

**OSEI TUTU II INSTITUTE FOR ADVANCED ICT STUDIES KUMASI, GHANA
AFFILIATED TO
KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI
SCHOOL OF GRADUATE STUDIES**



**E-LEARNING IMPLEMENTATION IN INSTITUTIONS OF HIGHER LEARNING:
A CASE STUDY OF PRESBYTERIAN UNIVERSITY COLLEGE, GHANA (PUCG).**

**A THESIS SUBMITTED TO THE OSEI TUTU II INSTITUTE FOR ADVANCED ICT
STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE
DEGREE OF MASTER OF SCIENCE IN ADVANCED ICT "ICT MANAGEMENT
OPTION"**

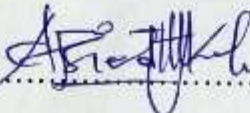
BY

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OCTOBER, 2009

DECLARATION

I hereby declare that this study was under taken independently and it is my original work. It is not replication of any work either published or unpublished. All references made in this study are duly acknowledged. Finally, all aspects of this study have been discussed with and approved by my supervisor, Prof. Kofi Sraaku-Lartey.

Signature 

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I declare that this dissertation was written under my supervision and that the Student has been consistent in his interaction with me for guidance and direction. He has my consent to present it for assessment.

Signature 

Date 15/10/09

PROF. KOFI SRAKU-LARTEY

(SUPERVISOR)

DEDICATION

I dedicate this thesis to Prof. Kofi Sraku-Lartey, the Principal of Presbyterian University College, Ghana and Harmin Dam of the Institute for Advanced ICT Studies.

This project is also dedicated to my brother Michael Yeboah Somuah. I am what I am and where I am today because of you, brother.

KNUST



ABSTRACT

Tremendous advances in computer technology and the evolution of the Internet have led to new approaches in learning and training which are summarized under the term e-Learning. With technology evolving at such a rapid rate, it is imperative that educational institutions equip students with technological skills that are essential for coping in the wider community. These skills are most effectively gained by learning with technology, rather than about technology. This MSc thesis examined the requirements for e-Learning environments: pedagogical, functional and non functional requirements. A checklist based on these requirements was developed that enabled us to analyze the authoring tools offered in the market and found the one that best fits the e-Learning needs of Presbyterian University College, Ghana according to these requirements. Afterwards, a structure that will define the concept for the e-Learning courses to be developed at the Presbyterian University College, Ghana was created; this structure served as a model to follow, being the core concept for future developments of e-Learning courses. A system prototype was developed to support the internal teaching process and its role in a technology-supported learning experience was evaluated. The results indicated that an e-Learning system must adequately meet the needs of the instructional process and support learners' behaviours and actions. These results also show that successful implementation of the e-Learning environment was dependent on four key factors: ICT infrastructure, ICT leadership, support and training initiatives and the teachers' ICT capacity. Ideas for further developments are sketched in this report.

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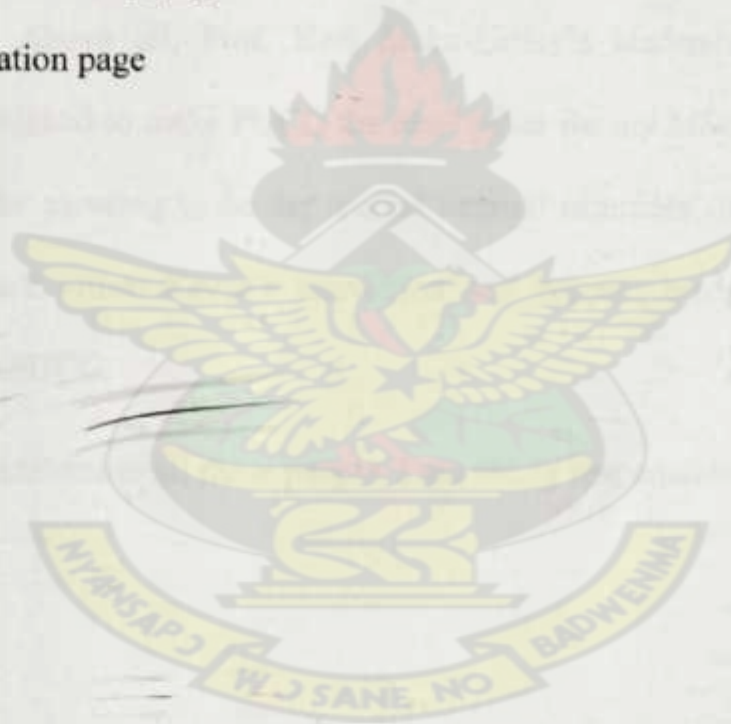
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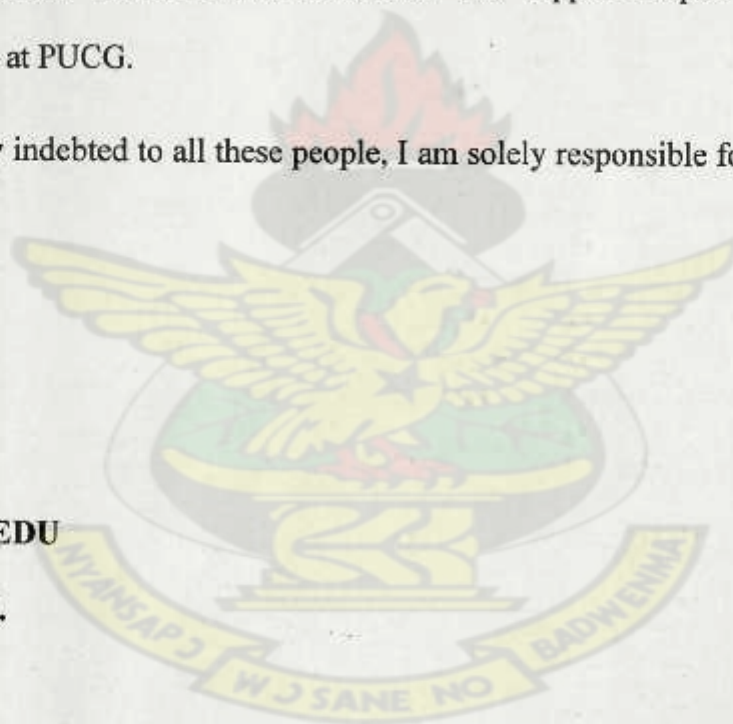
ACKNOWLEDGMENTS

I am indebted to my friends, colleagues, and students for their help, support, and teamwork over the past 32 weeks. Everyone at Presbyterian University College, Ghana and the ICT Department has been ready to provide valuable help and feedback, often at a moment's notice. Above all, Prof. Kofi Sraku-Lartey's leadership, vision and managerial skills combined to make PUCG the ideal place for my MSc Project. Many thanks also to him for agreeing to be the second internal examiner of this thesis. In addition to that, Mark Oliver-Kevor's conviction and support helped to make e-Learning a success at PUCG.

While I am greatly indebted to all these people, I am solely responsible for any defect in this work.

ERIC KOFI ASIEDU

OCTOBER, 2009.



ABBREVIATIONS

XML	eXtensible Mark-up Language
GUI	Graphical User Interface
SCORM	Shareable Courseware Object Reference Model
AICC	Aviation Industry CBT Consortium
LMS	Learning Management System



CHAPTER 1

INTRODUCTION

Chapter 1 gives an introduction of this Master Thesis, where a background and the problem description are discussed.

1.1 Background of the project

1.1.1 Presbyterian University College, Ghana

The Presbyterian Church of Ghana, as the pioneers of education in Ghana has established several schools in Ghana as God given duty to give equal education to all. It is the same concept that is behind the establishment of the Presbyterian University College Ghana (PUCG). It is a fee-paying institution, with a mechanism to promote sponsorship for needy students. It is privately and solely owned by the Presbyterian Church of Ghana.

The College opened its doors at its Okwahu Campus to the first students of 55 on 23rd November 2003 for the two initial programmes of ICT and Business Administration. This was the culmination of a year of hard work to get facilities ready and to obtain accreditation. The University has two (2) other campuses. These are the Akuapem Campus at Akropong and the Asante Akyem Campus at Agogo. These locations are all strongholds of the Presbyterian Church of Ghana. They lie on the hills and consequently have mild tropical climate. They are free from many distractions; the conditions are conducive to academic work. Currently students' population in all three campuses stand at about one thousand (1000), about 30% of which are females.

The College depends largely on funds from students' fees and the support of the Presbyterian Church as well as income from income generation and other fund raising

activities for its recurrent expenditure and infrastructural development. Higher enrolment figures would therefore ensure the sustainability of the College.

The University College was opened at the time when university education in Ghana was facing many challenges in terms of funding, quality and access. To ensure an expanded access to education, the PUCG has introduced several modules in its way of education including weekend school as well as long vacation modular programme. These programmes are geared at bringing in the working population who under normal circumstances may not be able keep their work while schooling. In this context e-Learning plays an important role, and the project described in this report is part of that effort.

1.2 Problem description

The Presbyterian University College Ghana (PUCG) is a private tertiary university college remotely located in the Eastern Region of Ghana. It offers about eight (8) courses in all its three (3) campuses. Some of these courses are: Information Communication Technology (ICT); Environmental and Natural Resource management; Rural and Community Development; Degree Nursing; Business Economics and Business Administration. It has a student population of about one thousand. PUCG has three streams namely Regular, Weekend Modular and Long Vacation Modular. The student population is very low in the latter since most of the students there are mostly employed and can hardly leave their jobs for longer periods.

The few workers who manage to take up admission into the College in the two modular programmes are mostly from nearby towns, usually between fifty to hundred kilometres.

Students from very far distances do not make it on time for their lectures and this discourages others from such places from taking courses in the College.

Interest and enthusiasm are high among most employees but the unwillingness of their employers to grant them study leave with pay simply does not allow them to upgrade their knowledge. Some employers have over the years expressed their desire to have their employees trained at their workplaces. The college has not been able to offer this service due to inadequate staffing at the ICT Department.

As part of the College's social responsibility towards its immediate environment, it has planned to offer community development through the use of ICT. This has not been realised due to infrastructural constraints.

1.3 Justification

1.3.1 The Need for e-Learning

Web Based Training and its newer and more general synonymous term e-Learning are two of today's buzz-words in the academic and business worlds. Decision-makers associate with them new ways of learning that are more cost effective than traditional learning strategies, e-Learning allows students to better control the process of learning because they can decide when, where and how fast to learn. However two questions immediately arise:

1. What exactly does e-Learning mean?
2. Is it really the best way of education?

The first question can only be answered partly and vaguely because it is still under heavy discussion what exactly e-Learning should look like, and different opinions even exist about what components it consists of. E-Learning consists of an e-Learning environment which works as an interface between the students and their learning objectives and provides different means to achieve the learning goal. Usually the e-Learning environment can be accessed using a Web browser over the Internet or Intranet and supports several learning strategies and different ways of interaction, communication and collaboration. Additionally e-Learning environments often include administration and management utilities and interfaces to other systems to support the organizational part of learning as well. Other terms for e-Learning environments, which are often used as synonyms or with slight variations in its feature-set, are e.g. (among many others):

- Computer Managed Instruction System (CMI-System)
- Learning Content Management System (LCMS)
- Learning Management Platform (LMP)
- Learning Management System (LMS)
- Virtual Learning Environment (VLE)
- Web Based Training System (WBT-System)

These terms would be used interchangeably, as they represent the same core idea. Strictly speaking e-Learning is just one part, the learning part, and needs to be complemented by e-Teaching. Both terms can be summarized under the term e-Education. However because most people understand e-Learning as the overall process it would be used as a synonym to e-Education.

The second question is easier to answer, because the answer is simply no, e-Learning is not yet the best way of education but it has the potential to be the most efficient one for many situations, if it is used in the right way. According to Goddard (1998) the demand for higher education is expanding exponentially throughout the world and by 2025 as many as 150 million people will be seeking Higher Education. This increase in demand is widely attributed to the changing culture of employment, where a job for life is no longer the norm and to the advent of the so-called 'knowledge-driven society' (Katz, 2001). Society requires higher levels of skills and qualifications to fill the same 'worthwhile' jobs (Davies, 1998), and individuals see education as a status provider (Pritchard & Jones, 1996).

Volery and Lord (2000) point to the capacity constraints and resource limitations that can be overcome through the implementation of e-Learning, creating a new opportunity to satisfy this growing demand.

The educational needs of individuals are now seen to be continuous throughout a working life, as labour markets demand knowledge and skills that require regular updates. A phenomenon of 'life-long learning' has begun and according to Davies (1998) this new concept is quickly gaining social and political recognition as Governments recognise the positive impact of education on the health and growth of modern economies. Consequently, higher education institutions will be required to provide for a more diverse student body. In particular, e-Learning will provide for the significant growth in the mature student market. The number of students who enrol each academic year into PUCG Long Vacation Modular Programme is continually decreasing. The reasons are not far fetched; about 95% of the students are matured and employed. E-Learning can reverse this trend in numbers since these matured students can learn without necessarily coming to the campuses of PUCG.

A recent report by the National Committee of Enquiry into Higher Education (2001a) reports that currently, more than 50% of Higher Education students in the UK are mature students (someone who starts a degree aged 21 or over). This figure is set to increase as online learning and virtual universities allow educational experiences to be tailored to the needs of individuals or groups of individuals. Other social groups, such as those from remote areas, those with family commitments and those with disabilities will also add to the diversity of the new student body as the physical and temporal obstacles to Higher Education are removed with the help of technology (University of Leeds, 2001).

1.4 Purpose and Research Questions

The purpose of this research is to investigate challenges and possibilities for implementing e-learning system in the Presbyterian University College, Ghana. The research would analyze the needs of PUCG and based on these requirements, implement an e-Learning system to enable the College expand its education.

In order to achieve this, the following question should be answered:

How can e-Learning expand access to Presbyterian University College education?

To help answer this question, the following sub questions would be tackled.

1. *What are the requirements of e-Learning environments?*
2. *What e-Learning authoring tools are available?*
3. *What e-Learning design architecture best fits the learning needs of PUC?*

1.5 Specific Objectives

This project seeks to:

- Assess the e-Learning needs of PUCG.
- Develop an e-Learning course model. This model would guide the future development of e-Learning courses in PUCG and any other institution that shares similar characteristics.
- Choose an e-Learning authoring tool for the development of Learning Objects in PUCG.
- Implement an e-Learning system for the College.

1.6 Research Methodology and Design

1 Analysis

- Analysis of PUCG Learning System, this would be done through Observation and Interviews with lecturers.
- Analysis of PUCG e-Learning requirements. This would result in a checklist that would enable the researcher to conduct a market survey of Authoring tools.

2 **Selection of an authoring tool.** An authoring tool would thus be selected for the development of e-Learning courses in the College.

3 **Design and Development of e-Learning System.** An e-Learning system architecture would be implemented.

4 Usability Evaluation

The e-Learning System would be evaluated after its implementation. This would be conducted through interviews and questionnaires with students and staff

1.7 Outline of Document

This Master Thesis consists of five chapters. Table 1 gives a description of each chapter.

Table 1: Outline of Document

Chapter	Description
1: Introduction	Chapter 1 gives an introduction of this Master Thesis, where a background and the problem description are discussed.
2: Literature Review	Chapter 2 reviews available literature on why the need for e-learning, the ideal e-learning system and the advantages of an e-learning system.
3: Analysis of PUCG Learning System	This Chapter analyses the e-Learning requirements of PUCG. This would result in a checklist that would enable the researcher to conduct a market survey of Authoring tools. An authoring tool would thus be selected for the development of e-Learning courses in the College.
4: Design and Implementation of e-Learning System	The main components of an e-Learning system are the platform or Learning Management Systems (LMSs) and the contents. This chapter first identifies an appropriate LMS and then defines a model

	for the development of contents using the selected Authoring tool in Chapter 3. The chapter ends with some discussions of implementation issues and testing.
5: Evaluation of e-Learning	In this chapter we evaluate the usefulness of the e-Learning. The evaluation deals with questions whether it was useful to use the e-Learning in the expansion of education in PUCG. If so, why; if not, why not; are there suggestions, remarks or refinements?
6: Conclusion and Recommendation	This chapter discusses final conclusions concerning the whole research; suggestions for further work are also discussed.

CHAPTER 2

LITERATURE REVIEW

This chapter reviews available literature on why the need for e-learning, the ideal e-learning system, the advantages and disadvantages of an e-learning systems.

2.1 Definition of e-Learning

As more and more personal computers were deployed in offices and homes in the seventies and eighties, the use of *computer-based training* (CBT) increased (Rosenberg, 2001). With CBT it is possible to learn by utilizing special training programs on a computer, often equipped with CD-ROMs, which makes the education more viable (Webopedia). CBT has the benefits of interactivity, which was missing in the previous period of educational television in the fifties and sixties. Although the benefits were apparent in the early days of the CBT, several imperfections soon were discovered. CBT programs were often limited by poor graphics, slow computer speeds and small hard drives, which led to dull programs composed by text based screens. CBT neither met the needs of changing technology nor the new approaches to learning where great advances were made in order to understand how people learn (Rosenberg, 2001). This gave rise to *web-based training*, which refers to the use of Internet or Intranet in order to provide training or instruction using a Web browser. For instance web-based training includes audio and video, portals of information and interactive methods such as chat rooms and instant messaging (Webopedia). This is similar to *online learning* which refers to education in a distance education mode and only occurs through the web. In this type of

learning there is no face to face contact or any physical learning materials (Nichols, 2003).

According to Rosenberg (2001) e-learning has greater possibilities than the concepts described above. Based upon three criteria he describes e-learning as follows:

- 1) First, e-learning is connected to a network, making it possible to update, store, distribute and share instructions and information instantly. This excludes instructional CD-ROMs that lack the possibility of immediate update and deliver immediately.
- 2) Second, e-learning is delivered to the user via a computer that uses standard Internet technology.
- 3) And finally, e-Learning focuses on a broad view of learning which differs from the traditional views of education. It goes beyond the terms CBT and web-based training as well as distance learning since it includes more than what these concepts consist of (Rosenberg, 2001).

In *distance learning* learners are separated from trainers and teachers mostly by time and space. Technology or media are used to make communication possible. Closely related to the term distance learning is *open learning*. *Open learning* has the ambition to describe learning with as few barriers as possible. Open learning is directed to whole populations regardless of gender, age, background or other possible barriers in the public surroundings. Students living in remote areas using distance learning are in a way also using open learning since the education is open for the students in the way it has not been

before. Although separated in terms, open learning and distance learning are closely linked, which makes it hard to discuss one term without the other (Daniel, 2005a).

E-Learning is a term that means something different to almost everyone who uses it. Some use the term to refer to packaged content pieces and others to technical infrastructures. Some think only of web-based self-study while others realize e-Learning can encompass real-time learning and collaboration. Almost all agree that e-Learning is of strategic importance. Almost all also agree that eLearning is an effective method that should be blended into a corporation's current learning mix (The Heritage Group, 2003).

The EU e-Learning Action Plan's definition of e-Learning is one definition that is most in line with my perception of e-learning; the EU e-Learning Action Plan defines e-Learning as "the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services as well as remote exchanges and collaboration." The definition is rather broad as it neither specifies the kind of learning methodologies nor the kind of technologies supporting it (multimedia technologies may cover almost any kind of computer based applications). It does however distinguish itself from distance learning, which can be done without the use of ICT technology.

In e-Learning environments learners interact with learning materials, their instructors and other learners from various locations and often at various times using network technologies. So by its nature, e-learning offers significant flexibility as to when and how learning occurs. E-learning can include independent, facilitated, or collaborative approaches to learning. Independent learning refers to each individual learner completing learning activities or modules on their own, in their own environment, on their own

schedule. The learner is independent of a facilitator and the other learners. This does not mean that the learner does not have access to other resources such as a facilitator or coach, but the learner is in control of whether they contact them, when they contact them, and for what.

Facilitated learning is designed to be completed through interaction with instructors or coaches. There are several ways this can work, for example, a learner might complete a section of learning on-line then discuss key concepts via e-mail with the instructor or with classmates. Collaborative learning relates to working with other learners in an on-line environment. For example: an e-mail discussion with other learners on a particular topic or everyone posting to a bulletin board or course room.

E-Learning can be asynchronous (meaning learners are experiencing the learning at different times) or synchronous (meaning learners are experiencing the learning at the same time) or it can incorporate both drawing on the strengths of each. Independent learning is, by definition, asynchronous. Facilitated and collaborative can be either asynchronous or synchronous.

2.3 A Brief Critical Analysis Of Advantages And Disadvantages Of E-Learning

2.2.1 Advantages of e-Learning System

2.2.1.1 Independence of learning place

Individuals in various places can effectively communicate with co-students or instructors without being in the same room. Students can learn at home in a relaxed atmosphere or at the working place. The biggest advantage here is cost and time saving, because neither

travel and accommodation expenses arise, nor do costs arise for missed working time due to traveling.

2.2.1.2 Free choice of learning time and speed and Just-In-Time learning

Learner can decide when the best time for learning is, e.g. during breaks or when the learner is relaxed and can adjust the speed of learning according to their needs like their powers of comprehension or whether they are in a fit state.

Just-In-Time learning allows individuals to learn on an as-needed basis. Employees or students can access information closer to the time the knowledge is needed rather than obtaining information that may never be used or may be used in the long-term.

2.2.1.3 Fast distribution and dissemination of new information to many people

E-Learning increases the rate at which knowledge is acquired, which is especially important in the corporate market and can be used to distribute information about e.g.

- new products and strategies that have a short life cycle to train account managers or consultants or
- procedural changes which have to be implemented by a large number of employees as fast as possible

2.2.1.4 Adaptive learning

With e-Learning the learning content and concept can be adapted to each individual's strengths and weaknesses to make the learning experience most efficient. Depending on the

knowledge background of the learner, which has been determined by pre-tests, the preferred learning style and type and the progress made so far (verified via post-tests and the speed of learning) the environment decides what and in which way content should be offered next. Possible parameters are different learning paths through the content, different ways of presentation of the same content (e.g. with or without audio) or offering a different set of functions which the user interface of the learning system provides to reduce complexity.

2.2.1.5 Multimedia and interactive learning is motivating and ensures learning success

Numerous research efforts on the effect of media on learning have shown that different media types have different efficiencies in terms of what a learner can recall. Especially the combination of media has very different efficiencies.

In general from 100 % of the learning material (facts) we can remember:

- 10 % through reading,
- 20 % through hearing,
- 30 % through seeing,
- 40 % through hearing and seeing,
- 80 % through hearing, seeing and doing (interacting)

In addition to that well prepared content is fun learning and thus motivates the learner which increases learning success.

2.2.2 Disadvantages of e-Learning System

2.2.2.1 No personal contact to teacher/coach and to other learners

Virtual communication such as audio and video conferencing is very costly, not always possible and also not a full replacement of face to face contact.

The lack of personal contact de-motivates learners and increases the drop out rate.

However, to keep online learners motivated, several measures can help:

- Community building: By creating a team of learners working for the same goal and supporting each other an internal pressure for progress and success is put on all members.
- Reachable and verifiable goals and milestones help the learners to check whether they are on track or need to speed up.
- Clear guidelines and a good user interface prevent that users are lost within the system and give up. User need to feel at home within the environment.
- In case of very difficult topics: Wrap the primary learning goal into a different more motivating story which is easier to understand and makes more fun. This uses the incidental learning effect [Holzinger & Maurer 1999].
- Mix online learning with real face to face meetings to introduce all members and synchronize their learning progress.

2.2.2.3 Only few online-learners finish a course

According to Forrester research 70% of learners starting with an online course will never finish it. Carr [Carr 2000] noted that dropout rates are often 10 to 20 percentage points

higher in distance education courses than in traditional courses. Is online learning really efficient enough?

2.2.2.4 The installation and use of learning systems is too time consuming and complex and thus expensive

Here we have to distinguish between the installation of the system and its usage. The installation is indeed a complex task which must not be reduced to the technical parts like setting up the system and its technical infrastructure but also have to include the organizational concept which is required to make e-learning a success.

Unfortunately the usage of the system for the different types of users is quite often too unclear and confusing and leads to improper and inefficient utilization.

2.3 Learning Theories

Learning is when we can detect a relatively stable change in someone's behaviour or behavioural dispositions, which is as a result of learning-activities. Examples of learning are learning to speak language, to calculate equations, to spend less money or to play a piano part by heart. In all these cases learning has occurred when we are able to perform those activities, which we were not capable of before. Learning is an active process, in which we can speak of learning-activities. We have to focus our attention, decode information and understand the information. Learning takes place in a learning environment. This means that learning occurs under certain conditions that are specially designed to improve learning.

2.3.4 Behaviourism

Behaviourism concerns itself solely with measurable and observable data and excludes explicit ideas, emotions, and the consideration of inner mental experiences and activities and is not interested in conscious (cognitive) control processes. The brain is understood as a “black box” which gets certain input (“stimuli”) and reacts in a deterministic way. In behaviourist thinking, the focal point of learning is in shaping the responses of the learner.

2.3.5 Cognitivism

In general, the term Cognition refers to mental processes that can be described as an experience of knowing as opposed to an experience of feeling or of willing. Cognition includes all processes of consciousness by which knowledge is built up, including topics like conception, perception, recognition and reasoning. Cognitivism stresses the internal processes within the human brain. For a cognitivist, the human brain is not a black box, where only input and output are relevant. Problem solving is the main way of learning: Not one answer or reaction to a certain question or stimulus needs to be practiced but more generally the right method(s) and procedure(s) have to be learned and understood and which of them leads to one or more of the right solutions. It is quite possible that not only one way leads to the optimum result but that several procedures can do this; however all of them will be trained explicitly. Cognitive theories emphasize making knowledge meaningful and helping learners organize and relate new information to existing knowledge in memory. Instructions must be based on a student’s existing mental structures, or schema, to be effective. Teachers should organize information in such a way that learners are able to connect new information with existing knowledge in some meaningful way. [Thomas Dietinger, 2003]

If we map the cognitivistic model to e-Learning environments we can derive the following requirements:

- Emphasis on the active involvement of the learner in the learning process such as learner control training. To support these techniques an e-Learning system should support the following tasks with built-in functions and tools:
 - Self planning the learning process (by e.g. offering several different ways of acquiring the information, by offering a calendar or simple planning tools such as tasks and milestones lists)
 - Monitoring learning progress (by e.g. including exercises or self-assessments and offering statistical reports to learners about their own learning progress)
- Emphasis on structuring, organizing, and sequencing information to facilitate optimal processing. Support of the use of cognitive strategies such as outlining, summaries, synthesizers or advance organizers by offering tools such as
 - An individual workspace, including simple authoring and structuring tools to summarize and reprocess information
 - Powerful search facilities to locate relevant information
 - Private annotations and typed links and bookmarks, automatically summarized by a learner's diary.
 - Mind maps
 - Semantic networks

- Creation of learning environments that allow and encourage students to make connections with previously learnt material. This should support the recall of prerequisite skills, use of relevant examples and analogies. This could be provided by an:

- Acquired-skill inventory (could be part of the skill management functionality), which is created partly automatically, by summarizing the difference between the pre- and post-test results after successfully finishing a course, and, also includes private entries to reflect additional experiences.
- Private knowledge base (or workspace) organized in a hierarchical or semantic structure and containing collected articles, summaries, annotations and bookmarks.

2.3.6 Constructivism

Constructivism differs from the traditional view that knowledge exists independently of individuals, the view that the mind is a tabula rasa, a blank tablet upon which a picture can be painted. Constructivism postulates that there are mental structures that determine how data and new information are perceived. If the new data make sense to the existing mental structure, then the new information is incorporated into the structure. Rather than simply absorbing ideas through endless, repeated rote practice, constructivism posits that students actually invent their ideas. Learning is considered as a reconstruction rather than a transmission of knowledge. However one logical disadvantage of the constructivist learning theory is that it is not well suited to approach a topic which is totally new for the students.

Constructivism makes it clear that the Teacher will only provide instructions on how to start with the knowledge acquisition. He should not influence the students too much and should not play an active role, because according to Constructivism, personal experience is in the foreground and not the helping tutor. This leads to the following requirements for the tool set of the learning environment:

- Authoring tool for the teacher to package all descriptions, contents, references and supporting tools which are required to work out the target topic by the students. This package goes beyond what is understood as typical instructional course material.
- Simple structuring and authoring tools to summarize gained knowledge and present it to others.
- (Background) libraries and glossaries which include internal material (background stories, electronic books and publications etc.), simulations (emulations of the real world or a connection to a real remote lab) and external material (such as rated and reviewed references) to browse for information.
- Rich and powerful search facilities including full-text, similarity and experts search and scheduled agents which allow learners to search within the internal and the external information.
- Synchronous and asynchronous communication features, such as discussion forums, messaging with mailing lists, text-, audio-, video chat, question/answer dialogs, shared whiteboards and application sharing tools to communicate with other learners, experts and tutors.

The different theories about the learning process also mean a different view about teaching and the way knowledge and skills should be imparted. In Behaviourism it is a matter of producing suitable input to cause the correct reaction. Appropriate feedback, which has been created outside, has to support this process. From this concludes an authoritarian teacher model: The teacher knows what is wrong and what is right and has to find ways and means to get it across to the students, who have to remember the correct factual knowledge to produce correct answers for predefined questions.

In Congitivism this evens out a little bit: Learners have to solve offered problems relatively independently (procedural knowledge: "know how"). However, the tasks are already didactically cleaned, meaning that all irrelevant facts have been removed; the situation has been simplified and has been presented as a concrete problem. The tutors coach the learning process, supervise and if necessary also help the learners.

In Constructivism the learner's own personal experience is given priority. Learners have to cope with complex situations and at the same time have to create the actual problems and tasks which they have to solve (social practice: "knowing-in-action"). Teachers play the role of coaches or moderators. They lose parts of their apparent infallibility because they are, together with the learners, exposed to the criticism of the actual situation. Their teaching role arises solely from their bigger experience (of life) and from their ability to support other people to cope with complex situations.

In real life there is not a single theory that fits well for all situations. Which of the learning theories are best suited to a certain situation depends on the background knowledge, the learning content, subject and goal of the learner.

According to Baumgartner [Baumgartner 2001] we can distinguish five levels of knowledge which correlate to recommended learning theories.

- *Level 1 – Novice – “Know that”*: Novices are not familiar with the learning topic yet and have not made any related experiences so far. First they need to learn basic facts and rules which they can not question and which they can only apply to real situations with guidance from outside because they can not decide on their own what the best rule to fit is.

In most cases the Behaviouristic model would fit the needs of novices quite well.

- *Level 2 – (advanced) Beginner – “Know how”*: Beginners start to perceive different cases and situations and to apply rules according to their contexts. Skills are executed in more variations but beginners still can not act on their own without close guidance and controlling.

Beginners achieve good results with a combination of the Behaviouristic and the Cognitivist learning model.

- *Level 3 – Competence – “Rational understanding”*: Competent persons know all relevant facts and rules and can distinguish between a wide spectrum of different cases and which solutions apply to them. Thus they can act independently within their areas and solve occurring problems.

Competency also means responsibility, taking a view and self-critical reflection.

However decision making is still cumbersome and difficult, competent persons are far away from sudden intuitions real experts can have.

Competent learners can be brought to the next step by a combination of the Cognitivist and Constructivist learning model.

- *Level 4 – Proficiency “Implicit understanding”*: At this stage the learners move from analytical realizations with subsequent applications of solution procedures to holistic perceptions of given situations. The learners seem to see the presented tasks together with their possible solutions.

In most cases only the Constructivistic learning model can bring proficient learners to the expert level.

- *Level 5 – Expert “Intuitive action”*: Experts perfect the holistic perceptions because various difficult tasks look familiar to them. This works because of an improvement of their ability to perceive and construct family likeness between different appearances. The art of this ability manifests itself in constructing cases, out of amorphous, unclear situations, which already contain their own solutions. Experts complement their knowledge best by constructing new one.

2.4 E-Learning Model

E-Learning models are derived from learning theories. These models usually describe the possibilities of how technology could support learning. Khan (2005), proposed the most comprehensive theoretical e-learning model for identifications of the variables that could be used as guidance for eventual implementation of e-learning systems. This is called the octagonal model for e-learning.

The eight factors that this model comprises have been grouped into three domains: educational, technological and organizational. Each of these factors addresses issues that need to be considered when designing an e-learning system.

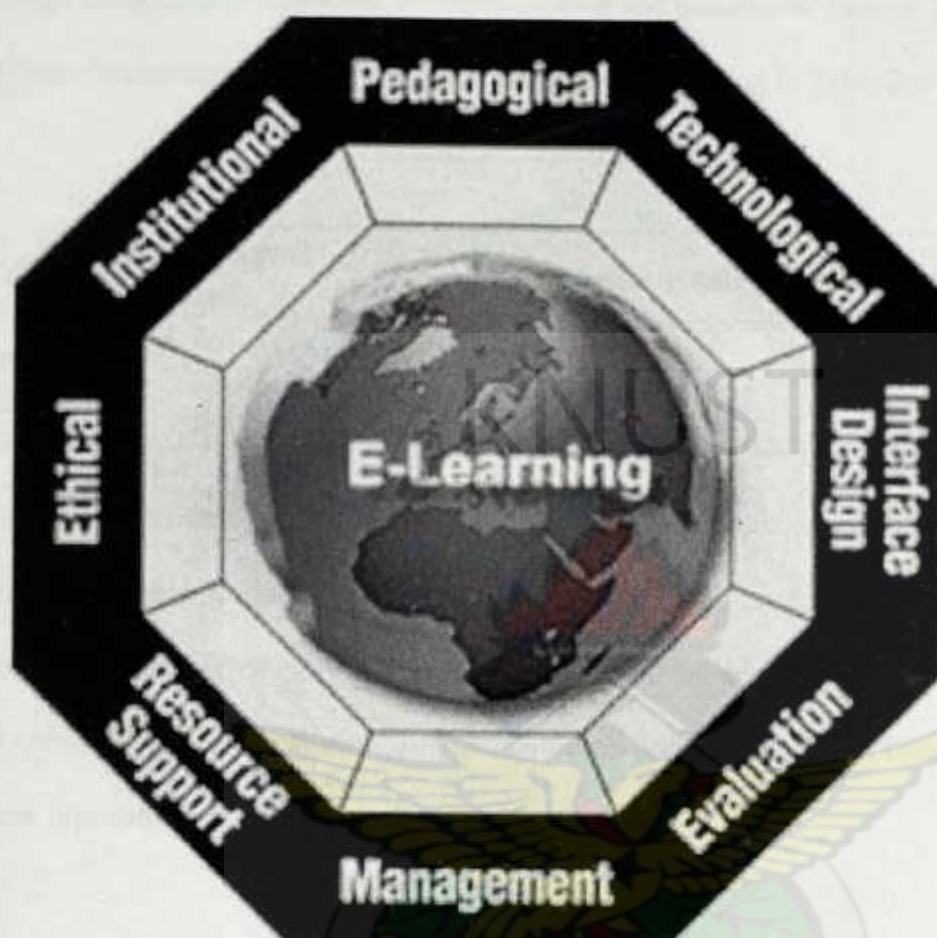


Figure 1. Octagonal model of e-learning (Khan, 2005)

As it can be noticed, this model represents eight (8) factors that should be considered when designing an e-learning system. These factors cover all the aspects of the e-learning and this is considered to be a very suitable model for the subject of this research. Since PUC-GH currently lacks an official e-learning system, it is important to identify all the factors that would determine the successfulness of e-Learning. These factors are grouped in three major domains: educational, technological, and managerial. Moreover each of the factors can be dissected in a set of issues that need to be addressed. The educational domain consists of: pedagogical, ethical and evaluation factors. The technological

domain consists of technology and interface design factors. And the organizational domain consists of institutional, resource support and managerial factors. The breakdown of these factors according to three main domains is presented in Table 2.

Table 2 e-learning factors

	Educational domain	Technological domain	Organizational domain
e-learning factors	1. Pedagogical 2. Ethical 3. Evaluation	1. Technology 2. Interface design	1. Institutional 2. Resource support 3. Management

Based on the model and this tabular breakdown of factors affecting e-Learning it is obvious that design and development of sustainable e-Learning system is a multidisciplinary effort. This basically implies that in the design and development of the e-Learning systems, the educational, technological and organizational factors should be taken into consideration.

2.4.1 Educational domain

Table 3 presents the breakdown of the educational domain into composing factors and issues that need to be addressed. According to the table the educational domain consists of pedagogical, ethical and evaluation factors. These factors have issues that need to be addressed. The main purpose of this domain is to ensure the educational benefit of the e-Learning system.

Table 3. Educational domain

Factors	Issues to be addressed
Pedagogical factors	<ul style="list-style-type: none">• Content provided• Learning strategy
Ethical factors	<ul style="list-style-type: none">• Geographical diversity• Etiquette• Legal issues
Evaluation	<ul style="list-style-type: none">• Quality of the learning content• Students performance

For the educational domain the first factor to be considered is the pedagogical factor. According to Khan (2005) the pedagogical factor should reflect information and guidelines concerning the content of the courseware offered and the learning strategies needed to be used in an e-learning system. This is especially important since e-learning offers new possibilities for digital learning content to be used. The use of digital learning content offers new possibilities and therefore potentially it will present a need for a change in the learning strategy for teaching. The second factor of the educational domain is ethical factor. This factor is important to be investigated and taken into consideration especially since e-learning systems creates a “gap” between the teachers and students. Thus in this way opening possibilities for unethical conduct from students while performing the learning activities within the system. Therefore it is extremely important to investigate the eventual threats that e-learning might present for institutions where the overall academic culture of the students is low.

The third factor of this domain is evaluation. The evaluation is closely related with the previous two factors. Especially in terms of the quality of the learning content provided and eventual possibilities for students cheating. Identifying proper evaluation methods should also be in line with the learning strategy chosen.

2.4.2 Technological domain

The technological domain is another part of the octagonal model. Moreover, the technological component is a part of other e-learning models proposed by other authors. This domain primarily addresses the issues of the technological infrastructure needed to be used for the development of e-learning system and the issues of the interface design of the software solutions used. In this aspect the issues that need to be addressed when dealing with technology is the hardware and software used for building the e-learning system. As the second factor of the technology domain is the interface design. The main issues that should be addressed according to Khan (2005) when investigating the interface design of the e-learning systems are: page and site design, navigation, accessibility and usability. All these issues directly affect the overall benefits of the e-learning systems. The breakdown of the issues to be addressed when analyzing technological component is presented in Table 4.

Table 4. Technology domain

Factors	Issues to be addressed
Technology factor	<ul style="list-style-type: none"> • Hardware • Software • Infrastructure
Interface design factor	<ul style="list-style-type: none"> • Page and site design • Navigation • Accessibility • Usability

2.4.3 Organizational domain

The organizational domain is the last domain that makes up the e-learning model. This domain is also very important for the successful implementation of the e-learning systems. According to Khan (2005) this domain is composed of institutional, resource support and managerial factor. In the institutional factor the main issues that need to be addressed are: the needs assessment issue in order to identify if e-learning is suitable for the institution,

return of investment if implementing an e-learning system and organizational changes that might occur in order to accommodate the e-learning. In the resource support factor the following issues should be addressed: the offered support for users of such system, should it be both online and offline resources available for such support. In the managerial factor the issues that should be addressed are: human resources for the e-learning system, team management. The breakdown of the issues to be addressed when analyzing organizational domain is presented in Table 5.

Table 5. Organizational domain

Factors	Issues to be addressed
Institutional factor	<ul style="list-style-type: none">• Needs assessments• Return of investments (ROI)• Organizational change
Resource support factor	<ul style="list-style-type: none">• Support provided• Online/Offline support
Managerial factor	<ul style="list-style-type: none">• Human resources• Team management

Decomposition of e-learning model into domains, factors and issues was a way to make the identification of the challenges that are faced during the e-learning system implementation easier. These challenges will help to create a clear picture of different stakeholders in the e-learning system. Moreover this decomposition will also be beneficial in methodological terms in order to dissect the main variables that are going to be measured and analyzed using different data gathering techniques. This would direct the kind of analysis that would be done in Chapter 5.

CHAPTER 3

ANALYSIS OF PUCG LEARNING SYSTEM

This Chapter analyses the e-Learning requirements of PUCG. This would result in a checklist that would enable the researcher to conduct a market survey of Authoring tools. An authoring tool would thus be selected for the development of e-Learning courses in the College.

3.1 Objectives of the e-Learning courses in PUCG

Getting to know first the objectives of the e-Learning courses helped in finding out the requirements of the courses, for this purpose, an exposure to the face-to-face courses offered by PUCG, prior to the start the project was of much importance, because this gave an in-depth understanding of the content of the courses, the way these courses were structured and the targeted people.

A regular face-to-face course held in PUCG consists of:

- No. of instructors/Lecturers per course: 1
- No. of students per course: 10 to 100
- Duration for a course: 16 weeks
 - 14 weeks for lectures
 - 2 weeks for examination

After a critical study of a number of Course outlines of the College, the following first characteristics of the courses were obtained:

- ~~Content~~ of the courses

The content of the courses has the main objective of training the human resource needs of the country in the specific area of interest of the student(s) e.g. Business Administration, Information Technology and so on.

A typical course content would include:

1. Course Outline
2. Schedule of Lectures, quizzes, projects and exams
3. Materials and notes

In the face-to-face courses, the theories and concepts in the course are first introduced and then where applicable showed step by step in the computer, afterwards the lecturer gives tasks to be solved. The task has to be solved, following the same steps explained beforehand. Sometimes, further explanation of some concepts related to the topic is also important. This way it is easier to understand the procedures and solve the task. From this information, it can be concluded that the e-Learning courses should offer **step-by-step simulations** where the user is not only able to see the way tasks are solved but also interact with the simulations and the **theory** to help in explaining some concepts and their importance.

- **Opportune training**

The contact hours for lecturer with the students are about three (3) hours maximum per week per Course. This does not offer the students enough time to seek explanation to some concepts and theories which might not have gone down well with them during the class. Another group of students, who are predominantly employed, cannot be in the classroom at certain periods of the year due to their work schedule. This means that

courses should be developed on demand to training these students in a way that suites them.

3.2 Actors and Roles

The e-Learning concept to be created affects mainly two (2) groups of people: the future developers of the e-Learning courses and the users of the courses.

1. Developers

The developers of the e-Learning courses are around fifteen (15) Lecturers of the College's staff, who have the most experience related to the delivery of the face-to-face courses in the three (3) departments of the College's main Campus.

2. Course users

The courses are targeted at the students in PUCG, who are divided into regular, weekend modular and long vacation modular. The regular students form the majority and have quite longer contact hours with the lecturer; they spend sixteen (16) weeks and also have the chance to meet their lecturers from Monday to Friday. The weekend modular students also spend sixteen (16) weeks but only meet with their lecturers on Fridays and Saturdays every week. The last group spends only 12 weeks doing one whole academic year of two semesters work.

3.3 e-Learning requirements

The second analysis step was to get to know the desired characteristics of the e-Learning courses, in other words, which technical features should the e-Learning courses offer according to the wishes of PUCG. These requirements helped to have a checklist and started looking for the most convenient authoring tool. The gathered requirements are here listed from most to least important:

3.3.1 Simulations

From the study conducted on the structure and content of the face-to-face courses prior to the start of the project, it was clear that simulations are one of the most important requirements. The authoring tool should offer screen recording features that allow the creation of step-by-step movies as a result of the recording actions while using an application, including mouse movements and keyboard activity.

Since this is an important requirement because that is the way most of the content of the e-Learning courses will be created, it should be expected from the authoring tool, as much flexibility in recording as possible.

3.3.2 Media synchronization – Special effects

It should be possible to present the content of the e-Learning courses with different editable media objects like text, graphics, video and animations in an integrated synchronized way. For example, the developer should be given the opportunity to add media objects to the simulation and to define their order of appearance and timing properties with the objective of controlling the flow of information, preserving the temporary relationships among the different media, focusing on important points and adding interest to the course. The authoring tool then should offer multimedia features that allow editing the simulations to enrich the content of the e-Learning courses.

3.3.3 Accessibility

It is also required that the courses be reachable via a Standard Browser from the corporate network, thus minimizing the Total Cost of Ownership (TCO) of the proposed solution (by avoiding the support costs associated with locally-installed fat client software).

3.3.4 Interactivity

Most of the time it is very useful for the user, for understanding purposes, to interact with the simulations and not just watch a movie. This allows the user to solve real world tasks without having to interact directly with the real application.

Learning by practice is more engaging for the user. For this reason the e-Learning courses should offer interactivity within the simulated applications, implying that the authoring tool should provide widgets (Graphical User Interface elements) for interactivity purposes, like buttons, text entry boxes, etc. From these requirements, it is relevant that there should be the possibility of branching so that the content can be customized according to the response of the user. For example, upon success or failure at a task, the lesson should be able to branch to the next appropriate content based on the user response. For this interactivity context, feedback is considered also important for the user to enhance the learning process and as a complementary functionality for branching, so that there is feedback according to the user's responses. Feedback captions should then be offered as a feature in the authoring tool. These can help for example: To offer hints about the correct action or answer, prompt the user to try again, offer praise for correct answers.

3.3.5 Quizzes

Sometimes it is also needed that the users of the e-Learning courses have the possibility of answering questions to help in learning definitions, procedures and basic principles that are needed when solving the problems. For these reasons the authoring tool should offer quiz functionality with multiple kinds of quizzes like multiple choice, true/false, etc.

3.3.6 Score Tracking

At the moment this is not a primary requirement but still a characteristic that the authoring tools should offer, because the e-Learning courses should also offer tests, so that the user is able to make a self-inspection of his/her abilities. It is also considered that in the future, there might be the need of tracking the scores of the user for controlling purposes. These controlling purposes demand the use of a Learning Management System (LMS), where the scoring information can be stored and assigned to a user. To make this possible, the authoring tool should be SCORM/AICC compliant, this means, the scoring data could be exported in SCORM or AICC compliant format to the LMS. The authoring tool should be able to create an XML file as output, which is required by the LMS to interpret the scoring data.

3.3.7 Standardized look and feel

The e-Learning courses should have a standardized look and feel to keep a comfortable yet formal interface. To help to realize this requirement, the authoring tool should offer template facilities to allow defining major project characteristics, like backgrounds, caption styles, etc. This could not only help in standardization but also to speed up the development of the courses.

As a summary of the above information, Table 6 shows the desired characteristics of the e-Learning courses and Table 7 lists the technical features to look for in the authoring tool.

Table 6: Desired Characteristics of the e-Learning courses

Content:	1. Software simulations 2. Special effects 3. Interactivity 4. Quizzes 5. Standardized look-and-feel
Output:	6. Score tracking
Accessibility:	7. Reachable via Browser
Others:	8. Rapid development (in days)

Table 7: Technical features to be found in the Authoring tool

Content:	1. Screen Recording features 2. Customizable Recording Window Size 3. Special effects 4. Editable media objects 5. Widgets for interactivity 6. Branching 7. Feedback captions 8. Quizzes 9. Templates
Output:	10. Score tracking 11. SCORM Compliance 12. AICC Compliance 13. Exporting content to text files
Accessibility:	14. Accessible via Browser

3.5 Choice of an authoring tool

Once a better overview of the requirements of the e-Learning Courses of PUCG was achieved, the market research started. The information gathered previously, helped the researcher to understand that an authoring tool that allowed the development of a Rapid e-Learning solution (REL) was required. A couple of such tools were considered as candidates for solving the PUCG e-Learning needs. These tools were chosen because of

their Rapid e-Learning capabilities and also because they seemed at a first glance to fulfil the e-Learning requirements of the College. These tools included among many others; Breeze, RoboDemo 5.0, Lecturnity, Commteaching and Knowledge Presenter.

Knowledge Presenter is the authoring tool chosen for this project. It fulfilled all the requirements needs on the checklist that was used to evaluate the authoring tools. Table 8 shows the results of the evaluation process. See Appendix C for the features of the other authoring tools that were considered.

Table 8: Features fulfilled by Knowledge Presenter

Content:	1. Screen Recording features	Yes
	2. Customizable Recording Window Size	Yes
	3. Special effects	Yes
	4. Editable media objects	Yes
	5. Widgets for interactivity	Yes
	6. Branching	Yes
	7. Feedback captions	Yes
	8. Quizzes	Yes
	9. Templates	Yes
Output:	10. Score tracking	Yes
	11. SCORM Compliance	Yes
	12. AICC Compliance	Yes
	13. Exporting content to text files	Yes
Accessibility:	14. Accessible via Browser	Yes

Besides the fulfillment of all the requirements that were evaluated in the different authoring tools, Knowledge Presenter has additional advantages as explained in what follows.

Knowledge Presenter enables the development of opportune training

Knowledge Presenter is a quite helpful tool, because it can easily fulfill the eLearning needs of anybody who needs to develop eLearning courses on demand, where the content of the courses should offer software simulations, interactivity, quizzes, surveys and synchronized multimedia without a steep learning curve. Thus,

Knowledge Presenter provides one of the most clear and easy to understand interface in comparison with many other tools, where the content of the courses is created in a comfortable Graphical User Interface (GUI). This makes the delivery of courses an easy procedure that can be achieved in days, to fulfill the training demands on time.

Knowledge Presenter is specialized in software simulations

Knowledge Presenter is an authoring tool that specializes in the creation of software simulations (which is the main purpose of the eLearning courses at PUCG). Thus, the recording features are quite flexible, it is possible to choose from a variety of recording types that can be also customized; these recording features can be seen as the core functionality of Knowledge Presenter. Recording features are also found in other authoring tools, but they do not provide so much flexibility as Knowledge Presenter does.

Knowledge Presenter offers a rich object library

Knowledge Presenter has a wide variety of widgets that help to enrich the content of the simulations. The widgets make possible not only to document the content but also to add interactivity. The variety of widgets is quite complete in comparison with other authoring tools that allow interaction only by means of playback controls or quizzes. It is not so easy to find a tool that provides so many different kinds of widgets as Knowledge Presenter does.

Knowledge Presenter allows construction of branching scenarios

Interactivity is well supported by the functionality of the widgets. With the widgets it is quite easy to simulate branching scenarios with their corresponding feedback, to guide the user to a certain point in the course, to a URL, to another course, etc. Other analyzed tools offer at most branching scenarios by the use of links, while Knowledge Presenter offers branching functionality as part of various widgets.

Knowledge Presenter provides accessibility.

Knowledge Presenter produces high-compressed files in Flash format; this allows reaching the eLearning content through a standard Browser. This is quite convenient since over 98% of all computers already have a Flash player.

Knowledge Presenter provides Export and Import Capabilities

The importing and exporting capabilities make the creation of the content a flexible process, since it is possible to import/export objects between Knowledge Presenter projects, to export/import the text content of Captions objects to a third software like

Word. Knowledge Presenter makes the process of developing e-Learning courses quite easy. A very convenient aspect is the flexibility offered in using different objects that help to enrich the content. This flexibility allows creating from the simplest e-Learning content, to quite interesting designs. The development of an effective and engaging content is left to the developer. The developer of the courses has to take care more about design and didactical issues, than about technical skills.

It provides other e-Learning features

From the quizzes and other interactivity objects like click boxes, button, text entries, etc. it is possible to score and track the abilities of the user and incorporate this information into a Learning Management System (LMS), because of its SCORM compliance.

Overview of Knowledge Presenter

Knowledge Presenter is a product of Deakin KM, a company specialized in Change Management, Documentation, Training and eLearning Consultancy, based in Australia. Knowledge Presenter is a tool specialized in the creation of e-Learning content for software simulation and multiple choice quizzes through synchronized multimedia presentations that can be accessed via any standard Browser. The learning unit produced has an HTML format, being also SCORM compliant so that it can be used in conjunction with third party Learning Management Systems. Knowledge Presenter offers a variety of objects that help not only in documenting the content (like caption, call out boxes, images, audio and others) but it is also possible to add interactivity. It is possible to create from a simple slideshow to detailed software simulations.

Authoring features of Knowledge Presenter

Rapid Development features

- **Wizards**

There is a wizard available to start up the creation of a lesson, ready to add images, text and presentation content. There is another for the screen recording process where the recording window properties are set, e.g. capture keys, capture region, capture mouse cursor.

- **Templates**

There is a variety of templates for the creation of different types of canvases, like assessments, multiple choice quizzes, evaluations, presentations, software simulations, slide shows and user created templates; these templates contain a set of canvases which already contain objects according to the type of template. Developers can also create and save their own templates.

- **Development and formatting features**

Knowledge Presenter offers the following features for course development and formatting: Import utility for direct import of Microsoft Word content, Import utility for direct import of Power Point content, library for reusable media objects, Quick preview function, Spell checker, Branching scenarios, Alignment tools for screen objects, Creation of hyperlinks to other URL, Creation of hyperlinks to other pages within the course and can print content in hard copy.

- **Assessment capabilities**

The multiple choice quiz engine assesses user performance where the learner can obtain feedback upon correct or incorrect answer. Also events can be scored, for example when a mouseover click event to a button has occurred then a point can be assigned to it. So the user interacts with objects that have a score associated with it.

The learner can obtain feedback upon correct or incorrect answer, directly after answer showing their current score and the total final score at the end of the lesson.

The types of questions offered are:

- Single correct answer
- Multiple correct answer

- **Tracking and Reporting capabilities**

Scoring is where Knowledge Presenter keeps a track of the actions of a user, and determines whether they get certain tasks and steps right or wrong.

- **Built-in LMS features**

Knowledge Presenter Professional edition is SCORM compliant, so it can communicate with interactive activities created in Knowledge Presenter. It can keep track of the progress of the user through a course, recording times and dates, activities that were taken, scores, times attempted. All of this information is stored in a database and retrieved when a user enters the correct name and password.

CHAPTER 4

DESIGN AND IMPLEMENTATION OF E-LEARNING SYSTEM

The main components of an e-Learning system are the platform or Learning Management System (LMS) and the contents. This chapter first identifies an appropriate LMS and then defines a framework for the development of content in PUCG. The chapter ends with some discussions of implementation issues and testing.

4.1 Learning Management Systems (LMSs)

The goal of any instructional system is to promote learning. Some researchers have attributed the effectiveness of online learning to the technological advancement while others attribute it to the contents of these online systems. There is a great debate about whether it is the use of a particular delivery technology or the design of the instruction that improves learning (Clark, 2001; Kozma, 2001). It has long been recognized that specialized delivery technologies can provide efficient and timely access to learning materials; however, Clark (2001) has claimed that technologies are vehicles that deliver instruction, but do not influence student achievement. Similarly, some researchers suggested that learning is influenced more by the content and instructional strategy in the learning materials than by the type of technology used to deliver instruction. Kozma (2001) argues that the particular attributes of the computer are needed to bring real-life models and simulations to the learner; thus, the medium does influence learning. However, it is not the computer per se that makes students learn, but the design of the real-life models and simulations and the students interaction with those models and simulations.

The main components of an e-learning system are the contents and the platform or LMS. Contents are prepared by the content experts or the Subject matter experts using Authoring Tools. The contents are then converted into multimedia based material for presentation to learners on demand. LMS is software that automates the administration of training, registers users, tracks courses in a catalog, records data from learners and provides reports to management. An LMS is typically designed to handle courses by multiple publishers and providers. It usually doesn't include its own authoring capabilities; instead, it focuses on managing courses created by a variety of other sources, organize and provide access to online learning services for students, teachers and administrators. These services usually include access control, provision of learning content, communication tools and organization of user groups. There are two (2) types of LMS.

- Open source code: This type can be used free of charge i.e., no license is required and the institution can change the source code as required. Examples of this type are: Moodle, Claroline (Dokeos), aTutor, KEWL, and Sakai
- Commercial LMS: These types need a license from the author and the source code cannot be changed. These types are more stable than the previous. Examples of this type are: WebCT, harf, ANGEL Learning, Captivate, and Blackboard (Microsoft)

The e-Learning environment of this project will mainly be built on Moodle. It is an open source code LMS. For many organizations like PUCG and many other universities in the developing countries, acquiring a commercial LMS to host their contents could be very costly. Secondly the open-source nature along with their relatively complete design

documentations available for these systems, it is possible to add specific features to such systems according to the universities needs by in-house professionals. In addition, since these types of systems usually belong to a very large group of programmers, they are regularly updated and in each release technical problems found are resolved and upgraded.

Nevertheless, there are shortcomings in using these systems too; one of the most important shortcomings of using the open-source systems is the security issue. Hackers can exploit these open source systems since they have the source codes but, because of the frequent upgrading of such systems, any aroused problem would be solved quickly. See Appendix D for a detailed Virtual Learning Environment comparison.

4.1.1 Moodle-LMS

Moodle (created by Martin Dougiamas, a computer scientist and educator) is an acronym for modular object-oriented dynamic learning environment. It is a Course Management System (CMS) that is free and open source software package designed using sound pedagogical principles to help educators create effective online learning communities. Moodle is multilingual with a support to more than seventy (70) languages and its ease of installation and maintenance has been the main reason for more than a thousand (100,000) official registered users of Moodle over one hundred and fifty (150) countries. Moodle has got one of the best support systems and with its online communities any question could be answered easily and promptly. It is easily customizable for different use and application. Usage of Moodle is claimed to be just below Blackboard and above all other LMS. At the same time, a satisfaction research

performed at Humboldt State University has indicated a higher level of satisfaction in Moodle as compared to Blackboard in many areas.

The learning content could be presented in different formats- pdf, txt, html, doc, graphical files, flash movie, presentations, interactive simulations etc. Moodle could be deployed on Linux, MacOS X and Windows platforms wherever PHP is supported. It recommends using Apache for web server and MySQL/PostgreSQL for database, although other web servers and databases are also supported.

Concerning security issue, the system uses basic *username* and *password* authentication. The software provides tools for administrators to assign access privileges to different group roles: administrators, instructors, students and guests. Moodle also comes with basic functionalities including glossary, survey, quiz, choice question, discussion forum, wiki, chat, assignment submission and integrated grading. On top of the basic functionalities, Moodle system can be improved to include external features such as photo slideshow, audio recording and flash video playback.

The various functionalities of Moodle are discussed in more details below:

4.3.1.5 Assignment

To add an assignment, one should click on Assignment under the Add an activity menu. The Assignment type field gives the option of allowing students to do the assignment offline (paper copies), or to upload a single file.

4.3.1.6 Chat

A chat is a chat room. It is used for live-time discussions. Moodle also supplies a bulletin-board discussion space. The main difference is that chat is a very efficient way to discuss things in live-time. If the instructor expects students to login over several days at different times, then the forum is a better choice.

4.3.1.7 Choice

A choice is basically a poll. When the instructor adds a choice, he asks a question and supplies two or more answers to the question. Then students may vote.

4.3.1.8 Forum

This is basically a bulletin board. The instructor may create a forum to discuss various topics for the class.

4.3.1.9 Glossary

The (Glossary) option adds a flexible way to present definitions that can be linked through the entire class site.

4.3.1.10 Journal

This option adds an online journal for the student. Each student has one and the journal can only be seen by the student and the teacher. The journal can be edited by the student and refined. The instructor may also assign as many journals as he wishes (one/week, one/unit, one/chapter, etc.) to see how each student's thought process and writing skills improve.

4.3.1.11 Quiz

This feature adds a quiz to the class. It can contain any number of questions and they can be true/false, multiple choice and fill-in-the-blank. These questions are kept in the course question bank and can be re-used within courses and between courses. Quizzes can allow multiple attempts. Each attempt is automatically marked and the teacher can choose whether to give feedback and/or show the correct answers. The quiz may also have feedback, where it can explain to the students why the answer is what it is.

4.3.1.12 Wiki

This adds a Wiki to the class. A wiki is similar to a blog (web log or journal), except everyone can contribute, edit, comment, etc.

4.3.1.13 Workshop

This creates a workshop space for the class. It is used to facilitate peer review. It has a range of options.

Among these major functionalities are some administrative tools which allow the instructor to:

- a) make changes to the class;
- b) ~~change the look of the class;~~
- c) list all the administrators (instructors) for the course;
- d) list all of the users in the class;
- e) manually enroll or unenroll a student from the course;

- f) backup data;
- g) restored old class data (that was previously backed up);
- h) define special scales for (i.e., excellent, good, average, etc.);
- i) list the grades of the tests and quizzes of each enrolled student;
- j) upload files to the course, or view any files that are already there.

The architecture of the e-Learning system developed in PUCG using Moodle LMS is shown in Figure 2

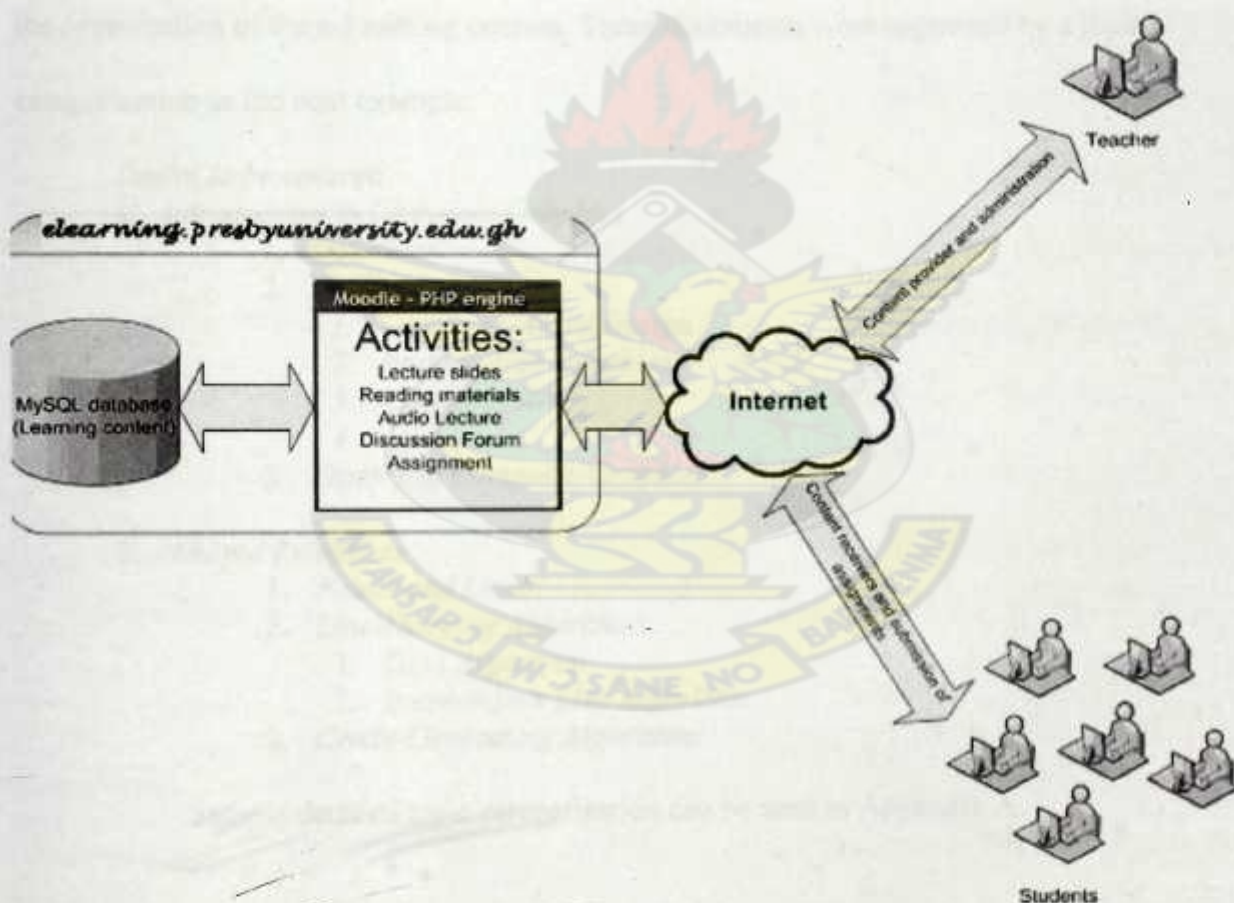


Figure 2: PUCG e-Learning system architecture

The Moodle LMS is installed (<http://www.elearning.presbyuniversity.edu.gh>) and it runs on MySQL database. The database holds the learning contents created using the authoring tools. Students' roles in the system are receiving these contents and also

submission of assignments. Lecturers, however, are responsible for creating these learning contents as well as managing them.

4.4 Learning Contents

To start developing the courses, it was first important to come out with some structure that reflects the e-Learning concept that PUCG wishes to offer. To do this, the prepared course outline that helped to document the face-to-face courses were taken as a basis for the organization of the e-Learning courses. These documents were organized by a topic categorization as the next example:

Topics to be covered

1. *Introduction to Computer Graphics*
 1. *Definition*
 2. *Application Areas*
 1. *Computer-Aided Design*
 2. *Presentation Graphics*
 3. *Computer Art*
 4. *.....*
 3. *History of Computer Graphics*
2. *Output Primitives*
 1. *Points and Lines*
 2. *Line-Drawing Algorithms*
 1. *DDA Algorithm*
 2. *Bresenham's Line Algorithm*
 3. *Circle-Generating Algorithms*

Sample detailed topic categorisation can be seen in Appendix A

So taken into consideration this topic categorization, e-Learning courses were to be developed for the topic in the lowest part of the hierarchy. This strategy was followed because the lecturers of PUCG (who will be the future developers of the courses) are very much used to this course structure.

Before developing the structure of the courses, some desired characteristics of the course were then more specifically defined. These characteristics are defined for the “Design requirements”.

4.2.1 Design requirements

A user-friendly interface is the most important principle in man-machine interfaces; for that the following issues are to be included in the design.

4.2.1.1 Learning modalities

There are certain topics that are better understood by interaction, others that only need some theoretical knowledge, etc. Depending on the topic of interest, there will be one or more modalities offered for the same course. The modalities that can be offered are:

Modality 1: Theory

Helpful when there are some concepts to learn.

Modality 2: Step-by-step Movie

Helpful when showing how to do something step-by-step is enough.

Modality 3: Exercise

Helpful when interactivity with the application under study is important, the user can learn by himself/herself.

Modality 4: Test with interactive simulations

Helpful when there is the need of tracking the user's abilities by his interaction with the application.

Modality 5: Test with questions

Helpful when there is the need of tracking user knowledge about the application.

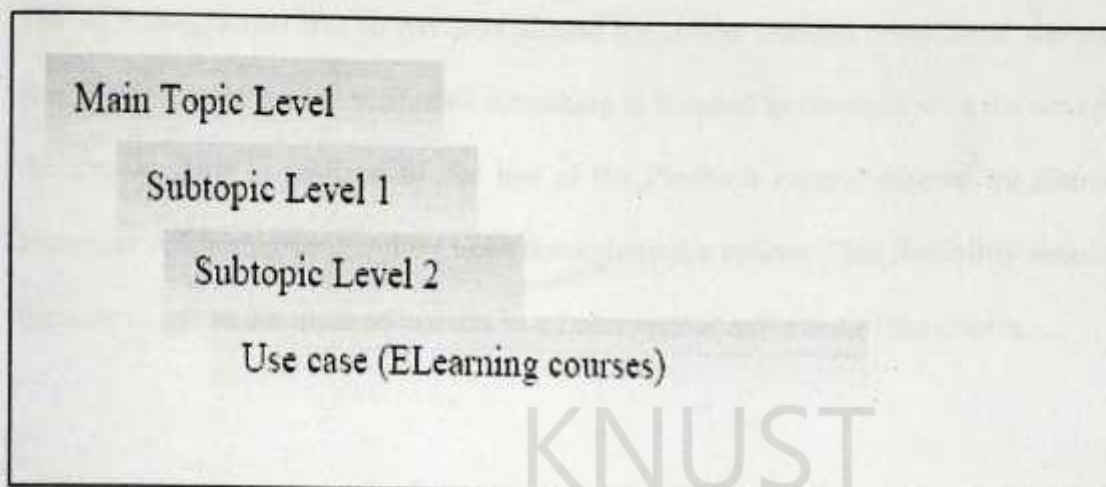
4.2.1.2 Standardized look and feel

It is wished to have a well-standardized design, in a way that every time a new course is developed, there is always the same look and feel. This has the main purpose of helping the end user to get used to a certain interface and independent of the content of the course, the structure will remain the same, so the end user will not have to lose time in understanding how to go through the e-Learning course each time.

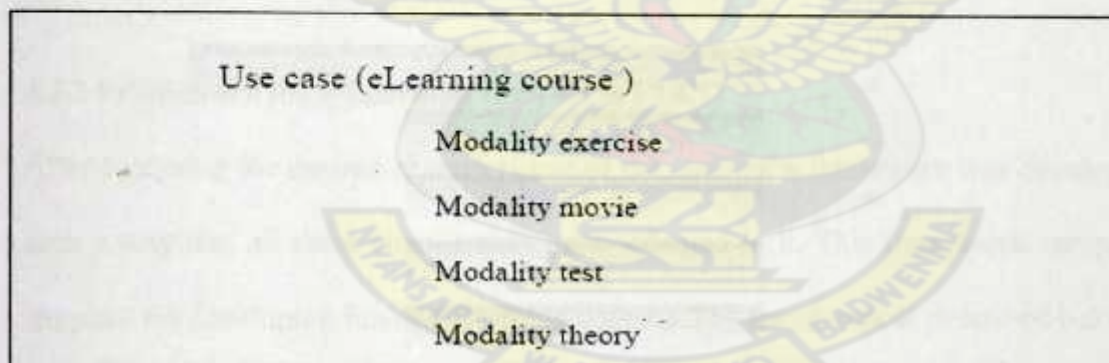
4.2.1.3 Size of resulting files

At certain point in time, there will be the need of changing the content of the course. To make this easier, the files created for each eLearning course should be as small as possible. To decide this issue, it was reasonable to consider the development of e-Courses for very specific use cases and not for wide and general topics, instead, these general topics are divided into subtopics, and the subtopics into use cases. Only at the lowest level in the categorization, use cases are found and e-Learning courses are developed.

This is shown in the diagram below.



For every e-Learning course developed, each modality offered in the course will also be developed independently. So at the end we have modality-oriented courses for the same topic, as the following graphic shows.



The advantages of this division include:

- Faster to update the eLearning courses.
- When changes in the content categorization are made, it is easier to adapt the courses to the new categorization.
- Smaller file size.

4.2.1.4 Navigation

The user should feel free to navigate around the course without restrictions; the purpose is not to force the user to wait until something is finished to continue with the next part of the course. This is realized by the use of the Playback control offered by Knowledge Presenter Authoring tool and by links throughout the course. This flexibility should help the user to get to the topic of interest in a faster way at any point of the course.

4.2.1.5 Help

The help offered should have the purpose of guiding the user in how to navigate through the courses; it is a reference to get to know the structure in which these e-Learning courses are based. The help should be offered from the e-Learning courses as a link.

4.2.2 Framework for e-Learning Courses in PUCG

After analyzing the desired characteristics of the courses, a framework was developed in such a way that all these characteristics are reflected in it. This framework served as a template for developing future e-Learning courses. The framework is described below.

a) Target Audience

Begin by identifying the target audience and determining both how much they already know about the topic and whether they have the necessary computer skills to access and complete the course. This would inform you on the level of complexity in the design of the course.

b) Objectives

Give a clear statement of learning objectives including attitude objectives as well as knowledge and skill objectives. You should state these objectives in measurable terms with expected outcomes and explain the criteria against which the outcomes will be measured. It is important to share these objectives with the learners so they know what is expected of them. This is critical for helping learners get the most out of an e-Learning.

c) Pre-assessment

Before beginning the course, you may want to provide the learner with a pre-test or self-assessment that will enable him or her to bypass a module or course if they already know the material or have the required skills. Another option is to have the results of the pre-test direct the learner to specific sections according to where his or her skill deficiencies exist.

d) Design

First, it is important to select a learning modality that is appropriate to your objectives. Some examples of such strategies include Theory, Step-by-step Movie, Exercise, Test with interactive simulations, and Test with questions. Keep in mind that the most effective learning occurs when learners are actively engaged.

Secondly, Content needs to be clearly organized and divided into appropriate chunks that are small enough for learners to assimilate. Be sure that you have provided for enough active exercises and practice to ensure the acquisition of the necessary skills and knowledge by the learners. If it is even possible design the instruction to be adaptive, so that it can adjust itself to learners' needs based on their responses to the pre-test and their

performance on previous modules. Prior performance can direct learners to only those modules that they need, allowing them to skip others.

e) Aesthetics

The visual appeal of courses can help determine an e-Learning initiative's success.

The following questions need to be answered by the course designers.

- Is the overall design attractive and appealing to the eye and ear?
- Is the use of colour appropriate and pleasant?
- Does the course have a consistent look and feel?

Additionally, screens should be neither too busy nor too stark, icons or clear labels should be appropriately used so that users don't have to read excessively to determine programme options.

f) Navigation

If the course is easy to navigate, the e-Learning experience can be beneficial even for users with minimal computer skills. Make sure you provide instructions about the navigation through the course. The directions and navigation controls must be clear and intuitive. Answering the following questions may help you determine whether your e-Learning course is easy to navigate.

- Have you provided a course menu (content map), one which links to all parts of the course so that the learner can choose where he or she will start or navigate to next (self-directed learning)? Are there several types of menus to help different learners?
- Can learners determine their own path through the course, if appropriate?

- Have you provided a glossary as an option to clarify meanings of words?
- Is an exit option always available?
- Is there a way for the learner to tell how far along she is? For example, are there progress bars, or an indication such as page X of Y?
- Is the navigation consistent among courses, chapters, pages, tests, etc.?

g) Media

The term rich media is used to describe the use of graphics, animations, video, and sound. It can be very effective in helping the learning process, but it is extremely important that its use be appropriate to the topic, the audience, the objectives and the learning modality used. It should not merely be for effect.

h) Interactivity

To maximize learning and maintain interest and motivation, it is important that web-based learning be designed to be as interactive as possible. Interactivity is not simply clicking on buttons, watching animations or video, or listening to sound. It involves active participation by the learner—making choices, answering questions, going through simulations, etc. The learner should be engaged through the opportunity for input. Having said this, the interactivity needs to be appropriate to the course's users, content, and objectives, in terms of both type and amount. It should not be gratuitous, but rather be designed to promote learning of the course's objectives. There are various types and levels of interactivity, which are listed below.

- Choice of where to go next. This involves basic navigation capabilities, planned choice points, and optional access to anywhere in the course via a course menu or map.
- Supplementary resources or activities, for example, texts, journals, corporate documents, or web sites where a learner can go for additional information.
- Branching as a result of answers to questions.
- Exercises with more than one step (e.g., research, case studies, and laboratory exercises)
- Games and simulations.
- Threaded group discussions (either synchronous or asynchronous)

i) Feedback

Feedback for questions and answers must be carefully designed. Where feedback is afforded, it should provide the learner with useful and helpful information. Various options, which you could use under different circumstances, include an overall test score, a specific response indicating whether each question is correct or incorrect, and a specific response giving the correct answer. You might also give the learner a chance to try the questions more than once. You could provide remedial feedback—not giving the correct answer, but pointing the learner to a place to find the correct answer or learn more.

j) Learner Assessment

Even if there are no marks being given or scores being kept, performance feedback for the learner is essential. It lets the learner know if he or she has achieved the objectives.

You will need to determine whether the mastery of total course content will be evaluated

(using a final exam or other means). You will have to decide what the pass, fail, or grading criteria are. Recording of scores and making reports available to learners, instructors, or administrators are other issues that need to be dealt with.

Several types of assessment can be used to measure learning in an e-Learning course.

Section quizzes or other learning checks are often part of learner assessment. Test questions need to be written at an appropriate level. You may want to randomly pick questions from a bank. In addition, a good variety of the various different types of quiz questions should be used. Some types are:

- True-false
- Multiple choice
- Multiple answer
- Fill in the blank
- Matching (using drag-and-drop technology)
- Short answer

k) Technical Issues

Because e-Learning courses operate in a technical environment—they must work on your *learning management system* (LMS), and people need easy access to them—there are a number of other technical issues that need to be considered. The following list highlights some areas you might want to take into account.

- Do the learners have the necessary computers and computer skills?
- Can learners access the course easily?
- Have you allowed for reduced bandwidth access to the course where necessary?

- Does the course start immediately when accessed? If not, is there a “please wait” message to the learners?
- Is the performance of the program adequate without long delays when making choices or using rich media?
- Does the course include clearly written and jargon-free instructions for accessing and downloading it (if appropriate)?
- Is the course compliant with standards, such as *Aviation Industry CBT Committee* (AICC), *Sharable Content Object Reference Model* (SCORM), etc., so that it will work properly with your LMS?

4.5 Implementing e-Learning

Whatever your reasons for adopting e-Learning, it is the way in which implementation is undertaken which will greatly affect its success. The move toward greater use of e-Learning will require change at all levels of an institution and for all categories of staff, including academics, students, learning support staff, administrators and managers. Successful implementation of e-Learning is dependent on a range of factors relating to the culture and structure of the organisation and the motivations of those affected by the changes.

4.5.1 Factors affecting e-learning implementation in PUCG

4.5.1.1 Leadership and resources to support and sustain e-Learning

Leadership is essential to successful institution-wide implementation of e-Learning.

The new technologies challenge the traditional approaches to managing universities and to learning and teaching practices. The key is to find an appropriate strategy that can balance the development of e-Learning; incubating and nurturing its development, whilst at the same time continuing to support existing practices. To achieve this, and ultimately the balance that is appropriate and sustainable, the management of PUCG led by the Principal has created an e-Learning Committee to see to the implementation requirements. The Committee is expected to create the right environment for development and collaboration through their own actions and by encouraging individuals with the expertise who can lead and influence to play roles in the implementation. The committee would also be required to draft an e-Learning Strategy for the College.

4.5.1.2 Developing an e-Learning strategy

Learning and teaching issues must drive e-Learning developments, but e-Learning will impinge on all processes within the institution and an e-Learning strategy should recognize the unique demands and opportunities of the distributed electronic environment, rather than attempting to replicate existing classroom and course design practices. For this reason, e-Learning raises many questions which will impinge on virtually all your institutional strategies and business processes, and which must be addressed to support sustained growth. Such strategies include teaching and learning, assessment, copyright and Intellectual Property Rights (IPR), information and ICT. In addition the strategy will also need to consider whether to adopt an institutional-wide

development or a more localized based approach which allows development to be decided at a more individual level and so with local ownership.

4.5.1.3 Institutional commitment and development

It is important that all relevant stakeholders across the institution are involved in e-Learning developments. Each department should have its own strategy that complements the institutional strategy. Project development is a successful way of initiating developments and achieving initial success. It is however, essential that such projects are not isolated, to ensure that lessons can be learned and applied across the institution. Senior level support is required to ensure that they can be sustained and scaled up across the institution. Without this commitment, developments are likely to remain isolated; investments will not bear fruit and ultimately may be lost completely. For this reason, the e-Learning Committee in PUCG has the head of the College as its chairman.

4.5.1.4 Changing roles and culture

The development of e-Learning will create new roles and different demands on staff. Staff can view these changes as threatening, often because e-Learning is still seen as an extra burden. Academic staff roles will develop more as facilitators of learning. The new role of learning technology staff will appear in the institution including; new specialists (learning technologists, educational developers, educational researchers, technical developers, materials developers and project managers), learning support professionals (IT and library staff) and established professionals (academic staff). E-Learning will be developed by teams of these new professionals aligned with the subject expertise of the

academic. To support e-Learning developments senior managers should recognize these new roles, provide suitable staff development and encourage collaboration and communication across the institution.

4.4 Testing of e-Learning System in PUCG

After the implementation of the e-Learning System, several tests were done. The testing phase was carried out to find out any implementation errors. Three categories of tests were carried out. These were:

a) Administrator testing

Description of Test

The system administrator is primarily concerned with tasks such as user registration and administration of the platform. The test was designed to create users and assign roles to these users:

Steps

- 1) Login using username/passwords
- 2) Click Users
- 3) Click Accounts
- 4) Click Add a New User
- 5) Provide the Details and Click Update Profile

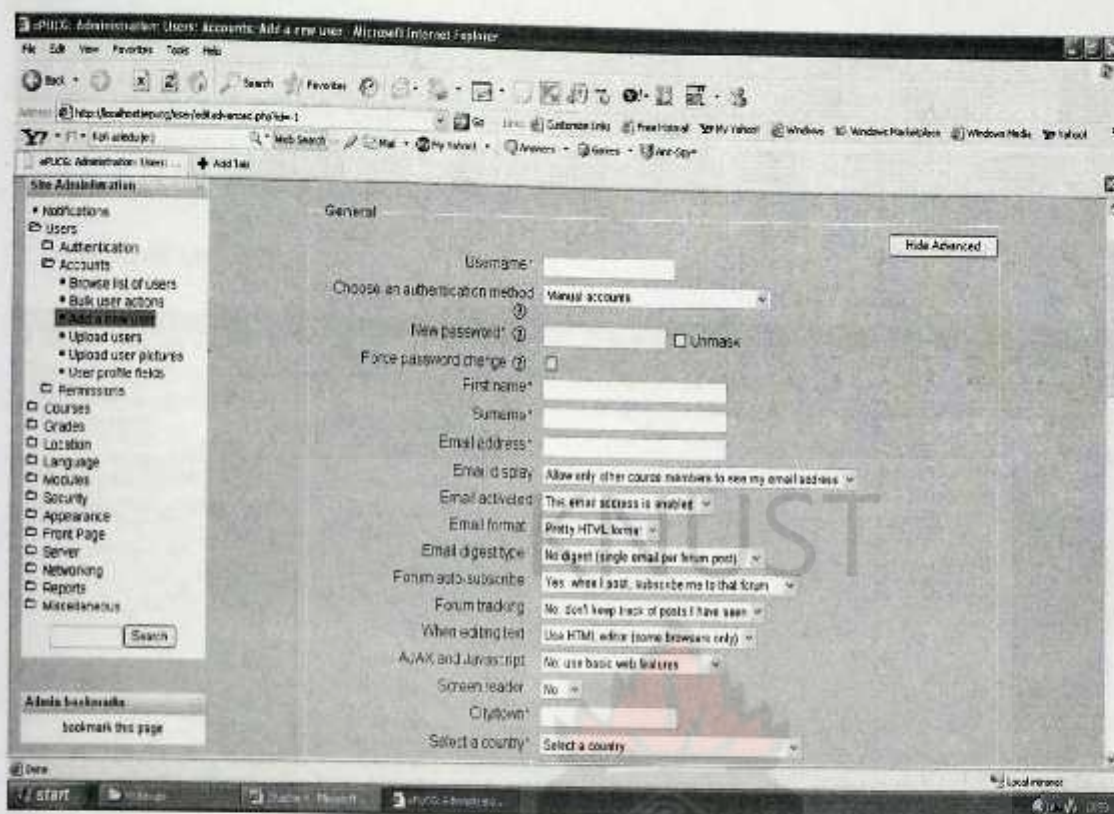


Figure 3: Administrator testing page

- 6) Click Permissions
- 7) Click Assign System Roles
- 8) Assign the necessary roles and update the profile

Results of Test.

Working just fine!

b) Teacher testing

Description of Test

This test is designed to test the course creation and grade setting by Teachers. It is only users with the roles of Teachers who can create courses and set grades for courses.

Steps

- 1) Login using username/passwords
- 2) Click Courses

- 3) Click Add/Edit Courses
- 4) Click Add a New Course
- 5) Add the details of course; the category, course name, course code etc
- 6) Save and exit

Presbyterian University College E-Learning Centre

Administration - Course categories - Add a new course

You are logged in as Ernest Darius (Logout)

Edit course settings

General

Category:

Full name:

Short name:

Course ID number:

Summary:

File:

Path:

Figure 4: Course creation page

Results of Test.

Working just fine!

c) Student testing

Test 1

Description of Test

A student with an account wishes to enroll on a course.

Steps

- 1) Student logs in using username/password

- 2) Student clicks on course.
- 3) Gets the screen "You are about to enroll...", and clicks "yes".
- 4) Is now enrolled in course.

Results of Test

Working just fine!

Test 2

Upload assignment

Description of Test

The student enrolled in a course should be able to upload assignments provided by the course teachers.

Prerequisites and data for Test

An assignment should be provided by a teacher. The time frame should be set so that the testing can be performed.

Steps

- 1) Student clicks on the name of the assignment
- 2) He or she reads the instructions
- 3) Uploads a file
- 4) Receives confirmation
- 5) Is later able to check feedback and grades from teacher

Result of Test

Working just fine!

CHAPTER 5

USABILITY EVALUATION

5.1 Need for Usability Evaluation

Usability is defined as the extent to which a system can be exercised in order to achieve specific goals and complete well-defined tasks effectively, efficiently and with satisfaction (Becker, L.A. 2000) including its social and cultural context (Almqvist J. P. F. 2006). Usability in e-Learning systems adds new dimensions since courseware delivery methods are not the sole driving concern. The system design, content structure and organization of a subject affect the ability to learn and understand. Therefore, understanding how learners interact with the e-Learning systems will contribute to improve the decision making process, the actions within development teams and the cost-effectiveness of learning. This translates into guidelines on how to improve systems and the instructional process, while influencing the acceptance by learners and enhancing the quality of learning results.

This chapter focuses on the interaction between learners and e-learning systems by exploring the usability of e-learning systems and how it affects students' behaviors, actions and satisfaction. This research relies upon collection of empirical data based on the predefined model/theory with an aim to explore students' experience with eLearning in PUCG and teachers opinion on applying e-learning system. From this perspective it can be said that this is an inductive research method. Typically inductive method implies drawing of general conclusions based on the empirical data. For successful accomplishment of this thesis two data gathering techniques are used in order to create

the empirical base that could offer some indications. In this case the focus is on two data gathering techniques: questionnaires and interviews. The questions of the questionnaire presented in the Appendix A.2 are used for data collection from students. This questionnaire is designed with predefined answers and also has some open questions for general reflection. In the Table 9 below, a detailed plan regarding areas of importance is addressed as the breakdown in factors. Furthermore it shows the connection to different stakeholders and the data gathering techniques.

Table 9. Detailed view of the data gathering techniques Khan (2005)

	Factors	Issues to be addressed	Primary Stakeholders	Data gathering techniques
Educational domain	Pedagogical	Content provided	Students, Teachers	Questionnaire and interview
		Learning strategy		
	Ethical	Geographical diversity	Students, Teachers	Questionnaire and interview
		Etiquette		
		Legal issues		
	Evaluation	Quality of the learning content	Students, Teachers	Questionnaire and interview
		Evaluation Students performance		
Technology domain	Technology	Hardware	Students, Teachers	Questionnaire and interview
		Software		
		Infrastructure		
	Interface design	Page and site design	Students	Questionnaire
		Navigation		

Organizational domain		Accessibility		
		Usability		
	Institution	Needs assessments	Teachers	interview
		Return of investments		
		Organizational change		
	Resource	Support provided	Teachers	interview
		Online/Offline support		
	Management	Human resources	Teachers	interview
		Management teams		

5.2 Empirical study

This section presents the information and data that has been collected using the questionnaire with students and interviews with teachers. The questionnaire data has been collected from 70 students and addresses the educational and technological domain. Interviews were conducted with ten out of the eighteen lecturers and the interviews addressed all domains, but the focus of the technological domain was more on their attitude and requirement perspective. This approach was taken because none of the teachers that have been interviewed have had previous experience with an e-Learning system. The data collected from the questionnaire is presented in the tabular form, while interviews are presented as a transcript.

5.2.1 Questionnaire

The questionnaire has been conducted with students attending “Designed and Development of Web-based system” course. These students are in their 3rd and 4th year of

studies in the Department of Information and Communication Technology in PUCG. In this course are enrolled 70 students, out of which 12 are females. The questionnaire included 18 questions. 14 questions were formulated with predefined answers and for each factor students had two open questions to reflect upon something that was not covered with predefined answers. In total 60 students answered the questionnaire. The complete answers are presented with the breakdown according to the component which is displayed in percentage. (See Table 2)

KNUST

5.2.1.1 Educational domain

The first domain addressed in the questionnaire is educational domain. In this section of the questionnaire issues regarding pedagogical, ethical and evaluation have been addressed. The main idea of this group of questions was to identify aspects related to: content provided, learning strategies, legal issues and students' performance. The breakdown of the answers from students is presented in the Table 10.

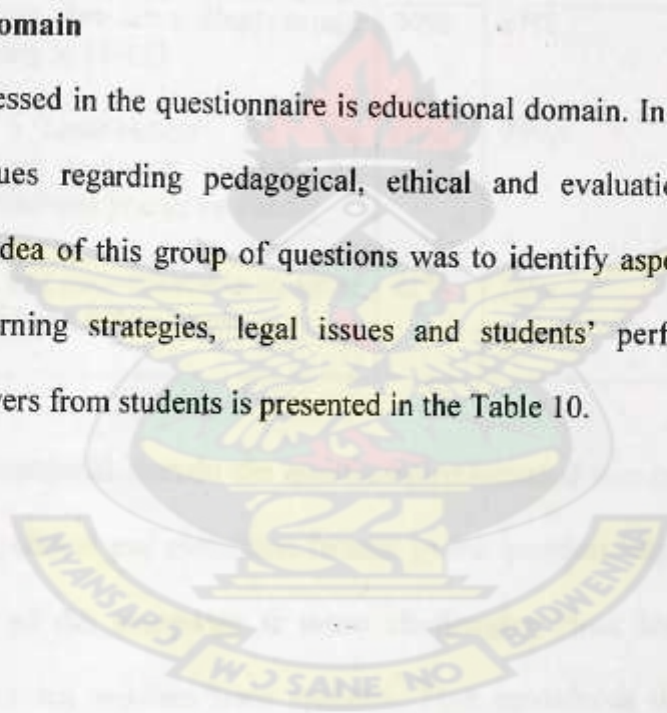


Table 10 Breakdown of student answers regarding the educational domain

S/N	Questionnaire	Agree	Agree to some extent	Disagree
1	E-Learning is a good way of delivering course materials.	77%	22%	1%
2	The content of the course is accurate compared to relevant literature	88%	12%	0%
3	The course content is regularly updated according to the curriculum	80%	20%	0%
4	The online discussion forums offered are effective for learning	78%	22%	0%
5	Internet connection fees are a disadvantage for using eLearning in PUCG	30%	47%	23%
6	Making your contribution on the assignments, forum posts etc, viewable by other students motivates you to try harder	60%	23%	17%
7	You sometimes feel uncomfortable as other students can read your forum posts.	42%	28%	30%

Also regarding the educational domain the questionnaire included two open questions, related to pedagogical, ethical and evaluation factors. In the question **“do you consider that sitting in front of the computer is more challenging than learning in the classroom”** there were ten answers from students. Five considered that it is more challenging; three others said that it depends on the course and two said that it is more attractive than the classroom.

In the last question about this domain which was **“elaborate what you think needs to be improved in order to better fulfill your needs”** five students answered that more lectures should be included on the e-Learning platform.

5.2.1.2 Technological domain

The other domain that is addressed in the questionnaire is technological domain.

Technology infrastructure such as hardware, software and interface design that includes page and site design, navigation, accessibility and usability has been addressed. The breakdown of the answers from students is presented in Table 11 below.

Table 11 Breakdown of students answers regarding technological domain

S/N	Questionnaire	Agree	Agree to some extent	Disagree
1	The Institution should have an orientation program that provides technical training to students before starting the course	87%	10%	3%
2	The server where the e-Learning was hosted was available all the time when you needed to access it.	80%	20%	0%
3	Offering videoconferencing lectures is a good way of providing educational materials.	77%	18%	5%
4	Audio lectures are much more preferable to video lectures.	37%	35%	28%
5	Internet speed presents a problem while using e-Learning to its fullest.	37%	38%	25%
6	The login procedure is simple.	92%	8%	0%
7	The organization of the course material allows for easy navigation.	72%	28%	0%

The questionnaire included two other questions related to the technological domain.

For the question about the most often used communication tool with the lecturer:

55% said they use E-mail, 27% said they use internal messages on the e-Learning platform, 12% said they use chat online, and 7% said they use forum posts.

In the last question of the questionnaire “**what other technological devices could be included in the e-Learning platform to enhance its performance**” only four students answered, and all of them suggested that videoconferencing lectures should be included.

5.2.2 Interviews

This research also includes interviews with ten lecturers. These interviews were done in person. The respondents are from two different age groups; five young lecturers (ages less than 50 years) and five old generation (ages above 50 years). The interviews included the presentation of the researcher and the research, the purpose of the interview, followed by the interview questions.

The younger generation of lecturers was selected from the Departments of ICT, Mathematics and Business Administration who has been teaching since 2006. The lecturers in the older generation category were however mainly selected from the Department of Business Administration and have been teaching since the start of the College in 2003. They also had been lecturing prior to their appointment in the College. The selection was made primarily because in the Presbyterian University College, age of the lecturer, affects their attitude towards technological solutions to enhance learning.

5.2.2.1 Educational domain

The first domain addressed in this interview is educational domain. Questions regarding pedagogical and ethical issues are included. The interview transcript below highlights some of the answers from the two categories of lecturers who were interviewed.

1. What do you consider as the main pedagogical challenges in e-Learning systems?

Junior teacher: I don't see any crucial pedagogical challenges in adapting e-Learning systems besides those of getting familiar with an appropriate IT setting.

Senior teacher: Certainly there are challenges. The idea of the teacher standing in front of the students, students taking notes, etc is still present in Ghana. Implementation of e-Learning would change this, and completely new learning style and new pedagogical approaches would have to be adopted.

KNUST

2. What efforts would you be willing to make (in terms of time for training etc) in order to change your current style of teaching?

Junior teacher: If I decide to change my style of teaching, it would not take me much time and effort to achieve that.

Senior teacher: First of all it is difficult for me to change the teaching style that I have used for 20 years.

3. Do you consider that e-Learning system increases the possibilities for plagiarism?

Junior teacher: I think that the issue of plagiarism depends on how the teacher manages the class and it is not related to whether the teacher uses face-to-face teaching or e-Learning systems.

Senior teacher: Of course it does. I think that with no direct supervision there will be all forms of plagiarism. The e-Learning increases the distance between teachers and students and thus potentially increases the possibility of plagiarism.

5.2.2.2 Technological domain

Another component that was included was the technology component. Since none of the lecturers have had a prior close encounter with e-Learning, the questions here are more general in nature. The interview transcript below highlights some of the answers from the two categories of lecturers who were interviewed.

4. What technology do you use in your teaching?

Junior teacher: Personal lap top and LCD which I use for power point presentation, and most likely I will use them for presenting video clips related to the course.

Senior teacher: I don't use any kind of technology, only in rare occasions I use overhead projector.

5.2.2.3 Organizational domain

Organizational domain addresses issues like needs assessment, return on investment, organizational change and management issues. The interview transcript below highlights some of the answers from the two categories of lecturers who were interviewed.

5. What would be your requirements for the e-Learning system in order to offer your course online?

Junior teacher: A short training on IT field in order to get familiar with technological requirements of e-Learning system.

Senior teacher: I don't think that I can really answer this question since I don't think that I would be able to provide an online course.

6. Implementing e-Learning requires a lot of investment from setting up the infrastructure to training staff and students for using it. Do you consider that if e-Learning is to be implemented in the University level there would be a return on investment?

Junior teacher: I don't know. The accurate answer in this question necessitates a comprehensive research.

Senior teacher: Maybe it would in the near future. Currently I don't think that there would be a return on investment because it is difficult for me and also for my colleagues to start to use the technology, it would require a lot of training in the IT field. Thus a lot of extra cost would be involved in implementing such systems, and I do not see any clear benefits of such a system.

7. Are you ready for the organization changes that e-Learning could bring?

Junior teacher: It depends on what you imply by organization changes (structural, formal, informal...or teaching methods, interactions with students, grading and exams...) however if I apply e-Learning system then it is understandable that I will easily accept any "organizational change" and try to adopt as much as possible. So the answer is more or less YES

Senior teacher: It will definitively require an organizational change. Currently the "learning cycle" comprises lecturers and students and this would be changed with introduction of technology. And in my case, beside technology, the new "learning cycle" would involve IT personnel as well.

8. Do you think that the institution should organize a survey with both staff and students to evaluate their readiness for online learning?

Junior teacher: Absolutely YES. But before doing that, a proper explanation should be given to both staff and students on what is an in fact e-Learning system and which are the pro's and con's of setting up this system. In this manner a survey could provide more reliable results.

Senior teacher: Yes. The institution should definitely conduct a survey with teachers and students. They should particularly explain thoroughly to the teaching staff what e-learning is because most of the teachers are not familiar with this concept.

9. What kind of support would you need for providing an online course?

Junior teacher: Potentially I would need a support from IT personnel, at least in the initial stages of the course.

Senior teacher: I can not talk about the support needed since I do not think that I would be able to provide an online course.

10. Do you consider that teachers could manage courses themselves or there should be a special unit at the institutional level for managerial purposes?

Junior teacher: Good Question! Clearly it depends on the lecturer, however an IT personnel (not necessarily entire unit) within particular faculty, should always be available.

Senior teacher: I think that if e-Learning is to be implemented there should be staff available in order to help. In my particular case I would definitively need somebody else helping to manage an online course, preparation of the course materials and all other jobs associated with it.

11. Can you suggest any other issues that need to be taken into consideration when implementing e-Learning in the PUCG, which was not addressed in this interview?

Junior teacher: Implementing the e-Learning in the Presbyterian University College, Ghana should be considered as a particular project proposal. Therefore it should undergo in depth analyses within the Project Management framework. For example an appropriate feasibility study should be performed in order to study the benefits of it before the system is implemented. Teacher's skills capabilities and resistance to change should also be taken into account. Most important without a doubt is the readiness of the student to accept this kind of learning and to see a benefit from it. Instead of running to implement something which is world trend, the contextual, cultural, professional (capabilities) and financial aspects should be analyzed prior to initiating any steps toward implementation.

Senior teacher: I think that in general implementing an e-Learning system in Presbyterian University College, Ghana might be a positive initiative, but I think that in depth study should be made prior to its implementation. Particularly having in mind the changes that this system would require from the staff and especially having in mind that over 50% of the University's staff is over 50 years old.

5.3 Analysis

This section provides an analysis of the data collected using the questionnaire and interviews and relate them to the domains of the theoretical model. This analysis is based on the idea of correlation of students and teachers opinions about the issues represented in the model. The analysis includes three main sections such as: educational domain, technological domain and organizational domain.

5.3.1 Educational domain

In this section the analysis is focused on discussion of the pedagogical, ethical and evaluation issues. The students' opinions and that of the junior Lecturer might be affected by the existing e-Learning system that they use, while that of the senior Lecturer is not affected since he has never used the e-Learning system before. From the students answers in the questionnaire there is a positive attitude toward e-Learning in general. This attitude can be verified in the highly positive answers in the question about: e-Learning as a good way for delivering materials (77% agreed, 22% agreed somewhat and only 1% disagreed). Even high percentage (78%) responded that they think that the online discussion forums offered are effective for learning. When it comes to lecturers, there is a different picture. The junior lecturer seems to have more open attitude toward the challenges that e-learning will present and is more willing to undergo eventual changes in teaching style. The senior lecturer despite having a positive attitude in his answers, there is a resistance toward eventual change. This is evident from the answer *"First of all it is difficult for me to change the teaching style that I have used for 20 years..."*

The issue of plagiarism is viewed differently by the two lecturers interviewed. The junior lecturers do not regard the technology as eventual catalyst for plagiarism. While the senior lecturers think that the distance created by the technology usage increases the possibility for plagiarism. This disagreement between the answers of the lecturers is mainly as a result of their attitudes toward technology; the senior lecturer considers that technology creates the distance between them and students. This is described in his answer: *"The e-Learning increases the distance between teachers and students and thus potentially increases the possibility of plagiarism"*. This could be expected because there is potential gap between junior and senior staff members' usage of technology in

learning. Also some students in an open question in the questionnaire suggested that only junior teaching staff is capable of actively using the e-Learning system while with senior ones it is going to be extremely difficult.

5.3.2 Technological domain

Data collected from the questionnaire with students and interviews with lecturers also addressed the technological domain described in the theoretical model. In this aspect issues regarding the technological infrastructure and interface design have been addressed. With students these questions are mainly related to the e-Learning case while with teachers are more oriented on their attitude towards the use of technology and their requirements concerning e-Learning system. In these answers it is clear that the students are positive towards e-Learning system.

Majority of them (92%) consider that the login procedure is very simple. But on the contrary, majority of them (87%) think that institution should have an orientation program providing technical training before the course. This suggests that despite students having basic IT proficiency when it comes to performing learning activities they ask for official support from institution. An interesting fact is when it comes to preferring audio over video lectures. In this question the answers were equally distributed (37% agreed to prefer audio over video lectures, 35% agreed to some extent while 28% disagree). This attitude potentially suggests that they perceive audio lectures to be more usable than video. This can be connected to their answers when it comes to internet speed and the Internet connection cost. Almost the same distribution of answers was in the question regarding the connection of the Internet speed with e-Learning usage to its

fullest potential (37% agreed, 38% agreed to some extent and 25% disagreed). Similar distribution of answers was for Internet connection fees as disadvantage for e-Learning (30% agreed, 47% agreed to some extent and 23% disagreed). The interesting change is that email was considered as main tool for communication with lecturers.

Regarding the usability of the current design of the e-Learning system, students were in general very positive. A reason for this positive attitude is mainly as a result of the fact that they didn't have any prior experiences with similar e-Learning systems. Therefore when it comes to interface design issues, these data should be taken into consideration with caution. Regarding lecturers, the situation is different and the questions mainly were related to their attitude toward use of technology. What becomes evident is that age of the lecturer affects their attitude towards usage of technology in teaching. The junior lecturers seem to have more experience and used variety of tools in teaching. This is evident based on his answer: *"Personal laptop and LCD which I use for power point presentation, and most likely I will use them for presenting video clips related to the course"*. The senior lecturers use technology on very rare occasions. When it comes to requirements the junior lecturers are willing to undergo training in order to get familiar with technology while the senior lecturers have a skeptical stand towards technology enhanced learning. On the whole, it seems that there is a potential "resistance to change" when it comes to adopting and using technology enhanced learning in the case of the senior lecturers.

5.3.3 Organizational domain

The organizational domain is the last domain of the theoretical model and was addressed with lecturers in the interviews only. The issues that were discussed in this domain address problems related to institutional, resource support and management.

Regarding the investments needed for implementing the e-Learning system lecturers have different opinions. The junior lecturers suggest a comprehensive research in the issue while the senior lecturers emphasizes on the expenses and suggest that there is no clear benefits of e-Learning systems. From both answers the common thing is the fact that there is a need for a detailed investigation and clear presentation of the drawbacks and the benefits of e-Learning to both staff and students.

When it comes to the organizational change that an e-Learning system would present, there is an agreement between both groups of lecturers. The junior lecturers regard this change as a part of adoption they would need to do while the senior lecturers consider this change as more substantial as a change of the "*learning cycle*".

The issue of the resources was another topic raised in these interviews and both groups of lecturers agree that potentially there is a lack of resources when it comes to implementing such system. Lecturers have different opinions regarding the resources for managing an online course. This could be explained from their IT proficiency level and their willingness to change.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Findings and Discussions

In general the empirical data collected in this exploratory study represents an overview of the current situation among students and teachers when it comes to implementation of the e-Learning system. The most evident patterns that could be identified from the data can be summarized as follows:

- Students in general are overwhelming in favour of implementing e-Learning systems.
- Teachers have a more careful opinion about such implementation.
- There is potential “resistance for change” among senior staff members.
- In depth investigation is preferable before implementation of e-learning systems.

Combining these general patterns identified from analysis of empirical data with the theoretical model chosen, suggests that deployment and implementation of the e-Learning system is a complex process. In this process, issues from eight factors should definitively be taken into consideration. These key factors are important in the implementation of an e-Learning environment. Four of these key factors emerged as recurring themes within the data collected from the questionnaire and the interviews.

6.1.1 ICT Leadership

Leadership and a whole-school approach are important in planning and implementing any e-Learning environment (Pearson, 2005). There are numerous barriers to overcome when implementing e-Learning. Under the realm of staff issues, a lack of vision and leadership

from senior ICT management can greatly affect the ability to successfully implement an e-Learning environment. The management of PUCG had employed people in ICT management positions to strategically lead the University through the change process. The incumbents of these positions not only possessed extensive ICT knowledge, they hold qualifications in education and had previously experienced careers in teaching. An understanding of the use of ICT in schools and the pedagogy underpinning their strategic planning decisions for the e-Learning environment were significant factors in a successful implementation.

PUCG has an organizational structure, which resulted in the successful implementation of the e-Learning environment. The University College employed a key player in the organizational structure, a middle management tier of ICT coordination. These employees undertook functional duties of ICT co-ordination and teaching within the College. As a result, they appeared to be the link between the strategic planners at the ICT management level and the teachers who were to deploy the e-Learning environment at the facilitation level. The ICT coordinators at PUCG were highly instrumental in the implementation.

Trinidad (2005) suggests that many teachers hesitate to implement ICT in their teaching practices for many reasons. These reasons vary from inability to recognize the benefits of implementing technology into their existing curriculum to incompatibility with their own teaching philosophy. In the researcher's opinion, the ICT leader at PUCG was a transformational ICT leader who understood the importance of identifying staff members

who would become early adopters of the e-Learning environment and exude a positive attitude toward the change process.

Clearly, without management support and encouragement, e-Learning will develop only slowly, if at all. Any innovation requires leadership at all levels of an institution, but particularly at the senior management level, if it is to be taken up

6.1.2 ICT Infrastructure

According to Jacobsen (2005), the technological infrastructure of the school is fundamental to the integration of the e-Learning environment. For teachers and students alike, the ability to gain reliable access to computers and the e-Learning environment is a key issue. The empirical data collected suggest that there is a lot to be improved and enhanced. One of such improvements is the ICT infrastructure of PUCG. Students accessed the e-Learning environment through computer laboratories which are supposed to be connected to the Internet but the true state of the laboratory rather discourages the student. There are less than 50 connected computers for a population of over seven hundred students. Internet connectivity also has about 70% availability and a bandwidth of less than about 512kbs.

Practical issues such as hardware (accessibility to computers), connectivity (hosted data centre environment) and networking (access to the Internet) will often influence a teacher's decision to use ICT resources in their teaching and learning practices. Ultimately, this can only be resolved at the school level, which exemplifies the need for a whole-school ICT approach that needs to be deployed by a significant ICT leader.

6.1.3 Support and Training Initiatives

A range of methods should be utilized to support the initial and ongoing use of e-Learning environments for both staff and students. The first method should be through the development of a policy or procedural document that outlines the standard practices for activity on the system. There was no evidence of this document in relation to the implementation of the e-Learning environment in PUCG. Implementation of e-Learning environments demands a change in the role of university lecturers. Traditional teaching and learning skills need to change in order to get maximum benefit from virtual learning, hence lecturers are posed with the task of developing a new model of effective teaching. Lecturers must concentrate on the psychological aspect of learning, purporting a need to shift from behavioural and cognitive approaches (whereby the lecturer controls the learning) to a humanist approach, where learners can take control of their own learning. The humanist approach suggests that the aim of education is to assist students to achieve self-actualization and consequently the role of the lecturer shifts from information provider to supporter – encouraging students to feed their own curiosity. The key message here is that students are not spoon fed, but rather shown the way. This requires that Lecturers as well as students are trained on the new model of education required by such learning platforms. Lecturers must be provided with sufficient time and resources to ensure that online courses are suitably developed and implemented to meet the needs of students. Alongside this, the transition into new teaching styles must be managed effectively to ensure that lecturers are supported through and beyond the evolutionary period.

6.1.4 Teachers ICT Capacity

The use of computers by teachers to transfer information to their students requires the acquisition of considerable computer skills. This has proved to be a stumbling block in the acceptance of computers by teachers as an instructional resource. The quality of e-Learning depends on the quality of the course material and the degree of sophistication of the user interface. Once the author has decided on the content of a programme, its format and the strategy of presentation, then the challenge is to author the pedagogic content that would best deliver the teaching programme in a way that can remain open to variable learning styles and pathways in the context of self-managed study. The options open to the courseware author will include using a high-level programming language, authoring languages, lesson/exercise generators and authoring systems. Although many teachers have mastered some computer application skills, they may still lack expertise in the area of human-machine interaction design, in the context of computer presentation of their subject matter. Moreover, the question of productivity is vital, since most of the material produced by teachers has to be prepared in parallel with their current instructional duties in the classroom.

To remedy the difficulties inherent in the preparation of e-Learning material, an e-Learning Committee was established in PUCG. This committee has experts in authoring systems who would provide assistance and training to lecturers as they prepare their e-Learning courses. After the lecturers go through training for preparation of e-Learning courses it would help them to focus on the experiences that would be best for learning from the learner's point of view, rather than just publishing and assessing the information they think they need to know. It can also help the lecturers realize how each participant in

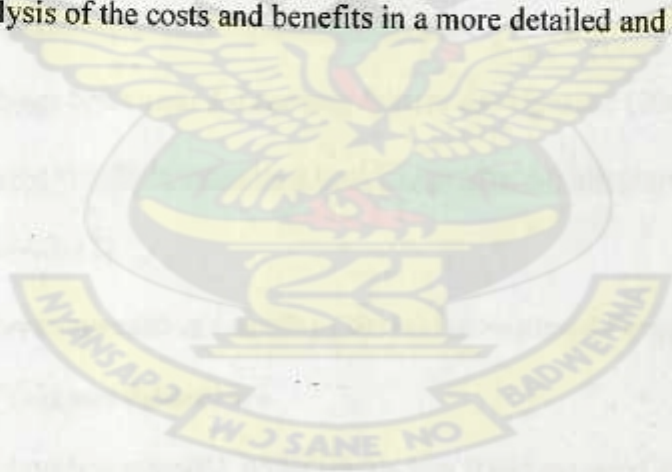
a course can be a teacher as well as a learner. Their job as a 'teacher' can change from being the source of knowledge to being an influencer and role model of class, connecting with students in a personal way that addresses their own learning needs and moderating discussions and activities in a way that collectively leads students towards the learning goals of the class. The most challenging role and responsibility of the online teacher is to provide a creative and interesting learning environment.

6.2 Conclusion

Implementation of e-Learning system in Presbyterian University College, Ghana was successful despite the technological challenges. A usability evaluation conducted on the system after its implementation indicated that students in general are overwhelmingly in favour of implementing e-Learning system. Again, Lecturers have a more careful opinion about such implementation. Senior staff members have potential "resistance to change" when it comes to the implementation of e-Learning systems in institutions of higher learning. Finally, an in depth investigation/ costs benefits analysis is preferable before implementation of e-Learning systems. It is important that the consequences of the implementation of such electronic tools for learning are thoroughly reviewed before the systems are implemented. It is too easy to focus on the technological possibilities alone.

6.3 Recommendation for further work

Interviews with the Lecturers have thrown up an interesting area for future research. During the interviews, Lecturers were asked their opinions on the Return on Investments in e-Learning projects. Their collective response necessitates a comprehensive research into the costs and benefits analysis of e-Learning project implementation. Costs and benefits of e-Learning projects are difficult to quantify due to the large number of variables involved. Many of the costs are specific and measurable, for example the cost of technology, and the cost of your time and the effort involved, many of the benefits are not. Perceived benefits include greater flexibility, improved access, widening participation, and increased student involvement. Therefore, it would be interesting to develop an activity based costing model for school/faculty implementation of e-Learning, which allows the analysis of the costs and benefits in a more detailed and systematic way.



REFERENCES

- Almqvist J. P. F. (2006) Replication of controlled Experiments in Empirical Software Engineering – A Survey. MS thesis, Department of Computer Science, Faculty of Science, Lund University.
- Becker, L.A. (2000) Online syllabus - Basic and Applied Research Methods. Retrieved 14/09/2007 from web.uccs.edu/lbecker/Psy590/default.html
- Carr S. (2000): "As distance education comes of age, the challenge is keeping the students", *The Chronicle of Higher Education*, 46(23), A39-A41.
- Clark, R.E., 2001. A Summary of Disagreements with the Mere Vehicles Argument. In: Clark, R.E. (Ed.). *Learning from Media: Arguments, Analysis and Evidence*, Greenwich, CT: Information Age Publishing Inc., pp: 125-136.
<http://homepages.hvu.nl/ilya.zitter/References.htm>
- Cognitive Design Solutions: *E-Learning System Architecture* (2009)
<http://www.cognitivedesignsolutions.com/ELearning/Architecture.htm> [Date accessed 2009-02-12]
- Daniel, J. - Commonwealth of Learning (2005a) *International Perspectives on Open Learning and Distance Education* -
http://www.col.org/speeches/JD_0504Gambia.htm [Date accessed 2009-02-10]
- Davies, D. (1998). The virtual university: A learning university. *The Journal of Workplace Learning*, 10 (4), 175 – 213
- Goddard, A. (1998, November 13). Facing up to market forces. *Times Higher Education Supplement*.
- Holzinger A., Maurer H.: "Incidental learning, motivation and the Tamagotchi Effect: VR-Friend, chances for new ways of learning with computers", CAL99:

- <http://www.cognitivedesignsolutions.com/ELearning/Architecture.htm> [Date accessed 2009-02-11]
- Jacobsen, M. (2005). Community leaders: Strategic partnerships through the Galileo project. In S. Trinidad & J. Pearson (Eds.), Using information and communication technologies in education (pp. 42-62). Singapore: Prentice Hall.
- Jacobson J.: "The last book", IBM Systems Journal Volume 36, Number 3, 1997; <http://researchweb.watson.ibm.com/journal/sj/363/jacobson.html> [Date accessed 2009-01-20]
- Katz, R. (2001, May 18). Campus champs tackle heavies. Times Higher Education Supplement.
- Khan, B. (2005) E-learning quick checklist. Hershey PA, USA: Idea Group Inc.
- Kozma, R.B., 2001. Counterpoint Theory of Learning with Media. In: Clark, R.E. (Ed.). Learning from Media: Arguments, Analysis and Evidence. Greenwich, CT: Information Age Publishing Inc., pp: 137-178. ISBN: 1930608772.
- National Committee of Enquiry into Higher Education. (2001a). Report of the National Committee. Retrieved October 26th , 2003 from www.leeds.ac.uk/educol/ncihe/natrep.htm
- Nichols, M. (2003) A theory for eLearning – <http://ifets.ieee.org/periodical/6-2/1.html> [Date accessed 2008-12-16]
- Pearson, J. (2005). Current policy priorities in ICT in education. In S. Trinidad & J. Pearson (Eds.), Using information and communication technologies in education (pp. 134-147). Singapore: Prentice Hall.
- Pritchard, A. L. & Jones, D. R. (1996). Global learning. Open Learning Australia. Retrieved April 13, 2004 from <http://www.ola.edu.au/paper1.htm>
- Rosenberg, M. J. (2001) e-Learning – Strategies for delivering knowledge in the digital age, McGraw-Hill, New York

- Rovai A. P.: "Building Sense of Community at a Distance", International Review of Research in Open and Distance Learning (April, 2002): 3,1, ISSN: 1492-3831, <http://www.irrodl.org/content/v3.1/rovai.html>, [Date accessed 2008-05-31]
- The eLearning Action Plan – Designing tomorrow's education. COM(2001)172 final Communication from the Commission to the Council and the European Parliament, Brussels, 2001-3-28
- The Heritage Group (2003) eLearning, a Definition [Date accessed 2009-02-11]
- Thomas Dietinger (2003). Aspects of E-Learning Environments [Date accessed 2009-02-11]
- Trinidad, S. (2005). Taking the next step in using technology. In S. Trinidad & J. Pearson (Eds.), Using information and communication technologies in education (pp. 1-15). Singapore: Prentice Hall.
- Virtuality in Education, Abstract Book; p70, 1999, London: Elsevier.; presentation available at http://www-ang.kfunigraz.ac.at/~holzing/vrfrfriends/vrf_at_cal_99/index.htm [Date accessed 2008-05-25]
- Volery, T. & Lord, D. (2000). Critical success factors in online education. The International Journal of Education Management, 14 (5), 216 – 223.
- Webopedia - <http://www.webopedia.com/> [Date accessed 2009-02-21]

APPENDICES

APPENDIX A

COURSE OUTLINE

Course: ICTP 401 COMPUTER GRAPHICS

Credit Hours: 3

Instructor/Lecturer: Kofi Asiedu

Teaching Assistant: Isaac Vanderpuije

Course Objectives:

- To develop an understanding of the mathematics and algorithms used in the synthesis of computer graphic imagery and animation.
- To teach you the fundamentals for writing your own graphics applications

Pre-requisite

- You will be writing programs in
 - C/C++
- An ability to learn a programming library on your own
 - OpenGL
- Comfortable with matrix algebra and calculus
 - Basic linear algebra used

Text book

- Computer Graphics C Version, Donald Hearn and M. Pauline Baker, 2ed

Assessment

- Programming Assignments 10%
- Other Assignments 5%
- Attendance and Contribution in Class 5%
- Mid-Semester Exams 20%
- Final Exams 60%

Topics to be covered

1. Introduction to Computer Graphics

4. Definition

5. Application Areas

1. Computer-Aided Design
2. Presentation Graphics
3. Computer Art
4. Entertainment

5. Education and Training
6. Visualization
7. Image Processing
8. Graphical User Interface

2. Overview of Graphics systems

1. Video Display Devices
2. Refresh Cathode-Ray Tubes
3. Raster-Scan Displays
4. Random-Scan Displays
5. Color CRT Monitors
6. Direct-View Storage Tubes
7. Flat-Panel Displays
8. Three-Dimensional Viewing Devices
9. Stereoscopic and Virtual-Reality Systems
10. Raster-Scan System
11. Video Controller
12. Raster-Scan Display Processor
13. Random-Scan Systems
14. Graphics Monitors and Workstations
15. Input Devices
 1. Keyboards
 2. Mouse
 3. Trackball and Spaceball
 4. Joysticks
 5. Data Glove
 6. Digitizers
 7. Image Scanners
 8. Touch Panels
 9. Light Pens
 10. Voice Systems
16. Hard-Copy Devices
17. Graphics Software

3. Output Primitives

1. Points and Lines
2. Line-Drawing Algorithms
 1. DDA Algorithm
 2. Bresenham's Line Algorithm
3. Circle-Generating Algorithms

4. Two-Dimensional Geometric Transformations

1. Basic Transformations
 1. Translation
 2. Rotation
 3. Scaling

5. Two-Dimensional Viewing

1. Clipping Operations
2. Point Clipping
3. Line Clipping
4. Cohen-Sutherland Line Clipping

APPENDIX B

QUESTIONNAIRE

Usability Evaluation of PUCG eLearning System
Students' Experience

Educational Domain

(Please tick in the box)

S/N	Questionnaire	Agree	Agree to some extent	Disagree
1	E-Learning is a good way of delivering course materials.			
2	The content of the course is accurate compared to relevant literature			
3	The course content is regularly updated according to the curriculum			
4	The online discussion forums offered are effective for learning			
5	Internet connection fees are a disadvantage for using eLearning in PUCG			
6	Making your contribution on the assignments, forum posts etc, viewable by other students motivates you to try harder			
7	You sometimes feel uncomfortable as other students can read your forum posts.			

Write your answers in the spaces below

8. Do you consider sitting in front of the computer as more challenging than learning in the classroom?

9. Elaborate what you think needs to be improved in order to better fulfill your needs.

Technological Domain

(Please tick in the box)

S/N	Questionnaire	Agree	Agree to some extent	Disagree
1	The Institution should have an orientation program that provides technical training to students before starting the course			
2	The server where the e-Learning was hosted was available all the time when you needed to access it.			
3	Offering videoconferencing lectures is a good way of providing educational materials.			
4	Audio lectures are much more preferable to video lectures.			
5	Internet speed presents a problem while using e-Learning to its fullest.			
6	The login procedure is simple.			
7	The organization of the course material allows for easy navigation.			

8. How do you communicate with your lecturer while on the e-Learning platform?

- a. E-mail
- b. internal messages
- c. chat online
- d. forum posts

9. What other technological devices could be included in the e-Learning platform to enhance its performance.

APPENDIX C

FEATURES OF AUTHORIZING TOOLS CONSIDERED

a) BREEZE

Content:	1. Screen Recording features	No
	2. Customizable Recording Window Size	No
	3. Special effects	Yes (Power Point function)
	4. Editable media objects	Yes (Power Point function)
	5. Widgets for interactivity	Yes (Power Point function)
	6. Branching	Yes (Power Point function)
	7. Feedback captions	No
	8. Quizzes	Yes
	9. Templates	Yes(Power Point function)
Output:	10. Score tracking	Yes (for Quizzes)
	11. SCORM Compliance	Yes
	12. AICC Compliance	Yes
	13. Exporting content to text files	Yes (Power Point function)
Accessibility:	14. Accessible via Browser	Yes (with flash plug-in)

b) LECTURNITY 1.6

Content:	1. Screen Recording features	Yes
	2. Customizable Recording Window Size	Yes
	3. Special effects	Yes
	4. Editable media objects	Yes

	5. Widgets for interactivity	No
	6. Branching	No
	7. Feedback captions	No
	8. Quizzes	No
	9. Templates	No
Output:	10. Score tracking	No
	11. SCORM Compliance	Yes
	12. AICC Compliance	Yes
	13. Exporting content to text files	No
Accessibility:	14. Accessible via Browser	Yes

c) ROBODEMO 5.0

Content:	1. Screen Recording features	Yes
	2. Customizable Recording Window Size	Yes
	3. Special effects	Yes
	4. Editable media objects	Yes
	5. Widgets for interactivity	Yes
	6. Branching	Yes
	7. Feedback captions	Yes
	8. Quizzes	Yes
	9. Templates	Yes
Output:	10. Score tracking	Yes
	11. SCORM Compliance	No

	12. AICC Compliance	Yes
	13. Exporting content to text files	Yes
Accessibility:	14. Accessible via Browser	Yes

d) COMMTEACHING

Content:	1. Screen Recording features	Yes
	2. Customizable Recording Window Size	No
	3. Special effects	Yes
	4. Editable media objects	Yes
	5. Widgets for interactivity	Yes
	6. Branching	No
	7. Feedback captions	No
	8. Quizzes	Yes
	9. Templates	No
Output:	10. Score tracking	Yes
	11. SCORM Compliance	No
	12. AICC Compliance	No
	13. Exporting content to text files	No
Accessibility:	14. Accessible via Browser	Yes

APPENDIX D

VIRTUAL LEARNING ENVIRONMENT COMPARISON – CLAROLINE AND MOODLE

a) Features included within Claroline:

- Courses are broken down into component elements, and then published on the site under separate areas (announcements, exercises, chats, resources, links etc)
- Students have full flexibility in the order that they undertake the elements of the course, whether they are exercises, required reading, discussions, etc.
- Categorised links feature for both students and course administrators to manage relevant URLs.
- Agenda feature included which allows authors to set announcements and deadlines for all course members to see.
- Offers fully optional layout for course beneficiaries
 - Administrators can control which 'course elements' are displayed via a simple interface screen
- Chat facility for all users
 - However, it is a very simple text interface system
- Claroline allows students to upload their own papers to the system for peer review
 - This feature could be useful in an attempt to create a system that is developed & sustained by both administrators and fellow students
- Option for the system to process registration automatically, or for manual administration.
 - (Self-registration would most likely be deactivated on a revenue generating system).
- Courses can start with a limited number of resources, but grow in size and complexity
 - Administrators can add them gradually as course users require them
- Statistics function for course administrators to monitor number of courses, course popularity etc.
- Ability for course administrators to set exercises and assign completion deadlines
- Ability to upload video files for use as course resources

b) Features included within Moodle:

- Layout of the site can be fully customised for particular courses
- Themed discussion forum
- Ability for the course planners to set weekly announcements in advance
 - Users are reminded of forthcoming announcements/assignments when they first log into the system
- Ability for trainers to set students any number of assignments, with targeted completion dates
- Moodle tracks assignments completed and grades allocated by trainers
 - However, this information has to be manually entered – the system does not mark, or allocate grades automatically
- Option to create a variety of surveys in order to spark discussion amongst learners
- Basic security features to limit customer access to particular courses
- Moodle allows users to upload their own learning material to the site to share with other users
 - This feature could be useful in creating an 'organic learning environment' where the amount of learning material available on the system grows without administrator intervention
- 'Journal feature' to allow students to post questions, maintain a course diary, or aid revision
- Theme feature to allow administrators/students to change the look and feel of the Virtual Learning Environment without requiring a new style sheet