Guide
Lecturer Details
Transparencies
Self Evaluation
M-Media Problems
Tutorials & Memos
Tests & Memos
AFRIKAANS
Studiegids
Disent. Inligting
Transperante
Self Evaluasie
M-Media Probleme
Tutorials & Memos
Toetse & Memos

Document: Done

Start Engineering Physics - ... Chapter 5 - Microsoft Word Acrobat Reader - [Jhans...

9:43 AM

MECI First year modules. - WebCT 3.6.3 - netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Shop Stop

Location: http://www.up.ac.za/SCRIPT/eci851/scripts/home_home

University of Pretoria MECI First year modules. MYWEBCT | HELP | COURSE MAP |

Hide Navigation Home Course context

Control Panel Visible to Teaching Asst Manage Students

HOME Getting started Course overview 1ST YEAR MODULES Course co-ordinator Technical assistance Information specialist

Course Menu Homepage Course context Calendar Discussions

ECI 853

Family-focused community intervention in Early Childhood

5 August to 19 September 2002

Lecturers	Prof. B. Louw (012) 420 2303 blouw@postino.up.ac.za	Ms M. Mophesha (012) 420 3051 emphos@postino.up.ac.za
Schedule	General online discussion 1 : 19 - 23 August 2002 General online discussion 2 : 2 - 6 September 2002 Group assignment : 12 September 2002 Individual assignment : 19 September 2002 On Site week : 29 July - 2 August 2002	
Case Study 5		Name: Baby K Age: 10 months Sex: Male Description: Multiple disabilities (severe spastic CP, hearing impaired and blind) Address: Soweto
Downloads (PDF format)	Study guide <ul style="list-style-type: none"> • ECI 853 information • Study unit 1 • Study unit 2 • Study unit 3 	Library resources <ul style="list-style-type: none"> • Resources • Study unit 4 (Refer back to readings of Module 851: Theoretical Framework and lesson in

Document: Done

Start MECI First year modul... 2:33 PM

The screenshot shows a Netscape browser window with the following content:

File Edit View Go Communicator Help

Location: http://www.up.ac.za/ed/2001_web/ed853/anc2/953unit2.pdf

Bookmark

- Introduction
- Learning outcomes
- Application question
- Guided readings
- First Reading
- Questions 1
- Questions 2
- Second Reading
- Questions 3
- Third Reading
- Questions 4
- Fourth Reading
- Questions 5

Masters in Early Childhood Intervention
 ED 853 – Family-focused community intervention in Early Childhood
 Study unit 2

Masters in Early Childhood Intervention

Module 3 – ECI 853
Family-focused community intervention in Early Childhood
Units 1 to 4

Unit 2
Ecological approach to ECI: Culture as context for family-focused community intervention

Introduction

The South African population is referred to as the "rainbow nation" due to its multicultural and multilingual nature. According to Hanson (1990: 116) early intervention interacts with cultural values more than any other set of programmes or services. Effective ECI services are characterized by being community based and conducted in the child's natural environment, which emphasizes the importance cultural diversity. The challenge to early interventionists is to develop culturally congruent and sensitive intervention strategies and to merge these with a family-focused approach to ECI to develop contextually relevant services for individual families.

Document: Done

Taskbar: Start | Internet Explorer | MSN First year edu... | Addresses | WebCTsamples-A... | Netscape | 2:05 PM



University of Pretoria **Anatomy 151** | MYBECT | HELP | COURSE MAP | RESOURCES |

Home: View Designer Options

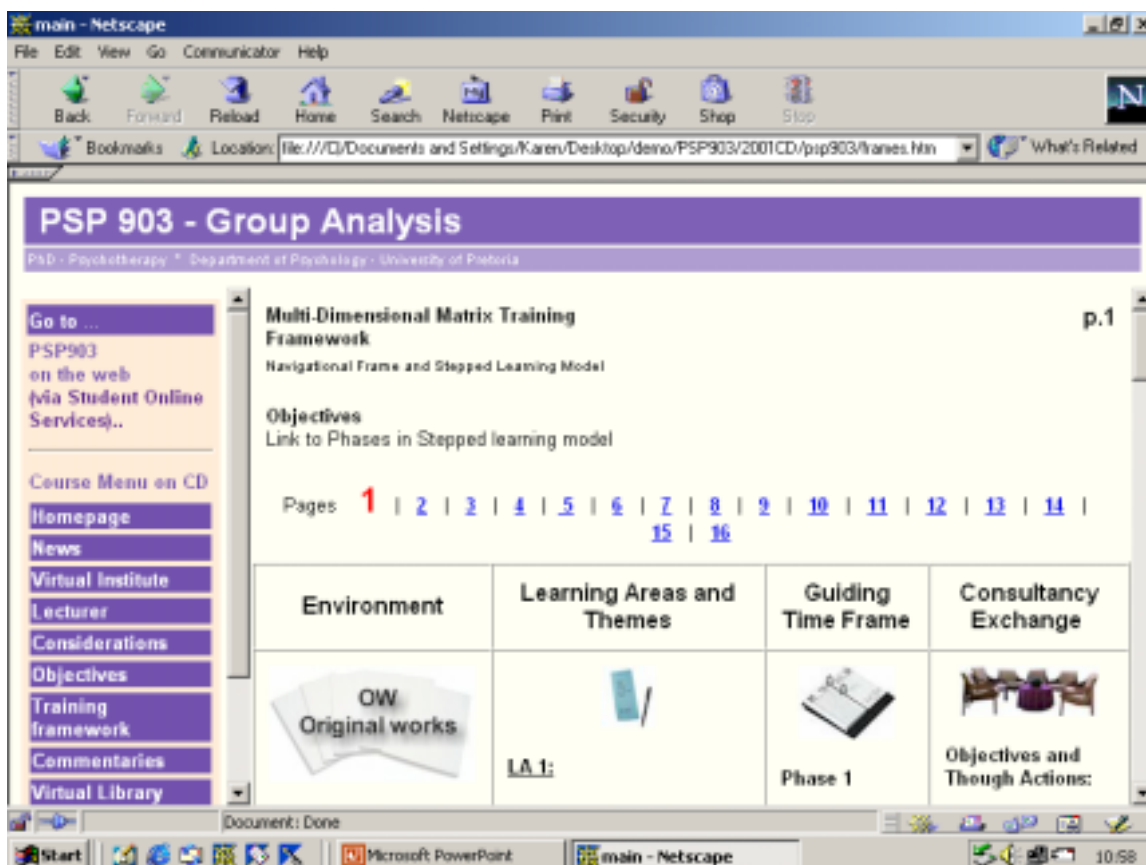
ANATOMY

PARAMEDICAL COURSES (BCur/BArb/BPhysT)

AFRIKANS ENGLISH

Technical support: [Erika de Bruyn](#) and [Honriette Wilmarans](#).
Library information: [Zonke Yantsa](#)

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main - Netscape

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Location: file:///C:/Documents and Settings/Karen/Desktop/demo/PSP903/2001CD/psp903/frames.Mim

PSP 903 - Group Analysis
PSP - Psychotherapy * Department of Psychology - University of Pretoria

Go to ...
PSP903 on the web (via Student Online Services)..

Course Menu on CD

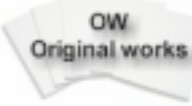



- Homepage
- News
- Virtual Institute
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- Considerations
- Objectives
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Multi-Dimensional Matrix Training Framework p.1

Navigational Frame and Stepped Learning Model

Objectives
Link to Phases in Stepped learning model

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Environment	Learning Areas and Themes	Guiding Time Frame	Consultancy Exchange
 OW Original works	 LA 1:	 Phase 1	 Objectives and Thought Actions:

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Annexure K

Glossary

Bandwidth

The difference between the highest and lowest frequencies available for a network signal. A measure of information-carrying capability of a transmission wire; the range of transmission frequency that a network can use. Wider bandwidths can carry more information.

Behaviourism

A theory about learning that is based on a stimulus-response approach in which contiguity, reinforcement and practice are imperative (Gagné & Glaser, 1987:51-56).

Bulletin board

A user can connect to a central host computer, post and read messages, or upload and download software.

Cognitive apprenticeship

An instructional model that includes scaffolding, modelling, reflection and exploration in settings where real-life problems can be worked with and solved (Wilson & Cole, 1993:48).

Constructionism and constructivism

Constructionism is a theory that locates meaning in language and the implied socio-cultural context. Constructivism places emphasis on the mental processes involved in establishing meaning.

Contiguity

Objects once experienced together tend to become associated in the mind (Gagné & Glaser, 1987:50).

E-mail

A network application for exchanging mail messages over various types of networks using various network protocols.

ERP system

Enterprise Resource Planning system

Flexible learning system

A flexible learning system is an approach to education that is learner-centred and provides the learner with a choice of learning strategies as well as a choice of place, pace and time.

Formal summative assessment

High stakes assessment like exams and semester tests, including the award of credits, qualifications and year marks, and the recording and reporting of these. It can be internally or externally assessed (Lubisi *et al.*, 1997:15).

HTML (Hypertext Markup Language)

A set of codes placed in documents so they can be displayed on the WWW.

ISDN (Integrated Service Digital Network)

A Network that accommodates digital transmission of voice, data, and video over standard copper telephone lines.

Listserv

A specific automatic mailing program that can run on any Internet server. It distributes email to users who are on the list.

Multimedia

A combination of video, sound, text, animation, and graphic images in a computer-based environment.

MySQL

My Standard Query Language

On-going formal continuous assessment

Formal continuous assessment is taken into account for credits and is included in summative assessment (Lubisi *et al.*, 1997:15).

On-going informal formative assessment

Self-assessment, peer-assessment or lecturer assessment that provide guidance to learners in terms of their progress. It is not used for credits but plays an important role to motivate and support the learner (Lubisi *et al.*, 1997:15).

ODBC

Open Database Connectivity

Online

Being actively connected to a network or computer system; usually being able to interactively exchange data, commands, and information via the Internet.

Positivism

Emphasis on the ability to measure and prove concepts.

Resource-based learning

Resource-based learning means that contextually-relevant media is used for communication between learners and lecturers (South Africa, 1996:272).

Scaffolding

Forms of support are provided to help learners to bridge the gap between their current abilities and the intended goal (Rosenshine & Meister, 1992:27).

Virtual campus

An educational institution that has web-enabled its product and service offering.

Virtual learning environment

Learning that predominantly makes use of technology to help achieve its aims.

WebCT

WebCourseTools

WWW (World Wide Web)

A hypermedia information retrieval system linking a variety of Internet-accessible documents and files.