A Model for using a Course Management System to develop Web-Based Learning Courses and Environments

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Abstract: The use of web-based learning (WBL) environments in higher-education institutions is escalating, with a need for more. Ideally, the design and development of WBL should be done by a multi-skilled professional team. However, resources are scarce, so pressure is placed on academics to develop WBL themselves, although many do not have the required skills in e-learning design. The process can be facilitated if they use a systematic development methodology. This paper presents an eight-step, yet flexible, model to support the individual educator using a course management system. The model was applied to develop and implement a WBL environment for a blended-learning course at a South African university. We describe both the development process and evaluation of the resulting product, which also have generic implications for using the model.

Introduction

The increasing deployment of web-based learning (WBL) within higher education brings the requirement for further such development. Ideally, WBL environments should be developed by multi-skilled teams of analysts, programmers, educational specialists and instructional designers, using an established software development methodology (Tan & Chan, 2009). In practice, this rarely occurs due to the lack of resources to support professional design and development. Pressure therefore falls on academics to develop their own WBL courses or full environments. However, successful development of a WBL application requires a systematic methodology to be followed (Dick, Carey and Carey, 2005; Tan & Chan, 2009). Furthermore, development of quality WBL applications should take into account elements of graphical design, instructional design and site design, with content that meets the needs of the target learners and the goals of the educator (Dupuis, 2003; Ruffini, 2000). This is a challenge for individual educators designing WBL environments, since they need not only to be knowledgeable in teaching and learning, but must also possess skills in the use of the appropriate design- and development technologies and methodologies. A further challenge is time required to develop the environments (Marcellas, 2009). Many university academics are not trained in e-learning design and do not know how to develop WBL (Cameron, 2009; Vovides, Sanchez-Alonzo, Mitropoulou & Nickmans, 2007). Consequently, many classroom-based and distance educators are reluctant to design such applications, despite the many advantages associated with WBL. This paper proposes a model consisting of steps that can be followed by the individual educator to design web-based learning environment for his/her course. The paper also describes an implementation of the model and an evaluation of the resulting environment.

Aim of the Study

The aim of the study is to:

1. Propose a model, consisting of steps that can be applied by an educator in the design of web-based learning environments;
2. Describe the application of the model in designing an Information Systems 3 course for a South African university;
3. Report on an evaluation of the environment by its users (students) and the implication of the evaluation for WBL.

Method

A literature review was conducted to determine the most appropriate steps to include in a model for the process of designing a web-based learning environment. The review was supplemented by the actual experience of the primary author in the derivation of the model. The model was then applied to develop a WBL environment. Finally, the environment was evaluated in a user-based evaluation as the students evaluated it both in terms of its usability and its support for learning.

Literature Review

Instructional Design and e-Learning

Instruction can be defined as a way of organising and sequencing information in order to maximise the transfer of information from educator to learner (Dillon & Zhu, 1997). Instructional design (ID) is the systematic planning and development of instruction (Ruffini, 2000). It involves a set of decision-making procedures by means of which the most effective instructional strategies are developed or chosen, given the outcomes learners should achieve and the conditions under which they are achieve them (Winn, 1990). The design of any instruction usually involves the use of instructional theories as well as design models and strategies, to help learners develop knowledge and skills (Dijkstra, 2001). Learning sessions in any form, whether face-to-face, at a distance, or delivered electronically, should provide opportunities for the learner to interact, control the information he/she must process, and give and receive feedback about the knowledge being constructed. E-learning is an instructional methodology that uses information and communication technology (ICT) to support learning (Gill, 2003), or a means of learning and instruction via a broad variety of electronic media including the Internet/intranets/extranets, satellite broadcasts, video/audio tape, interactive TV, and CD-ROM (Govindasamy, 2002).

Web-Based Learning and its Design

Web-based learning (WBL) is a subset of e-learning where the Internet is the medium of delivery. According to Crossman (1997), the World Wide Web is an instructional technology that permits the display of information in any medium, on any subject, in any order, at any time, i.e. asynchronous learning, independent of location. This is not possible with traditional contact teaching, where learners and educators go to a particular place, at a particular time, for a particular class on a particular topic. This means that the Internet, in general, and the Web, in particular, have changed the way in which people relate to time and space (Crossman, 1997). The Web is not only used to enhance teaching and learning in the traditional face-to-face environment, but it also supports distance learning and teaching by enabling learners to communicate both synchronously and asynchronously (Vrasidas & McIsaac, 2000). This type of communication allows for self-paced learning and reflection, which are advocated by the constructivist learning paradigm. Such means of teaching and learning have captured the interests of educators worldwide. Educators, from pre-school to graduate school, are rethinking the very nature of teaching, learning and educating, due to the existence of web-based learning environments (Owston, 1998).

Khan's framework for e-learning encompasses the major issues to be considered in designing or creating meaningful WBL environments (Khan, 2001). The framework has eight dimensions: institutional, pedagogical, technological, interface design, evaluation, management, resource support and ethical. Each dimension comprises a set of issues to consider (sub-dimensions). For example, the institutional dimension addresses administrative issues such as budgeting, academic affairs such as faculty and staff support, and student services such as registration; while the pedagogical dimension relates to teaching and learning (Khan, 2009). For successful development of WBL courses in an institution, all these issues should be carefully analysed before initiation of courses. Once all the necessary infrastructure and support for e-learning are in place, in most cases, it is up to the academic staff to design WBL courses for their students. For the actual development of a course or environment, a systematic methodology, such as that proposed in this paper, should be followed.

Course Management System

Course management systems (CMSs) form a subset of Web-based learning software. The body of Web-based learning software can be categorised as follows (Jackson, 2004):

- Authoring tools: Such tools are used essentially for creating multimedia. Microsoft PowerPoint is an example.
- Real-time virtual classrooms: These are virtual classroom software products or suites that facilitate the synchronous, real-time delivery of content or interaction via the Web but that do not necessarily handle course administrative tasks.
- Learning management systems (LMSs): This is a broad term that covers a wide range of learning management and asynchronous delivery tools, including:
  - Course management system (CMS): LMSs that facilitate Web delivery and management of courses, and provide integrated tools for measuring outcomes and reporting learners' progress.
  - Enterprise learning management: serve development teams by offering platforms for delivery and organisation.
  - Learning content management systems (LCMS): a recent form of LMS where the basic LMS features are enhanced with authoring tools that develop knowledge and database management systems.

Using this classification, WebCT (now Blackboard), the software used to create the online course in this study, can be considered to be a CMS, which is a subset of the LMS family. Davenport (2005) also refers to WebCT as a CMS. However, Kazmer and Haythornthwaite (2004) refer to it as an online course management system (OCMS), which is a software package that allows an instructor to easily create course content, to provide opportunities for learning interactions and assessment, and to manage the course (Widmayer, 2000). In this study the terms OCMS, CMS and LMS will be used interchangeably to refer to the WebCT software that was used to develop and manage *Info3Net*, the particular WBL environment described in this study.

CMSs have various advantages in designing web-based e-learning, including (Widmayer, 2000):

- It is easy to set up WBL environments and add further interactivity without using advanced programming skills.
- Course management systems provide productivity tools such an online grading facility, calendar, and student tracking to help educators manage and monitor courses smoothly.
- They support downloading of all the online support into a single password-protected space. Apart from convenience of use for learners, this provides a collaborative learning environment, while protecting the learners' rights to privacy.

These advantages form the motivation for individual educators to design WBL using CMSs. Moreover, they can be easily learned and used and the designer does not need specialised information technology (IT) skills.

Proposed Model

A structured methodology should be adopted in the development of any application. Dick, Carey and Carey (2005) proposed the ADDIE model as a systematic approach for designing instructional systems. It consists of the following steps:

- Analysis: analysis of learner characteristics and learning outcomes is performed.
- Design: learning objectives and instructional approaches are determined, and the blue print of the instructional material (content) is created.
- Development: the content is developed.
- Implementation: the content is used by the students.
- Evaluation: both students and learning content are examined to determine whether they achieve the set goals.

The steps closely mirror the conventional systems development methodology, which consists of planning, analysis, design, implementation, and operation and support phases (Shelly, Cashman & Rosenblatt, 2008). For an individual educator who has to carry on his/her normal teaching obligations, but must still find extra time to acquire the skills and develop an e-learning course, a conventional methodology may not be the most appropriate. However, some form of structured methodology should be used. Dupuis (2003) states that the design of web-based instruction should be an iterative process comprising the following six phases: articulating goals and objectives; selecting instructional approaches; selecting general site architecture; organising site content for each component, module, or subsection; testing the prototype site; and reviewing and revising the site. These phase correspond with elements of the conventional system development approach but are more clearly articulated for use by an individual educator to follow.

Taking into account elements of the ADDIE model, the phases of Dupuis (2003) and other literature, we propose a synthesized model appropriate for the development of web-based learning by an individual educator, instructor or designer using a CMS. The steps of the model are listed in Table 1 and discussed below.

1. Establish the scope of the application
2. Establish the most appropriate learning theory or theories to apply
3. Undergo basic training in using a CMS
4. Determine learning course outcomes and activities to be implemented
5. Design site architecture
6. Build the site
7. Test the application
8. Evaluate the application for usability and pedagogical aspects

Table 1: Steps in the proposed model for developing web-based learning using a CMS

Step 1: Establish scope of the application

Developing a web-based application can be viewed as a project. In cases where there is no proper planning in the early stages, with a defined scope and clear goals and objectives, many such projects fail. At this stage, the need, purpose, worthiness and feasibility of the project should be established. It is also at this stage that clear goals, aims and objectives are established (Cursonzon, 2003).

Step 2: Establish the most appropriate learning theory or theories to apply

It is essential that an instructional designer is cognisant with, and understands, the main learning theories and their contexts. This facilitates the selection of the most appropriate one/s to apply in each situation. The three main current learning theories are behaviourism, cognitivism and constructivism, (Alessi and Trollip, 2001; De Villiers, 2005). Acknowledging the role of pedagogy is one a factor that sets this model apart from some others. While educators often neglect this step in the design of e-learning environments, they do so to the detriment of their courses, since it is essential that instructional design is based on a foundation of sound learning theories and pedagogy for the successful implementation of e-learning (Govindasamy, 2002; Smith, 2003; De Villiers, 2005).

- ***Behaviourism*:** Proponents of behavioural philosophy maintain that the psychology of learning should be based on observable events and behaviours. Behaviourism proposes a stimulus-response-reinforcement approach and, despite its real contribution to teaching and learning, it is criticised because it disregards important unobservable aspects of learning such as mental processes, reasoning, reflection, and motivation. Although the approach is appropriate for teaching intended outcomes, it ignores valuable unintended outcomes. It over-emphasises the instructor and instructional material at the expense of the learner (Alessi & Trollip, 2001; Black, 1995).
- ***Cognitivism*:** Cognitive psychology emphasises unobservable mental constructs, such as memory, attitude, motivation, metacognition, reflection, and other internal processes. It stresses the vital role of prior knowledge and posits that learning is the incorporation of new knowledge into the network of prior learning (Alessi & Trollip, 2001).
- ***Constructivism*:** The major ethos of the constructivist learning theory is that learning is an active process during which learners construct new ideas or concepts based upon their current and past knowledge (Bruner, 1990). Constructivism views learners as active and participative creators of knowledge, who learn by observing, manipulating, and interpreting the world around them. It has emerged as the dominant current approach to learning (Ben-Ari, 1998) and is particularly relevant as an underlying paradigm for contemporary e-learning and interactive learning on the Web.

Step 3: Undergo basic training in using a CMS

Although educators may be keen to develop online material, they may feel intimidated by the technological aspects. It is important that they are trained in the necessary software and acquire the basic technical skills in the process. CMSs are not complex to use (Vovides et al, 2007). Basic hands-on training should be provided by the institution to its educators. They should not be overwhelmed by extensive sets of facilities within a CSM, but should rather be oriented in the basic skills, such as creating different types of pages and uploading documents. In most cases, content must be uploaded in specific formats such as HTML for static content. Educators should be explicitly shown how to compile documents and other content in the appropriate formats. The training should be gradual – from the basics to the more advanced features.

Step 4: Determine learning outcomes and activities to be implemented

Activities to be included in online environments should be related to achieving the learning outcomes of the course (McDaniel, 2003) and directly within the context and scope of its aims and objectives. Once trained and equipped

with prior basic training (Step 2), and familiar with some of the capabilities of the specific CMS, the actual activities to be implemented should be discerningly and pragmatically selected. This may necessitate reviewing some aims and the scope.

Step 5: Design site architecture

Using a drawing tool or paper, the site architecture should be designed to accommodate the required activities and processes. In web design, this may be referred to as the site map. Although it can be represented as a hierarchical structure (O'Hanlon, 2003) with the home page as the top node, it is not a hierarchical structure in the strict sense but rather a network structure. For example, users should be able to access the home page from any page (branch node). The structure should be flexible, so as to accommodate further functionality and features in the future. The structure should be intuitive, so that users are easily able to determine where particular features and lower level activities can be found (O'Hanlon, 2003).

Step 6: Build the application

This is the implementation phase during which the actual application is developed and constructed, according to the site architecture, and using the tools available in a specific CMS. For example, in Blackboard (formerly WebCT), one can use single or organizer pages, assignments, quizzes (self-tests), and discussion tools (Blackboard, 2009). Required files should be identified or created and uploaded. These may include static content files or media files (Glenn, 2003). Usability of the site should be considered right from the initial stages of the design (Koohang & du Plessis, 2004). Site design should be simple, so that users do not spend extensive time trying to determine how to use the application, instead of using the content effectively from an early (Nielson, 2000; O'Hanlon, 2003).

Step 7: Test the site

This step could be combined with Step 6. However, it is presented independently, since testing is vital for accuracy and functionality of the application and for successful use. Each component should be tested to determine whether it functions as required. When a component, for example a quiz, is implemented, it should be used and tested in a <Student View>, as seen by users when they log on. Once all the components have been individually tested, the site should be viewed in its entirety to ensure that components are well integrated and execute as intended. The site should also be tested to determine whether students can log on to the application not only from within the university campuses but also from outside.

Step 8: Evaluate the application for usability and pedagogical aspects

Once the application has been tested, it should be rolled out to students. Basic training or briefing on how to use the application should be provided. Because a WBL application should be dynamic, it is important, from an application design perspective, that there is continuous evaluation of the site in terms of its usability and support for learning (Ssemugabi & De Villiers, 2007a) in order to ensure that it meets its stated aims and objectives as set out in the scope of the project in Step 1.

It should be noted that the model is not rigid nor linear but rather flexible and iterative in nature. For example, the order of the steps can be altered and some steps can be repeated or performed in parallel, depending on the content and context of the learning environment being developed. Where appropriate, certain steps can be omitted. For example, where an academic is already familiar with the operation and functionality of the CMS, then **S**tep 3 can be left out.

Application of the Model

The model above was applied in the design of *Info3Net*, a WBL environment for Information Systems 3, for 3rd-level learners registered for either the National Diploma in Information Technology or the National Diploma in Financial Information Systems at Walter Sisulu University (WSU) in East London in the Eastern Cape Province of South Africa. The CMS used to develop the *Info3Net* website was WebCT, one of the commercial packages for designing and developing web-based e-learning applications. The designer and developer of *Info3Net* is the first author of this paper. As a lecturer at WSU, he was the subject co-ordinator of Information Systems 3 in the Department of Computer Studies. A subject co-ordinator is responsible for lecturing and the preparation of all study materials, such as notes, tests and practical exercises for the subject. The Information Systems 3 subject entails a one-year programme, in which 'Advanced Databases' is done during the first semester and 'Project Management' in the second.

About eighty learners were registered for Information Systems 3 when *Info3Net* was developed and evaluated. All of them were in the final year of one of the 3-year duration diplomas mentioned above. The site was mainly used in the first semester, since the content of *Info3Net* focuses on the teaching and learning of databases. The

online environment was developed to supplement face-to-face classroom instruction. This is termed blended learning, referred to by Singh (2003) as "blending offline and online learning" where, for example, the WBL application provides study material and research resources over the Web, while the lecturer presents contact sessions as the main means of instruction. Specifically, in applying Step 1, the following aims were identified:

- Develop an online environment to enhance class activities by providing facilities such as course material, a discussion forum, announcements, self evaluation exercises, tests, resources, and useful links.

- Assist in management of the course and record keeping;
- Expose the learners to an e-learning experience; and
- Evaluate the environment in terms of learning and usability to support reflection and generic WBL design.

With respect to Step 2, although the lecturer-cum-developer is trained as a teacher, he undertook self-study into current learning theories and paradigms. Ideally, he would have preferred a pure constructivist approach, but it was not realistic to achieve this during the first attempt. In fact, *Info3Net* incorporates aspects of each of the three main learning theories.

In terms of Step 3, WSU provided a three-day training workshop on the use of WebCT. Each academic was required to design prototype online courses during the workshop. As part of the training, Web resources that are useful in the design of a WebCT course were provided, for example, online help and <Ask Dr C>. Demonstrations of <Exemplary Course Projects> were also provided (WebCT, 2003). These are courses selected annually by the WebCT supplier, as applications that demonstrate best practices in course design; interaction and collaboration; assessment and evaluation; meaningful technology use; and learner support. These illustrations proved to be very useful during the actual design of *Info3Net*.

With respect to Steps 4 and 5, Figure 1 shows the architecture of *Info3Net*, including the activities that were to be done by students; provision of learning content and course material; assessment including self-tests; communication facilities such as discussion forums and notice board, and useful resources such as glossary, calendar and a site-search facility.

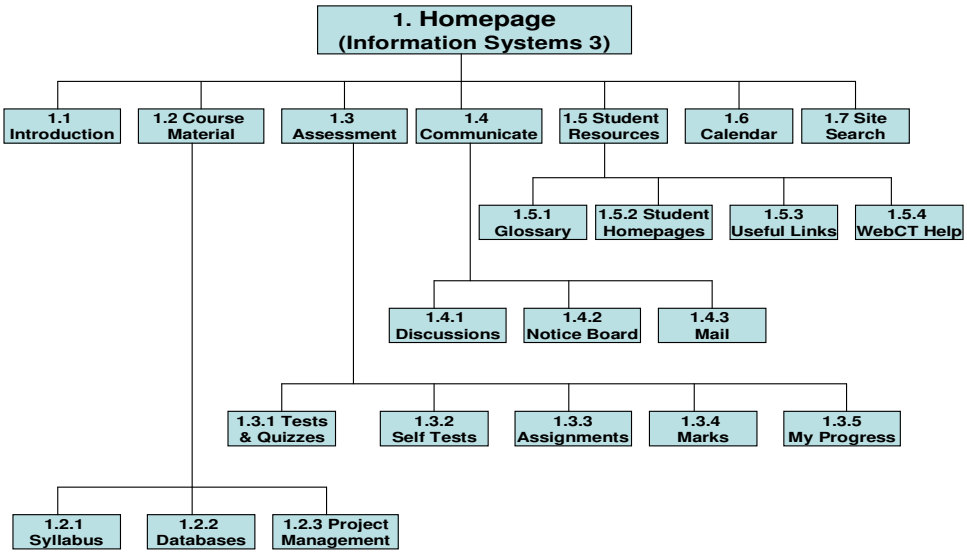

Figure 1: Site architecture of Info3Net

To apply Step 6, the course site was built using tools provided within WebCT such as Assignments, Calendar, Discussions, Glossary and Self-test (Blackboard, 2009). Figure 2 shows the homepage of the site with the course menu on the left, offering shortcuts to available content and to the activities indicated in the Site Architecture of Figure 1. Other facilities found useful were the <Organizer page> and <Single Page> functionalities. Similar to the <Homepage>, an <Organizer Page> allows one to organize links to tools with similar functions (Blackboard, 2009). For example, the Communicate page with links to Discussions, Notice Board and Mail was created using the <Organizer Page> facility. A <Single Page> enables one to present supplementary course material that is not

included in a Content Module or linked to other content pages (Blackboard, 2009). For example, the <Single Page> facility was used to create the Introduction page.

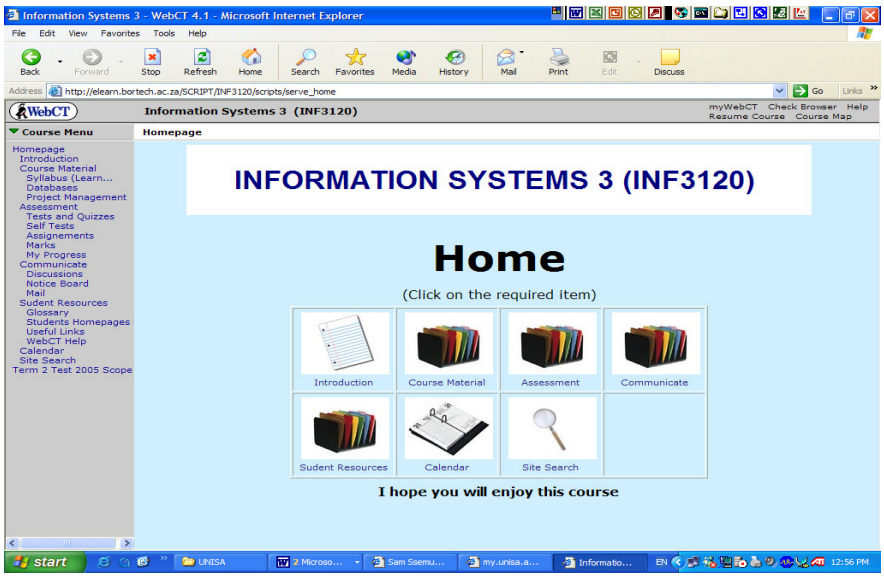

Figure 2: Homepage of Info3Net

WebCT offers a <Designer View> and a <Student View>. The designer view is used to create and modify the application, while the student view enables the designer to see the site as viewed by students. It is important to check the student view continuously to confirm that each created component works as required. It is also important to use the <Updating Student View> feature when modifying the site, for example, when a new version of a file is uploaded. Once a set of components has been created, it is advisable for the designer/instructor to log on as a student to view and check the new site content. With respect to testing in Step 7, both the designer view and updating student view features were constantly used during the implementation of *Info3Net* to ensure correct operation of all the functions. In addition, a <Guest> student account was created and used to access the site to test its functionality.

User-Based Evaluation of the *Info3net* Site

Once *Info3Net* was ready for use by students, they were given an overview of how it works. This session, which included completion of a small self-test, took about 45 minutes. Students were encouraged to inform the lecturer of any difficulties they encountered in the process. Due to thorough testing (Step 7), no site failures were encountered. Nearly all the problems reported were of a technical nature, such as failure to log in due to forgotten passwords. The WebCT server administrator solved all the problems and no re-development was required.

At the end of the semester, in line with Step 8, a formal site evaluation of *Info3Net* was done by the users (students) to investigate both its usability and support for learning. This user-based evaluation was based on a framework developed by Ssemugabi and De Villiers (2007b) comprising twenty usability and learning criteria (each with associated sub-criteria). Out of a total of 80 students, 61 participated in the evaluation, which was in the form of a questionnaire survey comprising 110 statements based on the sub-criteria. The students were required to indicate to what extent they agreed with these, using a Likert rating scale. The statements were phrased in a positive, rather than a negative form, for example, “The system is fast to work with” or “The content keeps me engaged”. On a Likert scale of 1 to 5 (strongly agree, agree, maybe, disagree, strongly disagree), the mean of the average ratings was 2.3 and the standard deviation was only 0.4. This shows that most learners tended to agree with the statements, indicating generally positive impressions of *Info3Net*. This is further confirmed by the fact that in 92 statements (84%) of the total 110, the average rating was less than or equal to 2.5.

In addition to rating the individual statements, learners were asked to assess the overall usability of Info3Net and its support for learning. Table 2 shows some of the data obtained in the evaluation, indicating percentages of students who selected a particular option (strongly agree to strongly disagree) for each statement or question relating to usability and learning value.

#	**Statement/Question (Usability Factor)**	***Strongly agree (Likert 1) (%)***	***Agree (2) (%)***	***Maybe (3) (%)***	***Disagree (4) (%)***	***Strongly disagree (5) (%)***	***Average rating (1-5)***
a	I found it easy to use the system.	38	52	8	2	0	1.7
b	The system is fast to work with.	23	51	11	13	2	2.2
c	The system performed tasks properly.	20	69	10	2	0	1.9
d	Once I learnt how to use the system it was easy to use it the next time.	33	62	5	0	0	1.7
e	I was satisfied with the system.	20	59	16	5	0	2.1
	Average % for **a** *to* **e** *(usability)*	**26.6**	**58.7**	**10.2**	**4.2**	**0.3**	**1.9**
		V. Good	***Good***	***Adequate***	***Poor***	***V. Poor***	
f	How well did the site work as a supplement to class instruction?	23	61	13	3	0	2.0
		Web site	***Class***	***Both***			
g	I would rather learn using:	10	5	85			
		V. Good	***Good***	***Adequate***	***Poor***	***V. Poor***	
h	What is your overall rating of this site?	21	70	5	3	0	1.9

Table 2: Percentage (%) of students who selected a given option for each statement or question

The table shows that most learners rated the site highly in terms of its usability (Questions **a** to **e**). The average percentages for 'Strongly agree' and 'Agree' are 26.6% and 58.7% respectively. This means that, in total, 85.3% (26.6 + 58.7) of the score falls in these two categories, indicating a high rating for usability of *Info3Net*. Question **f** investigates the role of *Info3Net* as a supplement to class instruction, and here 84% (23 + 61) responded favourably (Very good or Good). These percentages correspond well with the learners' overall rating of the site (Question **h**) where 91% (21 + 70) rated it as Very good or Good. Finally, 85% preferred a blended approach, using both class and site for learning (Question **g**), compared with 10% who would prefer the site only and 5% who prefer class instructions only. In general, even though none of the students had ever used a WBL environment previously, the statistics shows that they were positive regarding the usability of the site and its support for learning. This is confirmed further by some of their open-ended responses, for example:

- "The site is easy to use and has straightforward links".
- "The interface is easy to use".
- "I like the newness in learning – different learning styles. You feel like studying – it inspires you. You are like your own online tutor".
- "I like the site layout. The site is well organised and easy to navigate".
- "The site was fun to work with and I think it should be used more often in the future".
- "The site helps me to improve my skills and evaluate my learning abilities".
- "We should use WebCT for all other subjects".

Conclusions and Recommendations

Designing a web-based learning application is a complex task that requires a systematic methodology and skills in the use of a number of appropriate technologies. Despite the growing demand for university academics to develop and use WBL, many of them are not trained in the sign and development of e-learning. The model

proposed in this study consists of a set of simple steps that can be followed by a university educator to independently design a web-based application using a CMS. The model is iterative and flexible in its use, in that certain steps can be repeated, omitted or combined depending on the learning content and context of use. However, it is recommended that all steps should be considered for a successful development of the application.

The model was effectively applied in the design, development, implementation, and evaluation of *Info3Net*, a web-based environment to support a contact-teaching course in Information Systems 3, using WebCT as the CMS. This experience showed that it was easy to follow the steps and perform an actual WBL development using a CMS. Each of the three aims set out early in this paper, were met satisfactorily in the design of *Info3Net.* Aim 1 was achieved, based on a comprehensive literature study, combined with expertise gained by the first author in a training course. A comprehensive model was synthesized and its eight steps are explained in this paper. With regard to Aim 2, the model performed well when applied in the development of a multi-feature WBL environment, as described and illustrated. Furthermore, the assessments – self-tests and actual tests – were automatically graded by the application. Aim 3 required an evaluation of the environment, noting the implications for future WBL development. The evaluation showed a positive response from the students regarding both *Info3Net*'s usability and support for learning. For example, 84% of the 61 students who participated, rated it as 'Very good' or 'Good' as a supplement to class instruction. Given that none of the students had used WBL before, they were "thirsty" for such a means of learning. This is exemplified by comments such as "I like the newness in learning – different learning styles. You feel like studying – it inspires you. You are like your own online tutor" and "We should use WebCT for all other subjects".

The findings have generic implications. The evaluation indicates that, where facilities are available, there is a desire on the part of students to blend their classroom- or distance-based studies with WBL to offer them multiple representations and different modes of learning to enrich their education. More particularly, adherence to a stepwise, yet potentially iterative, approach fostered discipline and structure in the development process, in contrast to an *ad hoc* development. This systematic technique resulted in rigour, accuracy and user-satisfaction in the developed WBL product. It is recommended that the implementation of various course activities be done in a gradual manner as the academic gains experience in using the CMS, i.e. the level of blending should be low at first and then increased gradually. A benefit of using a CMS is that components can be reused subsequently or applied elsewhere; for example, the structure of an established environment can be exported and used as the basis of a WBL environment for a different course.

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