



PENINSULA TECHNIKON

FACULTY OF ENGINEERING

The design and implementation of a Discussion Forum Module to function within the architectural constraints of an existing Open Source Software (OSS) Learning Management System (to meet target-user requirements)

Prepared by: Zhanyu Wang (200206087)

Internal Supervisor: Bennett Alexander

Dissertation submitted to the Higher Degrees Committee of Peninsula Technikon in Fulfilment of the Requirements for the Master of Technology Qualification in the Department of Information Technology at the Peninsula Technikon

2003/2004

Declaration

I hereby certify that the work reported in this thesis is my own and that work performed by others is appropriately cited.

Zhanyu Wang

Acknowledgements

I hereby wish to thank Mr Bennett Alexander who helped me to finish this thesis by supporting me and enabling me to bring the thesis to a termination thanks to his flexible and friendly assistance.

I also wish to thank the people of the KEWL.nextgen group who involved me in the developing group to take a deeper look in KEWL.nextgen developing specifications and to include them in my thesis.

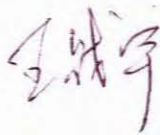
Furthermore, I want to thank all my colleagues at the Peninsula Technikon who assisted me in getting material and information to write this thesis.

Thanks to all my friends for spending spare time with me and freeing my mind when I got stuck.

Last but not least I wish to thank my family who supported me all through my life and for giving me the chance to do what I have done.

Special thanks go to you, Mom and Dad!

Signature of the author:



Zhanyu Wang

Abstract

Higher education and online discussions are an integral part of collaboratively based e-Learning systems. However, there problems can be associated with current online discussion models. For example, it can be easy to set open-ended discussions which attract little participation and to assess contributions can be difficult or time-consuming. Students may not achieve the expected learning outcomes without proper structure and management in online discussions.

This paper proposes to design and implement a discussion forum object to function within the architectural constraints of an existing OSS learning management system (to meet target user requirements) that is a web-based *environment for online discussions where the facilitator can structure each discussion according to its nature and where learning requirements are using already designed templates.*

Abbreviations

OSS: Open Source Software

IT: Information Technology

LMS: Learning Management System

KEWL: Knowledge Environment for Web-based Learning

KEWL.NextGen: Knowledge Environment for Web-based Learning Next
Generation

UWC: University of the Western Cape

MVC: Model-View-Control

GPL: Gnu Public Licence

CVS: Concurrent Versions System

MIT: Massachusetts Institute of Technology

OSI: Open Source Initiative

FSF: Free Software Foundation

SDLC: System Development Life Cycle

SMEs: Subject Matter Experts

UML: Unified Modelling Language

FTP: File Transfer Protocol

OOP: Object-Oriented Programming

AVOIR: African Virtual Open Initiatives and Resources

PEAR - PHP Extension and Application Repository

HTTP: HyperText Transfer Protocol

DNS: Domain Name System

URL: Uniform Resource Locator

HTML: HyperText Markup Language

Content

Chapter 1 Introduction to the Study	1
1.1 Research title	1
1.2 Introduction	1
1.3 Background	4
1.3.1 What is open source software?	4
1.3.2 Know the benefits	5
1.3.3 It is easy to procure	5
1.3.4 It fit for the purpose.	6
1.3.5 It is easy to change	7
1.3.6 It is high quality	7
1.3.7 Employees like it	8
1.4 Discussion forum of learning management systems	8
1.5 Statement of the problem	9
1.5.1 Limitations in existing online forum models	10
1.5.2 Open-ended discussion topics	10
1.5.3 Low participation or problem of “lurking”	11
1.5.4 Described discussions	11
1.5.5 Discussion management	12
1.5.6 Discussion assessment	12
1.6 Concepts for the study	13
1.7 The significance of the research	17
1.8 Intended Programme of study	18
Chapter 2 Literature Review	20
2.1 Distance Education	20
2.1.1 Definition	20

2.1.2 Rationale for distance education	21
2.1.3 A Brief Historical Account	22
2.1.4 Role of technology in distance education	23
2.1.5 Computer-Related Instructional Materials	24
2.2 Existing systems	24
2.2.1 WebCT	24
2.2.2 Click2Learn	26
2.2.3 Hyperwave	31
2.2.4 Summary	34
2.3 A review of the discussion forum policy at Colby College	34
2.4 Introduction to PHP	39
2.4.1 What Is PHP?	39
2.4.2 Architecture Overview	40
2.4.3 New challenges	42
2.4.4 PHP Meets Development Challenges	42
2.4.5 Faster time to market	42
2.4.6 Abundant connectivity	43
2.4.7 Leveraging enterprise logic	44
2.4.8 Portability	44
2.4.9 Open source	45
2.4.10 Conclusion	45
CHAPTER 3 Methodologies and Research Plan	47
3.1 Design Methodologies	47
3.2 Developing language	48
3.2.1 PHP and Design	49
3.2.2 Introduction to Design Patterns	49
3.2.3 Layers in Web Programming	50

3.2.4 Common web programming problems	51
3.2.5 Design Patterns for Web Programming in PHP	52
3.2.6 Problem and Pattern matching	57
3.2.7 Conclusion	57
3.3 Organizational Structure and Interfaces	58
3.4 Project Management and Control	60
3.4.1 How the plan is kept current	60
3.4.2 How the Project is managed	60
3.4.3 How progress is measured	61
3.4.4 How schedules are tracked	61
3.4.5 What specific methodology is used for software development	61
3.4.6 How verification and validation is conducted	62
3.4.7 Verifying that the product designed conforms	62
3.4.8 Validating the requirements satisfy the users need	62
3.5 Delivery plan:	63
3.6 Project management objectives and priorities	63
3.7 Assumptions, dependencies, and constraints	64
3.8 Risk management	65
3.9 Schedule control	66
3.10 Issue resolution	67
3.11 Technical process	67
3.12 Software Documentation	69
3.13 ACTIVITIES	70
3.14 Resource Requirements	71
Chapter 4 Requirement	72

4.1 Discussion Forum	72
4.2 Definition	73
4.3 Forum Features	80
4.3.1 General Features	80
4.3.2 General Forum Features	80
4.3.3 User Control Panel Features	82
4.3.4 Admin Control Panel Features	84
Chapter 5 Project Design	86
5.1 Template based discussion system	86
System: Actors & components	87
5.2 Expected benefits	88
5.2.1 Structured discussion objectives	88
5.2.2 Students' interest and reusability of their work	88
5.2.3 Well managed discussions	89
5.2.4 Assessment	89
5.3 Architecture of the system	90
5.4 The forum	91
5.4.1 The user centre	93
5.4.2 The admin system	95
5.5 Features	96
5.5.1 Discussions, advertisements, polls and chat	96
5.5.2 Mailing list	97
5.5.3 Moderation	98
5.5.4 Message reports and pre-moderation	100
5.5.5 Troublesome users	100
5.5.6 Maintaining the forum	101
5.5.7 Subtopic subscriptions	101

5.5.8 Linear and threaded views	102
5.5.9 Searching	103
5.5.10 Subtopic ratings	103
5.5.11 Member list	104
5.5.12 View new posts	104
5.5.13 Form mailer	105
5.5.14 Tell a friend	105
5.5.15 private messaging	105
5.5.16 Rich message options	106
5.5.17 Printer friendly pages	106
5.5.18 File attachments	107
5.6 System features and functionality	107
Chapter 6 Case Study	113
6.1 Introduction	113
6.1.1 What is KEWL	113
6.2 Module Design:	120
6.2.1 Introduction to UML	120
6.2.2 Use Case Diagrams	121
6.2.3 An actual use case	123
6.2.4 The actual use case of forum module	124
6.2.5 Activity diagrams	130
6.3 Database Design	133
6.4 Module Implementation	134
6.5 Enhancement:	137
Chapter 7 Conclusion	139
References	140

Appendix A: Learning Management System Overview	144
Appendix B: An Evaluation of the Development of a Discussion Forum Module against the Information Management Body of Knowledge (IMBOK) Framework	153
Appendix C: code of the module	165

List of tables

Table 3-1 Roles of major activities	59
Table 3-2 Risk management	66
Table 3-3 Tasks to be performed	71
Table 5-1 System features and functionality.....	112
Table 6.1 Coding repository.....	137

List of figures

Figure 3-1 Waterfall developing method	47
Figure 3-2 Developing process	48
Figure 3-3 Programming layers	50
Figure 3-4 UML diagram	53
Figure 3-5 MVC pattern.....	55
Figure 5-1 Proposed online discussion model	87
Figure 5-2 Architecture of the system.....	90
Figure 5-3 Message hierarchy	92
Figure 6-1 MVC approach	117
Figure 6-2 the forum module use case diagram.....	122
Figure 6-3 the forum module activity diagram	132
Figure 6-4 Database architecture	133

Chapter 1 Introduction to the Study

1.1 Research title

The design and implementation of a Discussion Forum object to function within the architectural constraints of an existing OSS Learning Management System (to meet target user requirements)

1.2 Introduction

The Discussion Board is a way of communicating with your students outside the classroom in an asynchronous environment, which means you do not all have to be online at the same time. It is convenient because you can read and post messages whenever you have time to do it. The conversations that take place within the Discussion Board are logged, so they can be reviewed at a later date. Each discussion topic is created by the instructor as a forum. All new posts and responses added to a forum are organized into threads.

Discussion forums are applied extensively as an easy-to-use and yet powerful communication tool in numerous Web-based applications in general and in learning management systems (LMS) in particular.

For example, in scientific digital journals and digital libraries discussion forums are heavily used to discuss different articles, to comment ideas presented in these articles, or simply to write "letters to the editor". In software development discussion boards programmers come together to exchange their views on different programming techniques, software design methods, project management concepts, etc. Also, the existence of numerous Web-based communities and communities of practice, such as Open Source communities, scientific communities, and many other relies mostly on discussion forums,

which are usually the essence of such communities. Such list of Web applications built with and around discussion forums goes on and on.

Similarly, in LMS systems discussion forums are applied with the highest user acceptance for many different purposes. Usually, each LMS course offered in the system is associated with a special discussion forum that provides the place for context-dependent discussion of issues related to that (Helic, Maurer, Lennon, Scerbakov, 2001, 38). Learners taking a part in the course work with the associated discussion forum to write there their questions about presented learning material, to discuss topics from the course, to publish their examples, and so on. Also, in problem-solving or project-related LMS courses learners may use discussion forums to discuss the actions they take on each particular step of their work (Helic, Krottmaier, Maurer, Scerbakov, 2003, 55).

On the other hand tutors, authors and teachers may use special discussion forums offered by the system to discuss issues related to implementing different training sessions in the system. For instance, they may discuss the content of a particular LMS course that they need to prepare, or a particular training strategy for the training session that they are conducting (Helic, Maurer, Scerbakov, 2002, 37).

One of the main reasons for the large success of discussion forums is the simple and intuitive nature of these tools. Discussion forums come with a very simple user interface, which is highly usable for a wide range of users with very different and possibly non technical backgrounds. Thus, users simply read through contributions arranged in a tree or a list and reply to those contributions by simply activating a special reply button. Structurally, contributions in discussion forums are arranged into a tree, where non-leaf nodes represent so-called threads, i.e. contributions that have replies.

Visualizing and providing a simple Web-based user interface to such a simple structure is technically very easy task to accomplish.

Another important aspect of applying discussion forums, especially in LMS systems is the possibility to reuse them as valuable learning resources in such systems.

For example, a particular discussion forum that was associated with some LMS course contains large amount of information in form of question and answer dialogues, discussions, attached examples that previous learners created, etc. Of course, new learners coming to that particular course may extract very useful learning information from this discussion forum. Further, a discussion forum attached to a problem-solving or project-oriented LMS course includes all the steps of the learners' progress in the course and shows all the actions taken by learners in reaching their goal. Moreover, the reasons for a certain learners' action at the specific moment in the project are described in details through the discussion that was going on at that time. Thus, such a discussion forum represents a new and valuable learning resource as well. On the other hand, discussion forums used by tutors, authors and teachers to discuss the content or methodology of a LMS course contains tremendous educational potential. Such a discussion of experts in a certain subject matter results eventually in a new learning resource containing knowledge and experience extracted from these experts. This, of course may be seen as a very fine read for interested or advanced learners.

This paper presents a possible approach to support conceptual structuring of discussion forums. In addition present the tool that implemented in the KEWL system called kngboard following the presented approach. This tool allows us to create, manage and reuse conceptually structured discussion forums but

still be able to preserve the basic premise of discussion forums: intuitive and highly usable organization and interface of these tools.

1.3 Background

1.3.1 What is open source software?

In order to understand what OSS software is, it is best to discuss two OS in two separate contexts. The open source movement (which your IT staff might be involved in), and open source as a type of software license.

Open source is seen as a movement among software developers. Since the 1960s, individuals from around the world have organised themselves to develop and use free software in real project environments. In the last ten years, this movement has evolved into a sophisticated system used by both private and public organisations.

In general, open source refers to any program of which source code is made available for use or modification as users or other developers see fit. Historically, the makers of proprietary software have generally not made source code available. OSS is usually developed as a public collaboration and it is made freely available. The OSS license tends to favour the end users of the software, as opposed to a propriety license, which favours the software vendor.

During software development, a number of OSS development tools can be used to speed up and improve the process of designing, authoring, building and unit testing business applications.

These tools are created for developers by developers, and they are often the

best in their class. Interestingly, commercial alternatives to several of the tools that augment development best practice do not even exist.

Tracking and understanding the relevance of each and every new OSS development would be extremely time-consuming and unproductive. Instead, commercial IT organisations need a way to consider the options from the point of view of their enterprise requirements.

1.3.2 Know the benefits

Many IT managers start out wanting to use open source software because it reduces development effort and costs, thereby saving the business money. However, after practical implementation, they soon realise there are several other benefits that are perhaps more significant and lasting. In fact, the majority of OSS is actually aimed at speeding up enterprise software development, simplifying system management and maintenance, and improving software quality. Enterprises that learn to think about OSS as a solution to their holistic enterprise development needs will find several opportunities to improve the efficiency of their business and IT organisations, and lower the cost of building and operating enterprise systems.

1.3.3 It is easy to procure

There is no doubt that OSS can dramatically lower the total cost of ownership of enterprise systems, but one of the greatest benefits of using free software is often overlooked: OSS eliminates the pressure to make big decisions up front about what is needed before it is needed. Enterprise development teams often needlessly force-fit expensive commercial products into their solutions simply to validate prior overzealous procurement of licenses. If they start with OSS, developers can get right to the work of building business applications, and incorporate third-party components (proprietary or open source) only as they are called for by specific business requirements. Unlike commercial products,

they will never be locked into a contract to use OSS, only to find that it is not required or not suitable.

1.3.4 It fit for the purpose.

OSS that is not easy to install, use and manage does not survive. Since open source code is scrutinised by thousands of developers worldwide, OSS developers are forced to keep their software as straightforward and as lean as possible. They have to limit their feature set to what is required right now and add features as their users request them.

Unnecessarily complicated and bloated products with large footprints, such as most commercial application servers, are uncommon and short-lived in open source software.

In practice, the small footprint of OSS application servers and databases also means that they are faster, cheaper and easier to use during development than the commercial alternatives

By using OSS with open standards such as PHP, Java, J2EE, HTTP, XML, and SQL, each developer can host an entire application infrastructure on their workstation: web server, application server and database, regardless of whether the finished product will be deployed onto OSS or commercial products. This not only saves on development licenses, but also reduces dependencies among team members and allows developers immediate feedback on whether or not their code works, which drastically speeds up development.

1.3.5 It is easy to change

Using OSS increases the options and the amount of control that can be exercised when developing, enhancing, evolving and retiring enterprise systems. Open access to source code means that a software developer can always enhance, fix, or otherwise alter any open source component at any time.

In addition, the strong pride of authorship and community behind most OSS projects means that if something does not work, there will usually be at least one insider who is keen to help and ultimately ensure successful use of their software. Often, defect and issue resolution in OSS is more precise and takes far less effort than it does with commercial software, because the users have direct access to the bug database and the authors – there is no corporate support hierarchy separating the user from the solution.

1.3.6 It is high quality

The methods used to develop OSS naturally favour the production of software that is higher quality than most other software, bespoke or commercial. Each OSS project is run like a small and efficient software business. The software is generally developed in cycles, each of which plans to release a new stable production version to the majority of users, who require predictability and reliability.

But what makes the open source development model uniquely better is actually what happens between production releases, where several smaller software changes are released to add new features and fix bugs. These developer-only releases are downloaded and used by tens, hundreds and often thousands of software developers worldwide, effectively creating a

globally distributed quality assurance team for each project. This “release early, release often” strategy finds defects early, which makes them easier to fix and improves the quality of the production release. Further, since the defect resolution process moves at such a rapid pace, the users develop very high expectations – project teams therefore has to provide timely fixes or their software will soon die out.

While a few OSS lacks features relative to their proprietary counterparts, this should not be considered indicative the quality of the software. Where concrete requirements exist for the features in the gap, these will eventually be added – with better methods and clear criteria for success. Most open source development teams openly publish the road map for their projects and any user can request enhancements. It is only a matter of time before the feature gaps close and commodity commercial software gives way to the higher quality open source alternatives.

1.3.7 Employees like it

The people factor should not be discounted. Working with new, cutting edge software might help attract, retain and motivate internal IT professionals, leading to greater productivity over time.

1.4 Discussion forum of learning management systems

E-learning is rapidly becoming mainstream in higher education. Computer-mediated communication is a key element of e-learning systems and strategies. Online discussions are one of the most important applications of computer-mediated communication in e-Learning environments (Kearsley 2000). They provide an asynchronous collaborative learning environment where interaction takes place between group members (Dillenbourg 1999) and

have been included in almost all courses or learning management systems.

Online discussions offer a number of potential benefits that can help engage students in activities that contribute to their intellectual growth (MacKnight 2000). For example, composing a response in online discussions often *requires greater reflection than in face-to-face discussions* (Harasim 1995). Other benefits include promotion of team building, promotion of critical thinking (Muilenburg & Berge 2002) and *supporting collaborative work* (Salter 2000).

The facilitator may actively control the discussion through means such as selectively releasing responses, limiting who can view them, or by active participation in the forum. On the other hand, the facilitator may take a more hands off approach and leave the students to themselves after posting a question or task. Unfortunately, simply asking students to respond to a topic or question given by the instructor is not likely to generate an effective collaborative learning environment. It may help students to interact with information but not with the instructor or other students.

1.5 Statement of the problem

There are some problems associated with the current models of online discussions in higher education. Discussions can end up as an open-ended, non-productive learning activity, there may be a lack of students' participation, discussions may not be well structured or easy to initiate and assess by staff. The proposed system has been designed to help overcome these problems. This may lead to better outcomes for both students and staff. These expectations are going to be tested through action research where the proposed system will be tested by faculty and students.

1.5.1 Limitations in existing online forum models

There are only a few models for online discussions with limited variation. The discussion area provides a platform where participants can share ideas by posting a message to initiate a discussion or to respond to already posted questions or messages of an ongoing discussion. One variation is to see whether the messages can be viewed in a linear or threaded fashion. In a learning environment, the facilitator that moderates the process may be a tutor, instructor or teacher. The facilitator explains the purpose and sets up the protocols such as discussion cycle, duration and assessment weight. The facilitator often starts the discussion by posting a question. Students answer the question in the form of a discussion posting and may be required to comment on other responders posting as well (Rossman 1999; Laurillard 2002).

The following problems can be associated with such model(s).

1.5.2 Open-ended discussion topics

Open-ended discussions may result in non-productive learning activities. Students are likely to lose interest where there is an overload of information that does not have direct application or use (Harasim 1995).

If there is assessment associated with the discussion question, students may be tempted to copy text from different sources to perform the activity rather than engage in the question. This does not help students to enhance their analytical and critical thinking. At the same time long unstructured responses can result in a greater information burden for other responders.

1.5.3 Low participation or problem of “lurking”

Lurking is another big problem that is often a lack of participation by students particularly where it is a new communication medium (Harasim 1995). Another common observation is that active students take an interest in discussion based learning whereas passive students tend to find it less attractive. This may be because it is a text-based, self-initiated learning environment.

Research proposes a number of strategies to hold students' interest and to enhance their critical thinking (Muilenburg & Berge 2002) but current technologies and models do not necessarily support them. Students become confused or lose their interest when a discussion is ill-structured or if there is no process designed to enhance their critical thinking (MacKnight 2000).

Low participation in discussion forums may also be linked with students' own learning styles. Some students strongly believe in individual learning. In that case, the existing discussion forum model, based on a collaborative approach, may not be appropriate (Sae-Chin & Resta 2003).

1.5.4 Described discussions

Students find it hard to initiate a response to them where the task is not well described. In contrast, it has been observed that students find learning activities more interesting when the task is specifically well defined and easier to follow (Muilenburg & Berge 2002). Similarly, the job of assessing the student responses is more time consuming and subjective when the task is not well defined (Burford & Cooper 2003).

1.5.5 Discussion management

Current discussion models do not include many management features that can assist in an educational setting. Features useful in educational settings include access control, discussion availability duration, assessment weight, and archive options. For example, a facilitator may want to release discussion responses only after he or she has added feedback and the last student has responded. Following this the activity may continue where the students are required to compare their responses. This can be a difficult process with current available software and tools. Typically there is no start or stop controls available and the facilitator do this by informing the students or closing the discussion topic manually. The H2O project (H2O Project 2003) allows facilitators to set some deadlines for submission of posting but it does not have the other features discussed in this paper. It is freely available at <http://h2o.law.harvard.edu>.

1.5.6 Discussion assessment

A continuing research problem is how to assess discussion contributions (Mochizuki et al. 2003). Assessment was not included in most of earlier discussion models. Typically, these have been used to share ideas and helping out each other. Many models were not formally linked to learning activities, outcomes and finally to assessment. However, messages in discussion forums can be useful for assessing collaborative learning (Mochizuki ET at 2003). Assessing a contributor is very hard and time consuming (Laurillard 2002) as there are few techniques available. A common technique is to count the number of postings (Salter 2000). This strictly quantitative approach does not necessarily correlate with learning or effort. Indeed, it may encourage students to simply post frequent and/or large messages but without making a serious attempt. In fully online courses, the

volume of posting may be huge both to read and to assess. In this case assessment may be done by the contributors themselves or by peers. The 'Peer and Self Assessment System (PSAS) suggests ways in which this might be done (Resta 2003 see <http://dl.aace.org/14156>). However, this kind of system may have some problems, such as it can be biased, time consuming and difficult to integrate into the main assessment system. Peer grading can provide strong motivation to do quality work, but students are often uncomfortable grading one another (Salter 2000). A simple rating system (e.g. excellent, good, fair, poor) can be used or students may be required to make only positive critiques (leaving the negative comments to the instructor).

Another assessment technique is text mining (Fujitani & et al 2003). However, this example is used for self assessment and only to see over-all discussion patterns, but it is not linked to actual student assessment. Other assessment methods are provided in Salter (2000).

However, whichever technique is chosen, greater management by the discussion model can make marking easier, particularly given the volume of responses generated by most discussions.

1.6 Concepts for the study

E-learning is a groundbreaking paradigm shift in the field of learning that provides high-speed access to knowledge and information. It offers online training that can be delivered anytime and anywhere through a wide range of electronic learning solutions such as Web-based courseware, discussion groups, live virtual classes, video and audio, Web chat, simulations and mentoring. E learning enables companies to transcend distance and other organisational gaps by providing a cohesive virtual training environment.

Open source, by definition, means that the source code is available. Open

source software (OSS) is software with its source code available and which may be used, copied, and distributed with or without modifications, and that may be offered either with or without a fee. If the end-user makes any alterations to the software, he may either choose to keep those changes private or return them to the community so that they can potentially be added to future releases. An open source license is certified by the Open Source Initiative (OSI), an unincorporated nonprofit research and educational association with the mission to own and defend the open source trademark and advance the cause of OSS. The open source community consists of individuals or groups of individuals who contribute to a particular open source product or technology. The open source process refers to the approach for developing and maintaining open source products and technologies, including software, computers, devices, technical formats, and computer languages.

Although OSS has recently become a hot topic in the press, it has actually been in existence since the 1960s and has shown a successful track record to-date. Examples of popular open source products include Emacs, GNU toolset, Apache, Send mail and Linux. The development of Perl is an example of the open source process.

PHP is a programming language, used on the server to create dynamic Web pages. The principles of this technology are similar to Allaire's ColdFusion, Mod_Perl, Sun's JSP, or Microsoft's ASP, which all address one problem: As Web sites and intranets get larger and more complex, static HTML files hit their limits. Today, the Web is an interactive, transaction-oriented business platform, featuring advanced Web based applications, such as online commerce, business information systems, and collaborative computing environments. To develop such applications, you need a technology to generate dynamic content for Web pages.

PHP is a convenient language for rapidly prototyping simple dynamic websites. Websites thus built can in many cases be deployed indefinitely, without spending time and money on refractory codes in a different language. PHP's simplicity makes it a good language for inexperienced programmers, such as those moving from a pure page-design role to a site development one.

For more experienced developers, though, the language's simplicity rapidly turns into complexity, slowing down the development process. These developers are the ones who have the skills needed to build large and/or complex websites; using PHP for such sites therefore tends to be a net loss. This tendency is reinforced by PHP's lack of the linguistic features needed to promote working on large software projects. If your project is at all large or complex, it may be better to look elsewhere when choosing an implementation language.

The real strength of PHP lies in the extensive range of built-in functions. Those available include functions to:

- Access a wide variety of databases (see below).
- Interrogate the Web server on which the code is running.
- Manipulate arrays.
- Access a full range of mathematical functions.
- Perform arbitrary precision mathematics (log, trig etc).
- Get the date and time and display them in a variety of formats.
- Browse directory trees.
- Execute external programs on the server and receive the results back.
- Perform a wide variety of operations on the server file system.

- Set cookies.
- Send mail.
- Perform network functions such as “Get the Internet host name corresponding to a given IP address”.
- Use Perl-compatible or POSIX-extended regular expressions.
- Use System V semaphores and shared memory o Manipulate strings.
- Test a variable’s current type.
- Use WDDX to easily exchange data with other applications over the Web.
- Gzip and gunzip files.

Creating powerful Web applications inevitably means storing and manipulating a lot of data, so the ability to access databases is vital. PHP includes support, via function calls, for a wide variety of popular databases, including Adabase D, dBase, Unix dbm, filePro, Interbase, Informix, Microsoft SQL Server, mSQL, MySQL, Oracle, Sybase, PostgreSQL, and Solid. In addition, any database, which supports ODBC, such as Microsoft Access, can be used. If you are trying to create an application, which is not database-specific, then there are a number of open source abstraction layers available, including Metabase and phpDB, which will let you do this painlessly.

Computer-based discussion forums are established to promote the exchange of information, questions, ideas, analyses, criticisms, and viewpoints within the *diverse array of academic and social contexts*.

Linux is an obvious Open Source solution for education. It is free and can be installed easily on almost any computer. Red Hat Linux is the most popular

distribution (version) of Linux in the United States. It offers ease of set-up, use, and maintenance. Another popular distribution is Yellow Dog Linux. It is based on Red Hat and made to run on Apple computers. Both of these methods can be used to breathe new life into an old computer. Linux has a reputation of running very well on older machines. This is good news for schools since a lot of the time they have older equipment.

Apache is most widely known as an http server, which takes care of hosting web sites. It was created by a few hobbyists who were not happy with the closed-source solutions available. They started “patching” (hence the name) a program together needs. Long story short, as of May 2003, Apache serves 63% of all internet web pages. (Netcraft Web Server Survey, 2003)

This is a very incomplete list as there are thousands of Open Source projects available. To find an Open Source project that fits your needs, visit some of the sites listed in the resource section of this paper.

1.7 The significance of the research

Compared with traditional instructor-led classroom instruction, e-learning offers numerous advantages, including:

- knowledge delivered globally at Internet speed;
- access to individualised learning, anywhere, anytime;
- interactive technology-based learning tools, including Web-based platforms, video and satellite broadcast;
- convenience that can be customised to specific needs;
- integrated delivery to audiences worldwide;
- the ability to deliver new courses quickly; and
- flexibility to set your own learning pace.

Discussion is a very important factor for success in education and to cultivate this habit. The discussion forum that talks on various issues and it is managed by students themselves. The discussion forum also serves as useful resource generator since students may raise queries regarding educational subjects and students or their instructors may again answer these. In simple words the discussion forums act like FAQs on various issues of interest. Since these discussion forums are split into sections and subjects, it is easy for someone to locate something that interests them. Once a student replies to a particular message on a discussion forum, all registered users of that forum are intimated through the web mail facility, thus keeping the discussion active and interesting for all involved.

1.8 Intended Programme of study

This project is divided into six phases, with most of the project activities being part of the third phase:

1. *Establishment and clarification*
2. Building up the network lab
3. Design and implementation
4. Testing
5. Reporting
6. Publishing

The actual times will depend on how the funding alliance is built up. Since most tasks are spread over the life of the duration, presenting a standard chart of timelines would add little value to this document. The actual times for project execution are based on a two-year framework, assuming a fully funded project

for implementation. Should this not be the case, and different sponsors are funding different aspects of the project, the timelines will need to have flexibility depending on which aspects of the project a particular sponsor is prepared to fund.

Chapter 2 Literature Review

2.1 Distance Education

The purpose of this first component of the review is to trace the advances in distance education from delivering instruction on ink parchments to delivering instruction via complex multimedia technologies. This section begins with a definition of distance education, followed by a rationale for it in pragmatic and in problem-solving terms. A brief history of distance education is presented. Next, a discussion relating distance teaching and learning to educational technology will ensue. Finally, an overview of Computer Mediated Communication (CMC) will be presented with an emphasis on the Internet and one of its networks, the World Wide Web (WWW) as an emerging learning environment.

2.1.1 Definition

There are many definitions of distant education. They reflect a range from the textual practices of traditional correspondence courses, to the recent uses of telecommunication innovations. Simms' (1977) definition reflects the early days of distance education, "The unique and distinguishing feature of correspondence education is that the learner is at a distance from the teacher for much, most or even all of the time during the teaching -learning process" (p. 6). Another definition is the separation of teacher and learner in space and/or time (Perraton, 1988). Some definitions reflect a functional perspective, such as Peeters' (1983) characterization of distance education as "a form of study complementary to our industrial and technological age" (p. 8). Some of central concepts underlying all these definitions include: distinguishing between face-to-face classroom activity and the physical separation of teacher and student, instruction offered by an institution for higher learning as opposed to

training or personal lifelong learning pursuits, and the use of some technical media as the context for the teaching and learning event (Keegan, 1980).

2.1.2 Rationale for distance education

The practice of distance education can be seen primarily as a response to perceived needs and demands for access to education (Neufeld, 1985), however, economic factors have also played an important role in the decision to use a distance format (Neufeld, 1985). Much has been made public about the unequal access to education for people in rural areas. Harasim and Johnson (1986) suggested that distance education alleviates some of the significant obstacles students often face related to, “geographic isolation, family responsibilities, scheduling conflicts, and lack of appropriate educational programs or facilities” (p. ix). Technology such as CMC, videos and audios (individually or integrated) provide convenient and flexible access to instructional opportunities.

An increasingly diverse student population in higher education which includes more “non-traditional students” creates a demand for novel ways to offer instruction. These students encounter time constraints due to full-time employment or other social obligations. In an attempt to address these needs, institutions are exploring the use of the WWW to provide convenient and accessible instruction to students.

Distance education not only provides access to education but it is regarded as increasingly essential because of economic factors. The recent budget cuts that many institutions of higher learning are facing, in addition to the decreasing number of traditional students enrolling in university and college relative to the number of nontraditional students (Wagner, 1990), have led some institutions or programs to opt for distance education. Kaye (1995)

argues that distance education can be economically advantageous because of the potential of high enrollment. He describes the student to faculty potential ratio as 200 to 1, and contends that there are “economies of scale associated with mass distance education provision” (p. 12). A second reason for the economic advantage is the reduction in the need for student-based campus facilities such as buildings for classrooms and computer labs, dorms, etc. (Kaye, 1995). By requiring students to own computer resources, institutions save on purchasing, as well as maintenance expenditure. If these non-traditional students access the course materials from home, the institutions save on utility, janitorial, infrastructure and renovation costs.

2.1.3 A Brief Historical Account

The history of distance education, in the broadest sense, could be traced back to medieval Europe, when letters and manuscripts--laboriously handwritten in ink on parchment--were disseminated to monastic scholars in geographically distant locations (Burke, 1978).

Messengers bearing these missives in saddlebags made such modes of informal distance education more economical (Burke, 1978). Another milestone invention in communications technology was the invention of the printing press in mid-fifteenth century, which revolutionized the world (Cauthen & Roth, 1994). The printing press dramatically reduced the labor and economic production costs of recording and duplicating books. It also hastened the dissemination of information and served to democratize access to new ideas (Burke, 1978). This print revolution, together with the development in later centuries of increasingly efficient and reliable postal delivery methods such as rail, motor, and airline transportation systems delivered much of the formal distance education: the correspondence course.”

Correspondence courses were an alternative to regular articulation in schools and institutions of higher learning. Subsequent distance education practices evolved to the use of radio, television, satellite, and computer technologies to deliver course content.

2.1.4 Role of technology in distance education

The nature of distance education--the time and place separation of students and teachers--requires technology to accomplish its instructional goals. Garrison (1987) suggests that: Distance education is inexorably linked to the technology of delivery. It can be seen as a set of instructional methods based largely on mediated communication capable of extending the influence of the educator beyond the formal institutional setting for the purpose of benefiting the learner through appropriate guidance and support. Without the use of technology, distance education would not exist (p. 45).

The early predominant practice in distance education was text-based correspondence courses. Recent uses of communications technologies such as the telegraph, telephone, radio and even recently, television (abetted by communications satellites), teleconferencing systems, the VCR, and computer have altered distance educational practice. The availability of these technologies instigated a change to supplement correspondence courses with audio and video cassette materials (Neufeld, 1985). This evolution continued with each successive technology; radio broadcasts, satellite and television broadcasts, audio-conferencing, and video-conferencing. The distance education practice became an integration of these systems, for instance, a satellite broadcast was augmented by audio-conferencing for all the participants. The use of innovations such as the telegraph, telephone, radio and, recently television (abetted by communications satellites), teleconferencing systems, the VCR, and computers have for the most part

served primarily as delivery systems.

2.1.5 Computer-Related Instructional Materials

This section traces the introduction of the computer into distance education as Computer Assisted Instruction and how it evolved to the use of Computer Mediated Communication technologies, specifically, the WWW environment.

2.2 Existing systems

This section introduces some vendors for e-learning and Knowledge Management Systems. This is only a small subset of all available systems on the market, but it shows which features and possibilities current systems deal with, which architectures are used, and how standards and specifications become necessary on the market.

2.2.1 WebCT

Overview

WebCT is the world's leading provider of e-learning solutions to higher education. WebCT positions itself as a pure e-Learning company which is true because WebCT does not develop any tools for content or knowledge management. They specify on e-Learning and enterprise products.

Products

WebCT offers two different products to support e-Learning and its administration, WebCT Campus Edition, which is designed to be a Course Management System with different features like the usual communication and collaboration tools, such as discussions, whiteboard, chat sessions, and internal course mail. Additionally, assessments are possible, using virtually all question types. Therefore, instructors have the flexibility to quickly and easily

build and administer customised assessments that contain self-tests, surveys, and quizzes. In addition to assessments, tutors can monitor and analyse factors such as usage patterns, individual and class performance on tests and quizzes, and how learners navigate through online materials. Of course, content development and import is made easy by using a drag and drop tool and supporting the IMS CP specification. Furthermore it is possible to create personalised content and to project a unified look-and-feel for WebCT's online learning environment. One really important feature is the Unicode support that allows using this product in many languages.

WebCT Vista was designed to be much more than only a Course Management System. It should become an Academic Enterprise System with the integration of the usual e-Learning features plus some other features that are accessible when implementing the IMS Enterprise specification. It over all communication tools such as integrated chat and whiteboard, discussion capabilities, integrated course mail, and a "who is online" instant chat tool.

Its extensive assessment capabilities are similar to those of the WebCT Campus Edition which is also true of any other features such as content importing and creating using drag and drop or the multiple language support or the personalisation possibilities.

WebCT Vista makes it possible to aggregate student learning data at the institutional level, extending the capacity for institutions to access and leverage learning data strategically beyond the boundaries of the individual classroom. Institutions have the ability to extract cross-sectional student performance data that can be instrumental to program assessment, reviews and broader institutional studies, contributing to the continuous enhancement and improvement of the educational experience. Furthermore, instructors have the

ability to access, track, and analyse student performance data to drive continual improvement of their courses and sections. WebCT Vista includes a full-featured Gradebook with spreadsheet-like flexibility for organising, viewing, and managing course member information, grades, and groups.

Standards

WebCT is a company that supports a lot of open standards. The varieties of implemented standards reach from simple XML over the IMS Learning Metadata Specification and the IMS Content Packaging and the really complex IMS Question and Test Interoperability Specification to the IMS Enterprise Specification.

2.2.2 Click2Learn

Overview

Click2learn is a pioneering leader in the corporate learning space. They help Global 2000 companies increase productivity and improve business performance through the strategic application of innovative learning software solutions and services. The company employs about 250 people and was founded in 1984 by Microsoft co-founders Paul Allen. The platform's revenues in 2001 were about 21 million dollars.

Click2Learn can be identified as a Knowledge Management System because of the rich features. Although they position themselves rather to be a learning enterprise than a knowledge management system.

Products

The company's products, including the Aspen Enterprise Productivity Suite and the ToolBook Desktop Authoring System are used to develop, deliver, track, and manage training and education programs. They say that they are

the only company that can provide a comprehensive product suite to meet all learning needs. Whether the focus is training automation, sales readiness, employee development, or customer education, companies can start to achieve their business goals quickly, rather than spending valuable time trying to weave disparate systems together. Click2Learn offers a variety of modules and products that can be used as add-ons to create one software solution that meets the customers needs. These are introduced in the following sections.

Aspen Enterprise Productivity Suite

Aspen is Click2Learn's Enterprise Productivity Suite that enables learning and collaboration. Aspen was designed for managing training, information and knowledge to increase the customer's productivity. It is a scalable cross-platform architecture that supports multiple languages, time zones and currencies. The supported browsers are Internet Explorer or Netscape Navigator. The Database Server used is Oracle on Solaris or Microsoft SQL Server on Windows Systems with the following application servers: Windows 2000 Server and the Internet Information Server.

The Aspen Enterprise Productivity Suite consist of the following modules and applications:

- Aspen Learning Content Management is a web-based application that is designed to facilitate the separation of presentation, logic, and behavior in learning objects, providing maximum flexibility and reusability.
- The team-based authoring environment allows concurrent development (which means that it supports version control), so that instructional designers, subject matter experts, project managers,

and reviewers can work together to create high quality courses quickly. Some of its key features are full-text searching, multiple language support, or a role based security.

- Aspen Learning Management can be used to enhance workplace performance management, competency management, regulatory compliance, student registration and tracking, records management, facilities, and curricula management and reporting.
- Aspen Virtual Classroom is a web-based application that provides an interactive virtual learning environment that can be used to deliver and share information across the enterprise. Some of its key features are session management, role based authorization, a sharable whiteboard, public and private chat, integrated voice over IP, and question and answer sessions.
- This module offers some important features both when talking about e-learning and Knowledge Management Systems with the possibility of public and private threaded discussion forums, instant messaging with peers and experts, community of subject matter experts, an indexed knowledge base with archives of all expert interactions, and a full-text search in all collaboration center interactions.
- Aspen Personalized Delivery This means that Click2Learn has the possibility to offer personalised views on content and the user interface. This is done by using an object infrastructure support for modifying content incrementally with version control, adaptive learning based on learning tracks, and pre-testing, or

context-sensitive collaborative study aids like notes, highlights and bookmarks at the topic or SCO level.

Other important features are dynamically created personal study plans that use the above-mentioned pre-tests and post-assessments with suggested remediation, personalized rule-based feedback, and last but not least, support for SCORM conformant courses.

- Aspen Performance Management

In this case *Performance* has the meaning of skills and competency. To fulfill these requirements some features are implemented in this module as managing job and organizational skill and competency profiles, flexible action-focused skill gap analysis, the support for assignment of skill requirements to courses, tracking and management of skill certification compliance, progress and completion tracking of development plans using competency assessments.

- Aspen Information Management

This module implements the widely known aspects of information management that include easy publishing of any type of document, hierarchical catalogs per user with support for both documents and courses, managing entire web sites, reporting and analysis, and secure access to documents.

- Aspen Simulation Editor

This editor is taken from the Toolbook Instructor as part of the Aspen LCMS. It offers a WYSIWYG environment for easy creation of various types of simulations: demonstration, practice, and

questions with the ability to create high-fidelity content that simulates target applications, complex, action sequences in response to simulation events and the ability to fully control granularity of simulation steps.

- Aspen Auditing

Using this module archival of all transactions can be done including date and time of the transaction, the user that performed the transaction, and the type of transaction (new record, update, delete)

Standards

One very important topic when talking about e-learning and Knowledge Management is the support of open standards. Click2Learn's products and modules are standards-based supporting:

AICC support is implemented by following the AICC guidelines and recommendations, specifically the ability to launch and track single AUs, including the ability to receive data such as score and completion from the AUs.

Additionally, Aspen was designed to provide accessibility to all parts of learning, administrative and delivery environment. However this does not necessarily mean that all aspects of Aspen conform to and in particular Aspen is not fully accessibility enabled because accessibility guidelines for this type of functionality are still in an incomplete state.

It is interesting that Click2Learn is one of those companies that produce e-learning and Knowledge Management Tools and is also integrated in the

evolution of the standards they are supporting because therefore they are able to implement everything in an early stage of adoption. Click2Learn is involved in several standardisation activities such as IMS with using the possibility of active participation in the specifications process, ADL (SCORM) where Click2Learn is a technical working group participant taking part in the architecture definition and specifications process, IEEE Learning Technology Standards Committee (LTSC) as an active member, or AICC as an observing member. Click2learn is also monitoring other standards initiatives, and occasionally contributing to meetings and other efforts in this area.

2.2.3 Hyperwave

Overview

Hyperwave is a company dedicated to unleashing the potential of organizational knowledge. Its Knowledge Management software solutions empower information distribution, team collaboration and continuous learning across the extended enterprise. Hyperwave was founded 1997 as spin-off of the Graz University of Technology. Today, the company consists of about 200 employees. The revenue in 2001 was about EUR 18.6 million. Hyperwave positions itself as a Knowledge Management Company which is true when looking at the features supported by its products.

Products

In its origin Hyperwave implemented a content management server to build applications on top of it. The features and possibilities expanded throughout the years and now, several well designed applications and modules are available to fulfill the companies' objectives.

Hyperwave Information Server - IS6

The Server is the base of the company's e-knowledge Infrastructure. Its key features are version control, link management and user administration with interfaces to LDAP and NTLM. Hyperwave has an integrated autonomy and verity search engine and is based on an Oracle or MS SQL Database in the areas of transaction security, high availability and data throughput. A client add-on for content delivery is also available.

Hyperwave eKnowledge Suite - eKS

This application is fully web-based as almost all other Hyperwave applications. The features available when using this application are all document management features including editing and linking. Additionally, an option to add notes to documents is available. Other features are a discussion forum, a shared calendar, and a team workspace. Last but not least, Active Documents and an Expert Search Facility assist users in getting information.

Hyperwave e-knowledge Portal - eKP

The Portal provides possibilities to give a special view on personal or team related information. Because it is based on so-called track architecture several different tracks (e.g. Outlook-Track, etc.) can be added with the ability to restrict the access-rights to users and groups using JavaScript or Java Servlets.

Hyperwave e-learning Suite - eLS

This part of the Hyperwave e-knowledge Infrastructure provides almost all functionality needed for e-learning. Some of the main features are tests, statistics, progress tracking, public and private chats and virtual office hours for direct communication with the responsible tutor in the way virtual classrooms are implemented. Other modules available are instant messaging, a threaded discussion forum, a background library, and an authoring system that allows

reusability of learning content. In the next version, SCORM 1.2 support will be implemented.

Hyperwave eConferencing Suite - eCS

It integrates extended chat features that expand the virtual classroom features of the Hyperwave e-knowledge Infrastructure.

Hyperwave Workflow Option

This module is rather important when talking about Knowledge Management because it introduces Business Process Management, create and manage process definitions, initiates business cases and makes it possible to work on tasks in an easy and intuitive way.

Standards

Right now Hyperwave implements parts of Dublin Core Metadata using attributes to all objects stored in the Hyperwave Database. Additionally, extended metadata support is implemented inside the eLS authoring and reusing module called Media Depot. In the actual version of the e-Learning Suite AICC is supported by following the AICC guidelines and recommendations. The next version eLS will support SCORM 1.2 and therefore also IMS CP.

Hyperwave is involved in some standardization organizations like AICC as a non-voting member to attend in AICC meetings which has been done sometimes. In most other organizations Hyperwave participates as observing member and in mailing lists. Hyperwave is also monitoring other standards initiatives and organizations.

Inside Hyperwave

Because this is the company that promotes my thesis and the practical part has been implemented as part of eLS and I am employed there, I give a little bit more insider information in this section. Most graphics have been taken from (Frank Kappe, 1999) a whitepaper that explains the Hyperwave basics.

2.2.4 Summary

In this section three companies that act as representatives of the different classes of systems have been introduced: WebCt as pure e-learning company with an extended usage of standards and specifications which helps them to be unique on the market (e.g. support of the IMS Enterprise Specification). Click2Learn defines itself more as an e-learning than as a knowledge management company despite the variety of features that are part of knowledge management systems (e.g. document management and version control). Last but not least Hyperwave was introduced as a Knowledge Management Company that offers almost all features to implement a broad working set for e-learning and knowledge management. The support of standards can be seen in its beginning but the acceptance of using and supporting them is growing and it have to be done to keep up with the growing number of requests from the market requests for interoperability and migration. Using, implementing, and supporting standards offers ways to incorporate existing modules in someone's products which guarantees the ability to satisfy the upcoming needs of future knowledge management solutions.

2.3 A review of the discussion forum policy at Colby College

Computer-based discussion forums are established to promote the exchange of information, questions, ideas, analyses, criticisms, and viewpoints within the diverse array of academic and social contexts at Colby.

The Code of Ethics for Information Technology at Colby College and other College policies apply to the discussion forums.

A forum may be requested for use by a regularly scheduled course, an academic or administrative department, a college committee, an official student club or other official student organization, or other officially recognized group within the college. Requests for a discussion forum for use by other campus groups will be evaluated on a case-by-case basis in the context of college policies. Decisions regarding requests will be reviewed as needed by a group consisting of the Vice-President for Student Affairs, the Academic Vice-President, and the Administrative Vice-President.

Access to a forum (membership) may be broadly inclusive or restricted, for example, to individuals enrolled in the course or members of an organisation. Access to a forum has to comply with other college policies.

The contributor of each posting to a forum is identified by name. There are no anonymous postings to any discussion forum.

Only those people authorised to post to a forum will be able to read the contents of a forum. A full list of those authorized to read and post to the forum will be available to each member of the forum. Permission for an individual who is not a member of a forum to read its content requires special permission from the Office of the President and notice of this special permission must be posted in the forum, if necessary by a system administrator.

System administrators are prohibited from inspecting the contents of any

forum of which they are not members, except in the routine performance of their duties in maintaining the operation of the system. System administrators have to preserve full confidentiality of any information about the contents of a forum obtained in the performance of their duties.

Members of a forum have to abide by the confidentiality policy stated for that forum. If, for example, the policy is that postings in the forum are confidential to members of the forum, it would be a violation of the code of ethics to give a copy of any of the forum contents to someone else. One's own posting in such a forum can be distributed elsewhere as long as the contents do not compromise the confidentiality of the forum membership and postings made by others.

Each forum will be closed one month after the end of the semester for which it has been opened. With special justification, approval may be given for a forum to remain open for an academic year, being closed one month after finals in the spring. JanPlan and summer forums are available on request. At least two weeks prior to its scheduled closure, the moderator or sponsoring department may submit a request for renewal of a forum with or without deletion of contents. When a forum is closed, all content is deleted with no archiving of postings. Moderators are responsible for any archiving of the forum prior to deletion, bearing in mind the need to maintain the confidentiality of content that is established for the forum. The deletion of a posting in a forum can create problems, especially if responses have already been posted. In general, only the moderator should be able to delete postings to a forum and the moderator may have to choose responses for deletion as well.

While it is anticipated that vigorous debate of ideas and opinions may occur within a forum, it is expected that civility in discourse will be maintained.

- Criticising ideas and opinions is a normal process of debate and each person should expect to have ideas challenged. However, personal attacks, such as denigration of another person's character or value, have no place in such discussions. Profanity is to be avoided.
- *Participants are urged to avoid responding quickly and emotionally to another person's posting. Quickly lashing out against a statement with which one strongly disagree often results in a personal attack and divergence from the primary topic at hand. A period of contemplation followed by reasoned criticism of the viewpoint is far more effective in convincing others.*

Each forum is created for discussion of a particular range of topics. Issues outside this range are to be avoided unless relevant to the discussion.

The forum moderator has a special responsibility in the case of a serious breach of the code of ethics, civility in conduct, or forum rules. A message and, if appropriate, responses to it may be removed by the moderator if the originating message is deemed inappropriate. The moderator should report violations of the code of ethics, the discussion forum policy, or other college policies to the appropriate Vice-President to determine whether disciplinary action should be initiated. Special care should be taken by the moderator in cases where the views, criticisms, or information are contrary to those of the moderator, are unpopular, or are in some way incorrect; in such cases it is usually better to debate the matter within the forum.

Each forum will have a person designated to moderate the discussion. This person will be responsible for

- stating the range of topics that the forum will cover and being active in keeping the discussion on topic,
- stating the forum policy regarding confidentiality of the postings to the forum;
- defining the forum membership;
- setting the tone of discussion;
- reminding individuals when necessary of the code of ethics and importance of civility in discourse, as well as dealing with significant violations;
- responding to complaints about people's participation in the forum; and
- conducting other administrative tasks as needed.

The Vice-Presidents' review group may close a forum if the moderator does not effectively carry out the designated duties or acts in a way that undermines the free exchange of ideas and views in a civil manner.

Complaints about postings to a forum should be directed to the moderator of the forum. The moderator may seek advice, if needed, from the sponsoring organisation, from the Director of Information Technology Services, the chair of the IT Committee, or from the appropriate Vice-President.

This policy document is reviewed annually by the Information Technology Committee, soliciting comment from the campus community, and posted on the Information Technology Services policy web page.

2.4 Introduction to PHP

What have sprint.ca, livebid.amazon.com, xoom.com, and mp3.lycos.com in common? All employ one of the Web's most up-to-date server side technologies: PHP, the PHP Hypertext Preprocessor.

While the success of open source software, like Linux or Apache, has been documented extensively throughout all mainstream media, the rise of PHP has gone largely unnoticed. Still, the Web scripting language PHP is the most popular module for the Apache Web server, according to a E-Soft survey (<http://www.e-softinc.com/survey/>). Netcraft studies have found that PHP is in use on over 6% of all Web domains in the world (see <http://www.netcraft.com/survey>). That is an incredible market penetration for a rather specialised product. This popularity continues to rise exponentially, with the new version 4.0 just around the corner. Increasingly, this is being reflected in traditional media: By May 2000, more than 20 books about PHP have been published in different languages, with more in the pipeline. Commercial players are beginning to join the bandwagon: PHP is included with Web servers, for example C2's Stronghold, and Linux distributions. A new company, Zend Technologies, has been formed to provide commercial add-ons and support for PHP. A long list of large-scale Web sites employ PHP as well as hundreds of thousands small to medium Web sites. Enough reasons to take a closer look at PHP.

2.4.1 What Is PHP?

PHP is a programming language, used on the server to create dynamic Web pages. The principles of this technology are similar to Allaire's ColdFusion, Mod_Perl, Sun's JSP, or Microsoft's ASP, which all address one problem. As Web sites and intranets get larger and more complex, static HTML files hit their

limits. Today, the Web is an interactive, transaction-oriented business platform, featuring advanced Web-based applications such as online commerce, business information systems, and collaborative computing environments. To develop such applications, you need a technology to generate dynamic content for Web pages.

Traditionally, developers have used CGI (Common Gateway Interface) scripts for interaction with users, querying databases, and so forth. However, because CGI scripts are separate software programs, which get executed as stand-alone processes whenever a user requests the script, scalability was lacking – CGI scripts could quickly consume all available memory and CPU power. Enter PHP: Rasmus Lerdorf, a then Toronto-based IT-consultant, developed PHP in late 1994 as a quick hack to embed macros into HTML pages, to avoid the forking of external programs. When he decided to make his project open source, it proved to be popular, and users started to contribute to it. In 1997, Zeev Suraski and Andi Gutmans, two developers from Israel, rewrote the core engine of PHP, the language parser, and made a complete programming language out of a pet project. The current rewrite, PHP 4.0, is again much cleaner, especially with complex scripts and when used in business environments.

2.4.2 Architecture Overview

Working with PHP leads to three-tier architecture in such a coherent way that many developers do not even notice it. In the first tier there is a thin client - translated to the world of Web applications, this would be the browser. The middle tier (application server) is obviously PHP and the Web server as host application, while the third tier consists of a database system.

PHP scripts are often embedded in the HTML code of page, and then get

parsed on the server-side – the browser sees plain HTML only. A typical Hello-World script looks like this:

```
<html>
<? Print ("Hello World!");?>
</html>
```

This is the method that novice developers find the easiest to work with. Larger and more complex applications usually go other routes, to enforce a cleaner separation of layout and application logic. When embedding the script directly in HTML, average, HTML-literate Web designers cannot easily edit the contents of the page without being familiar with the scripting language used. PHP offers a variety of libraries to work with page templates, which solve this problem, and introduce an efficient development methodology and simplify maintenance. This way, developers focus on the application logic, and designers can change the layout of a dynamic page without involving the developer or interfering with the program logic. This translates into faster application development, and makes maintenance tasks easier by dividing them into content and logic tasks, which can be handled by separate team members.

PHP needs not be used for Web development exclusively. It can also be compiled as stand-alone script interpreter, and handles simple system administration tasks as well. For example, one could use a small PHP script to send daily statistics from your e-commerce application. In version 4.0, the language core engine, the Zend parser, has been abstracted enough to be embeddable in other technologies. Rumours go that it is planned to integrate PHP as stored procedure language into the popular MySQL database system.

2.4.3 New challenges

As has been shown, the new opportunities created by the Web bring new challenges to IT organisations building the applications. Choosing the right technology is critical to the success of any Web application development project. The main challenges are an increased demand on productivity, connectivity, portability and performance.

2.4.4 PHP Meets Development Challenges

The first advantage of PHP was one common to many open source projects: it simply delivered, while other technologies were still vapor ware. PHP pre-dates ASP, Mod_Perl, and ColdFusion by at least 12 months. Over the years, PHP had the opportunity to strengthen its core base and to integrate more features and today provides a base that can easily stand out in the increasingly crowded server-side application development platform market, as the following points will show.

2.4.5 Faster time to market

The development time of Web applications is measured in days and weeks - dinosaur projects spanning multiple years belong to an era which many Web developers do not even remember. IT managers and developers are struggling to keep up with this pressure, and demand high productivity from their development environments.

Perl is a general scripting language, Java is a full-fledged, complex programming language, Visual Basic Script and JScript have been post-integrated into ASP - PHP, on the other hand, was built with the needs of Web developers in mind. In Web application development, there is no problem that cannot be rectified by PHP.

Unlike other cumbersome, overhead-laden approaches, PHP is lightweight and focused on the Web - where it can solve complex problem scenarios quicker and more easily than comparable technologies.

The syntax and grammatical structure of PHP resembles the C programming language with the complexity (for example, memory management, pointers, and strong typing) taken out. The developers of PHP are not hesitant to integrate the best features of other languages, though, so there are elements of Perl and Java in PHP as well. For programmers familiar with C, Perl, or Java, it is a matter of days to get acquainted with PHP. Thanks to the excellent reference manual, anyone developers can probably produce small database enabled applications after just one afternoon.

2.4.6 Abundant connectivity

And there is a lot to explore. For example, PHP implements native interface to a wide variety of database engines, from Open Source systems like MySQL or PostgreSQL, to commercial products like Oracle, SQL Server, DB2, and many more. The native database access offers better performance and tighter control than layered access methods such as ODBC (which is still available for databases *not supported natively*). Especially on the Web, a fast response time is crucial for the success of applications.

Besides databases, PHP supports most current Internet standards: IMAP, FTP, POP, XML, WDDX, LDAP, NIS, and SNMP - to list only a few of the acronyms. For corporate and IT needs, this simply means that PHP is able to talk to different standards and technologies with ease: All from one common tool set, without the need for expensive third party modules.

2.4.7 Leveraging enterprise logic

I hear you say already: "Nice features - but unfortunately, we've all of our business logic already developed with Foo", where Foo stands for Java classes, Enterprise Java Beans, or COM components, depending on the corporate bias. Since version 4.0, however, PHP supports direct access to Java objects on any system with a Java Virtual Machine available, as well as distributed COM on Windows. Multiple Web applications can reuse the same components. This enables the user to keep his business logic in separate components, and to use PHP for what it does best, and where it outperforms its alternatives: Web application development. This means a significantly lower cost of ownership, because it enables business to control existing technology and develop new applications in an easier way.

2.4.8 Portability

When mentioning Java, one of its key features comes to mind instantly: portability. PHP could be integrated only as module into the Apache Web server, or run as a separate CGI program, which would eliminate many of PHP's speed benefits. In version 4.0, however, the Web server interface (Server API, or SAPI) has been abstracted, and PHP now integrates well with different Web servers: iPlanet/Netscape Enterprise Server, IIS, Apache, Zeus, fhhttpd, and so forth. Platform independence has always been an advantage of PHP. It runs on all popular Unix platforms, including Linux, on Windows, on MacOS, and even on OS/2.

Portability is the key to scalable applications. It is possible to run the same application on a low-scale Linux box and on a high-end Solaris machine, without being concerned about platform-specific features. In addition, PHP interfaces transparently with clustering solutions from simple Round Robin IP

clusters to advanced Cisco solutions.

The broad platform support can be attributed directly to the fact that PHP is distributed with full source code. Anyone with the necessary skills can port PHP to a new operating system. The resulting modifications to the core system can then be contributed back to the community.

2.4.9 Open source

Open Source software in general means a number of significant advantages for the corporate IT infrastructure. Because the full source code is available, it can be inspected in thorough security audits. If third parties find security issues, these are usually fixed within hours or days. If no one is going to do it, the client can fix this by himself. Because the full code is readily available, the use is no longer external software manufacturers.

Then there is the community. Free help is available from mailing lists, newsgroups, and IRC channels. The PHP core developers participate in these support forums, and provide developers with top-level advice -usually within hours. In the very near future, even more commercial support options will be available.

Open Source brings with it that rough edges are corrected promptly, and that the overall strategy is unbureaucratically adjusted to new requirements. For example, originally no one had thought that PHP would be used in most *sophisticated business scenarios*, and only version 4.0 is really prepared for that environment.

2.4.10 Conclusion

Considering the vastly growing number of servers on which PHP is now

running, taking a look at the huge step PHP made from version 4.0 to version 5.0, and seeing its mature and up-to-date base, PHP has surely become what it has been aiming at: a great tool for rapid development of stable and fast Web applications. If the user's business relies on Web applications, you should certainly consider PHP. Gone are the days, when a business could post static pages on a Web site - today, sophisticated Web applications demand that companies use technologies that can provide them with rapid development, performance, scalability, openness, and security - and PHP is a strong option in the Web application development area.

CHAPTER 3 Methodologies and Research Plan

3.1 Design Methodologies

Generally product development for conventional software systems use a variation on the “Waterfall” methodology referred to as the “Software Development Life Cycle”.

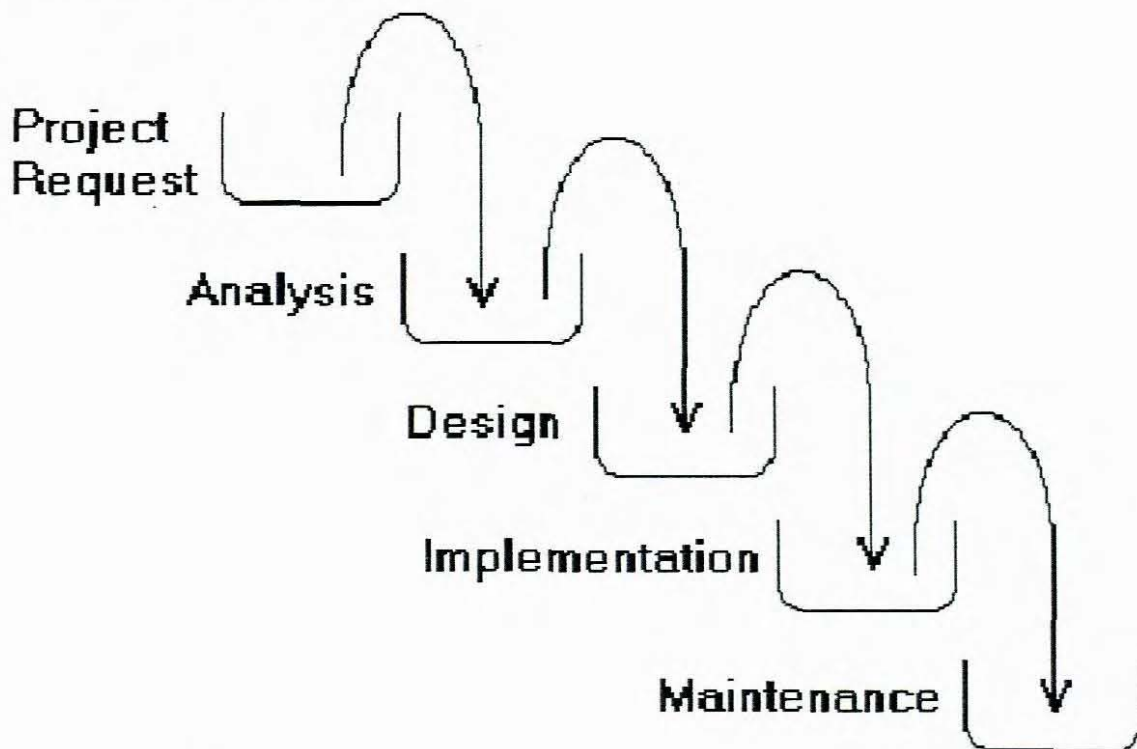


Figure 3-1 Waterfall developing method

One view of this methodology is illustrated above. As one stage of the life cycle is filled, i.e. completed, then the next stage commences. Each stage has a deliverable associated with it.

The method that we are going to use to develop multimedia applications is not dissimilar to the conventional life cycle. An overview of the design method is illustrated.

The project outcome and scope are defined, together with constraints.

Deliverable: Project Plan

We build an understanding of the system under study, with attention paid to those elements relevant to the “project”.

Deliverable: Systems Requirements

We propose a change to the system, or we present and contrast several alternatives, with recommendation.

Deliverable: System Design

We build or modify the system, properly test it, install it and train the audience.

Deliverable: System and Its Documentation

Problems with the system are corrected, and required enhancements are addressed.

Deliverable: Updated System and Documentation

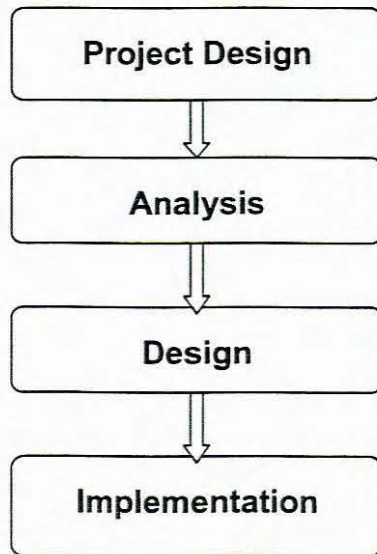


Figure 3-2 Developing process

3.2 Developing language

PHP stands for: PHP: Hypertext Preprocessor. It is a simple open source

server-side scripting language that is widely used on web servers. The current version (PHP4) limited implementation of object-oriented programming. It supports class definitions, member functions, and inheritance.

But it doesn't support multiple inheritances and real encapsulation (because member attributes can't be privately defined). Also the support for polymorphism is in its infancy. With the upcoming introduction of version 5 most of these problems will be solved.

3.2.1 PHP and Design

Before talking about design patterns we should have a look at what a good design can offer you while programming web applications. As I stated before, PHP is a simple scripting language. Some people think that men should never use objects because functions and simple pages will do. For some situations this is certainly true, but in others you might want a higher level of abstraction. Here are some features that a good design can offer you. A good design can increase the following properties:

- readability
- reusability
- simplicity
- modularity
- portability
- adaptability
- maintainability
- extendibility

As you can imagine most of these features are very important for web applications bigger than a few pages.

3.2.2 Introduction to Design Patterns

Design patterns are written descriptions of well-known solutions to common

design problems. Design patterns are a form of reuse: if one person writes it down, many people can use the same ideas in their own designs. A design pattern consists of the following elements:

- Name used to identify the pattern
- Problem what problem is attacked with this pattern?
- Context in what context should this pattern be applied?
- Solution & Consequences the solution for the stated problem and its consequences

3.2.3 Layers in Web Programming

Web programming is concerned with many layers. These are: human computer interaction, interface design, information design, scripting, code library development, database design. We could envision them in the following diagram:

Human computer interaction
User interface design
Information design
Scripting
Code library development
Database design

Figure 3-3 Programming layers

A design pattern for web programming exists in one of these layers. It is good to know at which layer the design pattern has to be applied. With this layering

you get insight to what extend the design patterns is language or domain specific. Design patterns residing in the scripting layer will of course be more language specific than one residing on the user interface design layer.

3.2.4 Common web programming problems

Multiple Presentations: Most of the web applications are accessible via the internet. That means that people from all over the world can access these applications. Therefore it's often important to offer multiple presentations of the same application. Think for example about an international website that needs support for different languages or needs support for different currencies.

Navigation: One of the most important aspects in web design is navigation and information design. Users need always to be able to recognize their position within the website. In a site without a clear and structured navigation it is hard to find what you are looking for.

There exist a lot of navigation structures nowadays. Choosing what kind of navigation best fits your site is not always straightforward.

Database operations: Nearly every large website gets its content from a separate database. It is very important to think about how you are going to make use of that database; how you are going to access it. For example: putting your SQL-queries directly in the PHP-page where you need them is not a good way of using the database. If the database structure changes, you have to manually update all the separate queries in the different PHP-pages.

Authentication, sessions, etc.: User- or session tracking is done to provide personalized websites for the user. In earlier times, web programmers had to do the session handling manually but since the introduction of PHP4 there are several standard functions for automatic authentication and session tracking.

Therefore it is not really a big problem anymore.

3.2.5 Design Patterns for Web Programming in PHP

Singleton pattern

Name: Singleton

Problem: You need exactly one global instance of a class and a global point of access to it.

Context: Any

Solution & Consequences: Make an encapsulated static variable holding the single instance of a class. Provide a get-method that: has a static variable for holding the one and only instance instantiates the instance if it does not exist already returns the instance.

This method returns the one and only instance of the class. So from the performance point of view you gain a lot. The singleton pattern prevents the application for making unnecessary many objects, which results in a performance gain.

Implementation: There are some problems with implementing the singleton pattern in PHP:

- In PHP4 it is not possible to define static variables in a class. But we definitely need a static variable to store the instance. Happily we can define static variables in a function.
- PHP did not support static methods but the latest version of PHP4 you can just call a method like this: `class: method ()`. This is used in the implementation example.

Strategy pattern

Name: Strategy

Problem: You need several different strategies that solve the same problem to be easily interchangeable with each other. For example, a website with

support for multiple languages and currencies.

Context: Any

Solution & Consequences: Solution:

- Create a super class (Strategy) that is used as a shared interface for the concrete strategy classes.
- Define a subclass (ConcreteStrategy) for each strategy needed, that overrides the member functions of the super class.
- Create a reference in your PHP application to one of the sub classes (the concrete strategy that you need) and use this reference throughout your program.

The consequence is that in the PHP-application you can freely change the reference from one subclass to another (from one concrete strategy to another) because they now have the same interface.

PHP does not support interfaces, so you are not forced to stick to the interface of the super class. It is your own responsibility to check if you stick to the interface.

UML diagram:

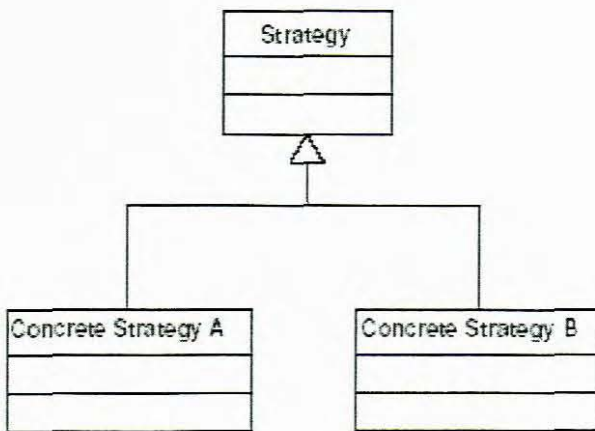


Figure 3-4 UML diagram

Implementation: In this example implementation we want to print a list of names.

We want two strategies: one for printing the list lexicographically ascending,

and one for printing the list lexicographically descending.

Model View Controller pattern

Name: Model View Controller

Problem: You want to be able to change the appearance (UI) of your web application from time to time, or you want to offer multiple UIs for the same application in an easy manner.

Context: Changing or multiple UIs for the same application

Solution & Consequences: Divide your application into 3 parts:

The Model (Processing): the model is a representation of the data and the possible operations on it.

The View (Output): the view renders the contents of the model. It is a view on the model.

The Controller (Input): the controller translates interactions with the view into actions to be performed by the model.

Implementation: This is a sketch of an implementation of a MVC-pattern applied to a web shop. In this example the user can look up a product, or add a product to the system.

Let us have a look at the controller component. I found some implementations of the MVC-pattern for PHP that have a separate class for the controller part. That class is used in the PHP-file the user requested. This suggests that the controller class is the controller component of the MVC-pattern. This is not a nice way to apply this pattern to PHP.

In this way the controller class is just a subset of the functionality of the controller component. The controller class and PHP file together are the controller component in the MVC-pattern. Because the functionality done in

the PHP-file also belongs to the controller, it is the part that interacts with the user.

A better way of applying the MVC-pattern is to look at the PHP-file as the controller component, so the controller component is the PHP-file itself:

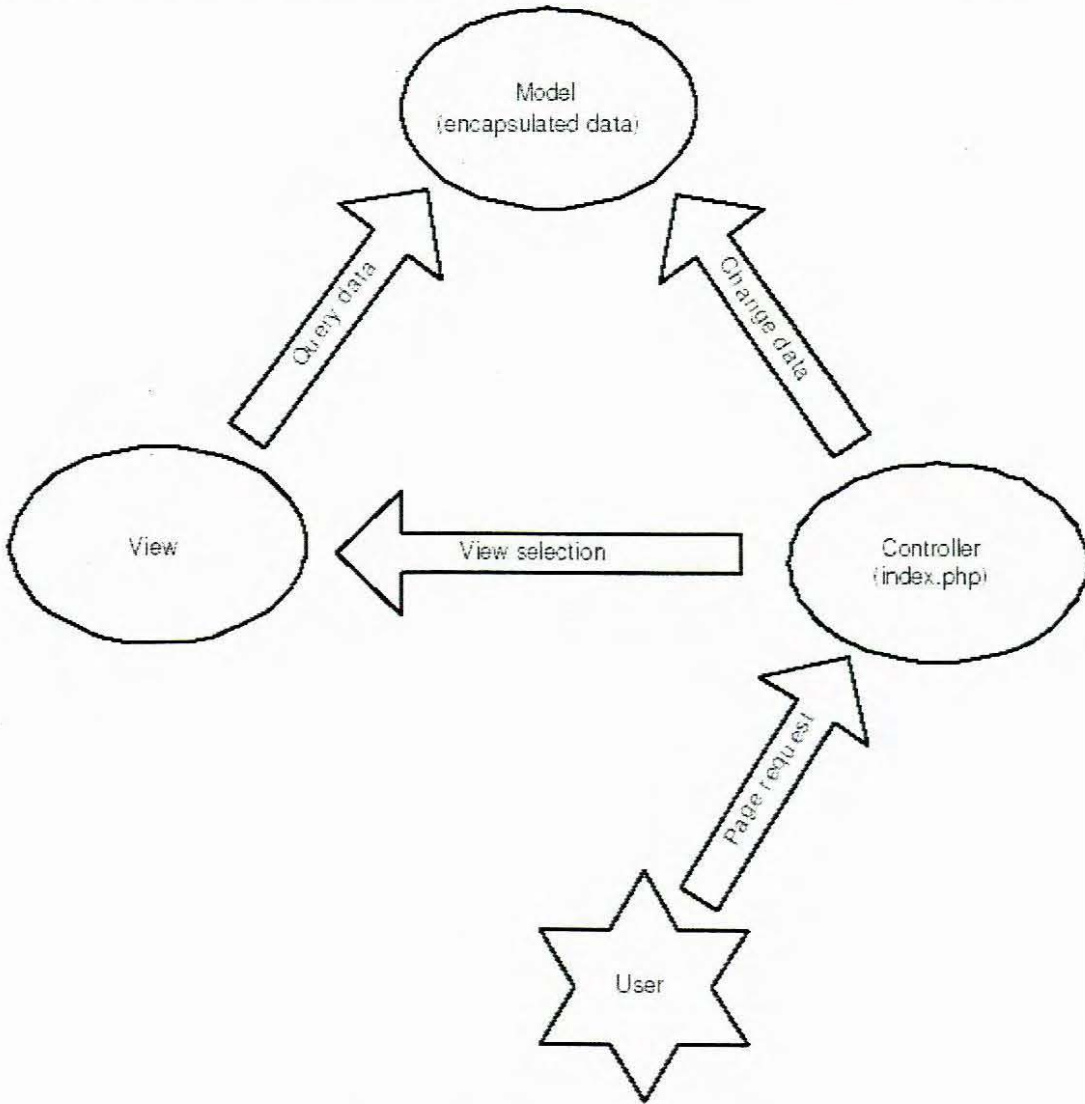


Figure 3-5 MVC pattern

These calls are normally made by the same (if you extend this controller) or other controllers with the same model and view. With this implementation we have a separation of the model, view and the controller. As you can see now, it

is rather easy to plug-in a new View class resulting in a new UI for your web application.

Session object pattern

All the previous patterns are projections of existing pattern onto PHP. I mean, they are general (and mostly Object Oriented) patterns that are adapted to be used in PHP. The now following pattern is a new pattern that I would like to introduce. It is a solution that I have used very often in my history as a web programmer.

Name: Session Object

Problem: You are programming a web application that makes use of sessions and you want to remember the information about the session (throughout the session) in an organized and structured way. E.g. keep the shopping basket content available throughout the session in a web shop.

Context: Web applications with sessions. Session information has to be available throughout the session.

Solution & Consequences: Create a class definition that represents the information that needs to be available throughout the session. At the top of each PHP-page:

- Start or continue a session.
- Register a session variable(for holding the session object)
- Check if a session object exists, if not: create an instance of the class(defined earlier) and assign it to the session variable.

Now you can always access the session information in an organized way (via an object) and that object will be available during the whole session.

Normally objects do not live very long in PHP, because they only exist during the time of processing the PHP-page (mostly just a fraction of a second).

When you call a page, the objects are created and they are used for the processing of the page. After the result has been sent back to the user, all variables, including the objects, will be lost. With this pattern you register an object as a session variable. That means that, after the processing of the page, the object is stored in a text file together with the rest of the session information. At the time you that you load the session again(in another page request), the object will be loaded again and will be available in your application.

This is a stripped version of a Shopping Basket object that I used in web shops store the products chosen / selected by the user.

3.2.6 Problem and Pattern matching

In the beginning of this essay I stated some common problems. Afterwards I introduced a few PHP-patterns. In this section I want to make a matching of problems to a few important patterns.

Multiple presentations MVC pattern.

Navigation this is not a typically PHP problem, for navigational patterns.

Database operations Adaptor pattern (GoF) (convert the database interface to an easy to use interface by making use of an adaptor class) not discussed in this essay, but the Adaptor pattern is easy to project on PHP.

Authentication and sessions Session Object pattern.

These are some matching that I find very useful. This is not intended to be an exhausting list.

3.2.7 Conclusion

At first sight projecting known patterns to PHP looks quite easy. But if you take a closer look and try to implement such patterns in PHP you will probably figure out that there are some more problems to solve than you thought of in the beginning. That is why there are a lot of PHP patterns floating over the

internet with poor quality.

These problems are mainly due to the fact that PHP is not a real object oriented language and that the most patterns are object oriented. So we can conclude that patterns depend on language expressiveness. In the future it will be easier to map these (OO-) patterns to PHP because with the introduction of newer versions the OO support in PHP will become more mature.

It is important to know that patterns do not have to be object oriented.

3.3 Organizational Structure and Interfaces

Our development group is made up of seven members. Five of us are masters in IT department of Peninsula Technikon. We are in charge of developing *different modules of the Learning Management System*. Team members have been assigned a role according to their personal strengths. Currently acting as the Team's Project Manager is Mr. Bennett Alexander. His duties include organizing tasks, delegating parts to the team members who can best accommodate the workload, and holding Team members accountable for the work they promise to perform. Acting as Executive Secretary is Reneat. She is responsible for include taking notes in Peer review meetings, IT Department supervisor meetings, and developers meetings. These notes are posted to a website and individual member accessible can access the information, so that follow-up can be performed for any task delegated or discussed in previous meetings. We have made it a high priority to be on time with all project phases and thus the schedule arrangement by developers is crucial. My responsibility to analyze the time required for developing discussion forum model phase and outline an allotted time in which the development process must begin and end. In Peer review meetings, to measure progress and offer suggestions to further benefit the efficiency with which the developer performs. We also assimilate individual hours worked each week and present them to the Internal

Supervisor: Mr. Bennett Alexander. These hours are used to measure overall work performed on the project thus far. Each position is important in its own right. The developer is responsible for the overall look, feel, and readability of all chapters presented to our Internal Supervisor. The technical content supervisor, Mr. Bennett Alexander is responsible for the feasibility of all Project design structures and implementation schemes. Mr. Bennett Alexander is also responsible for implementing open source packages and linking them to each other in our testing environment. The follow table displays the roles of each phase.

Major Activities	AUTHOR	SUPERVISOR
Software System Proposal Of Discussion Forum	Zhanyu Wang	Mr. Bennett Alexander
Software Project Management Plan Of Discussion Forum	Zhanyu Wang	Mr. Bennett Alexander
Software Requirements Specification Of Discussion Forum	Zhanyu Wang	Mr. Bennett Alexander
Software Design of Discussion Forum	Zhanyu Wang	Mr. Bennett Alexander
Code	Zhanyu Wang	Mr. Bennett Alexander
System Test Chapter Of Discussion Forum	Zhanyu Wang	Mr. Bennett Alexander
System Test Report Of Discussion Forum	Zhanyu Wang	Mr. Bennett Alexander
Dissertation	Zhanyu Wang	Mr. Bennett Alexander

Table 3-1 Roles of major activities

3.4 Project Management and Control

This section describes in detail how the plan is kept current, how the project is managed, how progress is measured, how schedules are tracked, what specific methodology is used for software development, and how verification and validation is conducted. It also discusses the method the developer intends to use to deliver the system.

3.4.1 How the plan is kept current

If the need arises to update the Management Plan, or any other chapter, a change request is given to the developer. The developer makes the necessary changes, and appends information about the change to the end of the chapter.

3.4.2 How the Project is managed

All the members rely on daily communication to ensure that the project is being well-managed. At least once a week the internal supervisor keeps the developer up-to-date on current progress and upcoming deadlines. The Project Manager Delegates tasks to an appropriate developer based on the schedule, the developer is then held accountable for completing these tasks on time. Mr. Bennett Alexander currently assumes the ITMPT Project Management role and tasks are delegated to the appropriate members according to job title and emphasis strengths. As these tasks are completed, a peer review between group members occurs where suggestions and special details are given. When all tasks are completed, the chapter is synchronized for grammar usage and reading flow. Once the chapter is in its first draft form, it is presented to the internal supervisor and returned with further suggestions for revision. The developer resynchronizes the chapter after the revisions are completed and a second draft is presented. The department supervisor may return minor revisions and the chapter is presented to the users after these revisions have been addressed. A chapter is considered to be in the baseline

stage once it has been signed by the internal supervisor. Once a chapter has reached the baseline stage, the developer starts working on the next chapter.

3.4.3 How progress is measured

A critical aspect of the Software Project Management Plan concerns the completion of work products. Progress is measured as a function of parts completed for the deliverable in question. These elements are delegated by the internal supervisor and are reviewed, refined, and revised in-department meetings. The Project Schedule tracks where start and deadline dates have been suggested for each phases and is used to ensure developer completes tasks before they are to be delivered. The date on which a work product is deemed complete is termed a milestone. In order to determine whether a work product has indeed reached a milestone, it must first pass a series of reviews performed by Team members, the developers, and the internal supervisor. A typical milestone is the date on which the design is completed and passes review. Once a work product has been reviewed and agreed upon, it becomes a baseline and can be changed only through formal procedures. After the HOD of IT Department signs the chapters for baseline validation, the developer will moves into the next required stage of the process cycle.

3.4.4 How schedules are tracked

To ensure that deadlines are being met, the developer will keep schedules current and up to date by recording development's progress in each phase.

3.4.5 What specific methodology is used for software development

The following is a collection of techniques adopted throughout the complete life cycle:

Discover the customer's needs and desires.

Define flexible functions to accommodate these needs.

Propose these solutions to the customer through formal communication chapters and contracts.

Remain open for customer feedback, comments, and revisions.

Design the functions that fall within the scope of the application to be integrated inside LMS.

Present a testing version to be tested by the customer for functionality and approval.

Revise any components that need additional attention.

Present the finished product with all required documentation.

3.4.6 How verification and validation is conducted

Verification and validation occurs as a series of steps involving peer reviews, developers, and eventually an internal supervisor. Each phase may occur multiple times before the final version is created and all parties have come to a mutual agreement.

3.4.7 Verifying that the product designed conforms

Verification of project conformance to users' requirements is a high priority in users' reviews. Each need is reevaluated to assure that features and functionality of the system cover the users' requirements. Amendments to this Software Requirements Specification are made if any additional functions or features are needed, after which they are then agreed upon by the users and developer.

3.4.8 Validating the requirements satisfy the users need

The developer is responsible for holding the users accountable to suggest

whether these needs are covered or whether additional functions must be implemented to cover any special cases the users may have.

3.5 Delivery plan:

1. Deliver and install module on LMS.
2. Test module by itself.
3. Test module after integration with rest of system.
4. Have users verify that the module adheres to its requirements.
5. Go back to step #1 until the entire system has been integrated, tested, and accepted.

3.6 Project management objectives and priorities

Our goals are to learn as much as possible about the technology used in our project and about software engineering in general. In order to do this the developer works hard to plan ahead by scheduling meetings that is an effective use of Team members' time. The developer also practices and examines waterfall engineering methodology through development process.

Meetings are seen as a high priority. They are scheduled in the following manner:

Regularly scheduled meetings take place Saturday.

Online Teleconferencing meetings are scheduled as needed.

Phone bridge meetings are conducted at the onset of any new phases, and as needed thereafter.

Late night school meetings occur before the final draft of any phases is due

The developer meets with supervisor Mr. Bennett Alexander every Saturday between 9:00pm and 12:00am to learn about software engineering, and to be

briefed on details of the work we are doing.

The developer, once a week, goes over the progress to get tips on improving the phases.

The agenda for the meetings are set at the preceding meeting when possible, but time is always set aside to work on any new issues that may arise. The agenda is posted in the 'minutes' section.

The developer will keep track of the hours he spend on the project, then at the end of the week, hours are sent to supervisor Mr. Bennett Alexander.

3.7 Assumptions, dependencies, and constraints

It is assumed by the developer that the need for a developing a document of LMS really exists, and that because of this need, existing LMS will work in a cooperative effort to help the developer complete all aspects of the requirements of project on the progress and requirements of project. Additionally, the developer is assuming that MySQL is a viable option for a database. The developer also assumes that users at LMS use common web browsers, such as Netscape Navigator and Microsoft Internet Explorer. Also, that user at LMS has an existing email system that developer can use to send Simple Mail Transfer Protocol (SMTP) mail. Finally, the developer assumes the project is intended for a staff of 100 users or less.

The developer uses-open source code when deemed valuable to extend the functionality of the product. The developer is required to create original code and configuration parameters in order to make the system unique and to meet the customer's specific needs. It may require substantial time to learn and install these packages; there would be greater limitations to the complexity of the features included in the System. LMS utilize open source products whenever feasible and develop and integrate the product into their existing

systems.

It is also critical that the system not be dependent on a product where there could be problems integrating and using the software.

At the time of delivery, LMS will provide a server environment where the product and any other required software are installed.

The developer will provide detailed documentation of the project to show how database schemas can be easily created inside the delivered source code, and how each portion of the system is used. Once the developer completes the primary deliverables, we will also include documentation to describe how to extend the capabilities.

3.8 Risk management

Risk:	Solution:	Severity:
Loss of Member	Role Switching	Serious
Loss of Data/Work	Backup Plan	Minor
Sponsor not available	Continue the Project using current assumptions	Moderate
Deficiency in one or more of the other programs that we require	Seek an alternate software solution, if this fails, negotiate a change in the requirements with the Sponsor	Serious
Loss of Sponsor	Seek an alternative Sponsor that	Serious

	can use as much of the work that we have already done on a new Project	
Hardware failure	Set up a new box running Linux if we need to Moderate	Moderate
Missing requirements after the Software Requirements Specification has been baseline	Consult with the Supervisor and Sponsor, and update the Software Requirements Specification with a change form.	Moderate

Table 3-2 Risk management

The project takes extreme precautionary measures to ensure the safety of all data produced for the developer. Through the incorporation of an automated process, redundant versions of all files are created on three physically separated servers. A batch process has been created which has two jobs running off developer computer every night. The first job, which starts at 3:00AM nightly, authenticates automatically into the group's remote file transfer protocol (FTP), *ITMPT.homepage.com/staff*, and fully backs up all data to developer. At 4:00AM developer's computer synchronizes with the group's practice implementation environment Linux Sever computer so that this third machine becomes aware of any changes made to the *homepage.com/staff* directories. Through this method, three redundant fail-safe versions of data are created nightly.

3.9 Schedule control

Current progress of the task at hand is compared against the baseline for

particular task. As development progresses, the Team makes estimates about the time needed to finish the task. As the Team gets closer to the baseline, these estimates will govern the pace needed to meet the baseline. Once a task meets the baseline in the estimated time, the task is marked finished and development moves on to the next task. However, in the event the Team needs more time than the baseline, the rollover will affect the baselines for remaining tasks.

3.10 Issue resolution

One-on-one (personal) issues should be dealt with privately, if those problems cannot be solved, the problem is brought to the group's attention and the group works on solving it. Technical issues need to be agreed upon by the developer and the supervisor if necessary. The Project Manager holds one-on-one conferences with the members to discuss any issues that may come up, and to ensure that everyone is working to their best ability.

3.11 Technical process

This section defines the general technical issues of the project, and describes the tools and techniques that developer to develop the system. It specifies the development methodologies, programming languages, and identifies what tools and techniques are used to specify, design, build, test, integrate, chapter and deliver the project's work products.

Formal project chapters

All the formal project chapters are written in and managed using Microsoft Office 2000. Chapters with low complexity are written in Word. More complex chapters are written in Word, plus other Microsoft applications and are combined using Microsoft Binder. The Change Control features within Office 2000 are utilized to assist the group members in identifying and tracking changes. However, the security features are not utilized; passwords within

chapters are not set because the group members feel that this would not enhance productivity.

All group members are required to contribute to each formal chapter. This presents a problem with managing change control. If two group members download, modify, and upload a change to a chapter, there is a chance that one person's work may be lost. To minimize the chances of this occurring, each group member must follow this process.

1. Inform other group members using both email and ICQ that you intend on *working on a chapter*.
2. Download the largest revision number file.
3. Make changes
4. Make certain that someone else has not uploaded a larger numbered file
5. Upload changed file
6. Inform other group members, again, using email and ICQ that a new version has been posted.

Software package configuration files

Configuration files control the behaviour of the software modules. For example, the configuration file, which controls the Apache server, is named `httpd.conf`. It is managed with the Concurrent Versions System (CVS). The process that group members use with CVS is as follows:

1. Check out a local copy of the file. Either use the `cv`s checkout `<directory>` command from a LINUX workstation, or use the Windows WinCVS (<http://www.wincvs.org/>) to check it out.
2. Make the necessary changes to the local copy using an approved editor.

3. Before checking in the changes, run the cvs update to examine any changes have been committed by other Team members.

4. Commit the changes with the cvs commit command.

Web based help files

The Web based help files are written using Microsoft Word 2000. They are managed just like the formal chapters with respect to version control.

Web template files

The web template files are used to create a consistent look-and-feel to all the web pages and forms. The template files are treated similar to source code with respect to version control. They are edited with a text editor and managed with CVS.

The Inc and PHP driven scripts

As users access the system, they activate the PHP processing scripts, which are to be written in PHP. Additionally, there are some regularly public Class or Function files will created, which are also activated by PHP. These files are written in PHP as .inc scripts. Both the PHP scripts and the inc scripts are managed using CVS as described in the “Software Package” section above.

Tables

The tables are treated as though they are application configuration files and are managed similarly.

3.12 Software Documentation

The software documentation is kept in the same servers and directories as the

source code itself. It is managed using the same tools as the source code. In fact, the software documentation will become the code. The HTML template files contain comments, which are the software documentation. The Technical Chapter Manager provides several template files that include examples. The templates are specialized for specific types of tasks. For example template-facetemp.inc is a template for building interface based PHP programs. Another example would be: template-db.inc which is a connection to the MySQL database server. Included in the template are sections and examples for documentation, including .php and .inc. Each template contains instructions regarding how to re-name the template, check it into CVS, and how to make changes. The dates which the design was reviewed, who reviewed it, and when it was baseline approved appear within each file. Any changes beyond the baseline must also be reviewed and approved.

3.13 ACTIVITIES

This section outlines the tasks that need to be performed throughout the project, and how developer manages the budget and schedule of the project.

Activities and Tasks

The sequence of work activities to be performed over the life of the Project is identified below. Each phase contains a set of tasks that lead to the completion and approval of a baseline product for that phase.

Phase	Task	Deliverable
Conceptual study and literature review	Identify project Prepare project proposal	Software background and literature review chapter

Project Management Plan	Plan ,prepare Software Project Management Plan	Software Project Management Plan
Software Requirement Generation	Complete requirement analysis Prepare technical specification	Software Requirements Specification
Software Design	Prepare architectural design Prepare detailed design	Software Design Chapter
Implementation	Write Code Perform unit testing Perform integration testing	Code
System Testing	Prepare system tests Perform system testing	System Test Chapter, Results
Engineering Report	Write whole document for project	dissertation

Table 3-3 Tasks to be performed

3.14 Resource Requirements

The developers of project spends an average of 20 hours a week on the project making a total of 3200 man-hours by project completion time and also needs access to a high quality printer and paper to print the deliverables required throughout the Project. On the days the developers convene with our internal supervisor Mr. Bennett Alexander, meetings generate unseen costs incurred through Mr. Bennett Alexander. Potential miscellaneous unseen costs may also occur due to meeting room occupation and scheduling.

Chapter 4 Requirement

4.1 Discussion Forum

The Discussion Forum is a communication tool that can be used to enhance a

course site. It is designed for asynchronous use (users are not present at the same time to converse on-line). An additional advantage of the discussion board is that student conversations are logged and organized. Conversations are grouped into threads that contain a main posting and all related replies.

To design and implementation of a Discussion Forum object to function within the architectural constraints of an existing OSS learning management system with all the features below:

4.2 Definition

Admin Control Panel

The Admin Control Panel (AdminCP) is, as the title suggests, the area is for the administrator configures and sets up their board.

Only administrators have access to the AdminCP.

Administrator

An administrator is person with permissions to access the AdminCP where he/she can control the configuration and settings of their forums and users.

ASCII

American Standard Code for Information Interchange

Avatar

An avatar is a small image that users can include in their profile and will be displayed on every post they make.

There are two types of avatars, predefined and custom:

- **Predefined avatars** are images that the board administrator has made available to use.
- **Custom avatars** are images created by the user that are uploaded to the board.

BB Code

BB Codes, sometimes referred to as vB Codes, are used to replace the need for html tags when formatting text in posts.

Bulletin Board

A Bulletin Board is a software package designed to allow users to carry on conversations via the internet. Unlike chat software, the threads and messages are stored on the server and can be accessed by users until the board administrator deletes them, allowing the conversations to continue over long periods of time.

Category

A Category is a heading used to group forums that are similar in content or theme.

CGI Shebang

A CGI Shebang is the path to your PHP installation. If your server is running PHP as CGI you may be required to have this at the top of your website's php pages.

Cookie

A cookie is a file that is created and stored on a computer that contains information about a user or users' preferences when viewing certain web pages.

CSS

CSS is short for Cascading Style Sheets. These are a means of controlling the display qualities of a webpage. vBulletin makes extensive use of CSS.

Domain

A domain is a name leased to identify your website on the internet.

DST

Daylight Savings Time

FAQ

Frequently Asked Questions

Firewall

A firewall is an application running on a computer to prevent unwanted connections to be made to that computer. Firewalls protect both incoming and outgoing traffic on a computer.

FTP

FTP is short for File Transfer Protocol. This is a means of uploading files to your website.

Guest

A 'guest' is any visitor to your board who is not logged-in as a member.

This could be because they have not yet registered, or because they are a registered member who has logged out.

HTML

Hyper Text Markup Language. This is the language behind the World Wide Web. It defines how a page should look to visitors with a web browser.

HTTP

Hyper Text Transfer Protocol. This protocol defines how computers communicate with each other over the Internet when webpages are requested by a web browser.

IP Address

An IP Address is a 4 section string of numbers used by the internet to locate a website. It is much like a telephone number for your site.

An example would be IP Address 66.135.192.87 is for ebay.com

Localhost

localhost is the default host address of a computer on which a service is running.

localhost uses the reserved loopback IP address 127.0.0.1.

Member

A member is a registered user on your board.

Moderator

A Moderator is a user appointed by the Administrator who is put in charge of maintaining a forum or forums. The duties can include deleting offensive or inappropriate posts, pruning old threads and banning users from their particular forum(s).

MySQL

MySQL is a database management system that uses SQL. vBulletin uses this to store and retrieve all the data from your board.

PHP

PHP Hypertext Preprocessor

PHP is a script language and interpreter.

phpMyAdmin

Graphical User Interface (GUI) for MySQL available from <http://www.phpmyadmin.net>

Post

An individual message entered by a user, making up a part of a thread.

Prune

Prune is to delete a large number of posts and/or threads from your message board. This is often used as a step in maintaining a small database. To prune messages you would do so through the Admin Control Panel under the Threads / Posts heading or from the Forum Tools menu within a particular forum. This option only shows up if you have permission to use it.

Replacement Variable

Replacement Variables allow you to globally replace text with alternative text anywhere in your forum.

Server

A server is a computer that accepts connections from other computers for the purpose of exchanging information.

Spider

A spider is a program or script that systematically follows URLs on a page gathering information.

Typically search engines use spiders to gather information from web sites to increase their search index.

Example search engine spiders:

- Googlebot
- lycos
- ask jeeves
- scooter
- fast-webcrawler
- slurp@inktomi
- turnitinbot

SSH

SSH (Server Shell) is a secure server-side application that allows you to run command line functions on your website.

You will need to check with your hosting company to see if it is available with your hosting package

Sticky Thread

A sticky thread is a thread that always shows at the top of the threads listed in a forum.

Making a thread sticky is part of the Thread Tools that are available to Administrators and Moderators.

Telnet

Telnet is a server-side application that allows you to run command line functions on your website.

You will need to check with your hosting company to see if it is available with your hosting package.

Thread

A thread is a collection of posts usually with a common subject matter.

URL

Uniform Resource Locator. This is the address of a server and it allows computers to route traffic between each other on the Internet.

User

A User is a registered member of the Forum.

User Control Panel

The User Control Panel (UserCP) is the area of the forums where members can administer their own profile preferences, such as signatures, avatars.

Usergroup

A usergroup is a means of grouping users together, all of whom will have the same permissions.

WYSIWYG

Acronym for: **W**hat **Y**ou **S**ee **I**s **W**hat **Y**ou **G**et

XHTML

Extensible Hyper Text Markup Language. This is a language similar to HTML but with stricter rules. To find out more about XHTML please visit the [World Wide Web Consortium](#).

XSS

XSS stands for Cross Site Scripting. Cross Site Scripting is usually a sign of vulnerability in a software application or script. This allows information to be exchanged with one or more computers without verifying the factuality of that information.

4.3 Forum Features

4.3.1 General Features

- Scalable solution - database server and web servers can reside on separate machines.
- MySQL back-end database
- The forum can be run on any machine that can support PHP and MySQL (Solaris, BSD, Linux, Windows, Mac)
- Written in PHP which makes for a fast and efficient product
- Admin Control Panel
- Moderator Control Panel
- User Control Panel

4.3.2 General Forum Features

Threads

- Thread display options - sort by, sort order, from date
- Thread and forum subscription (notification by email optional)
- Thread preview on mouse-over (optional, via Admin CP)
- Active Users viewing thread shown
- New Post Indicator
- Printer Friendly versions on threads
- Admin tools for Threads - edit/delete/move/lock/Make sticky/ etc

- Email page to a friend option
- Similar Threads displayed on all thread views

Posts

- Linear, Threaded, Hybrid display views available
- Supports BB Code in posts
- Supports HTML in post
- Smilies
- Avatars
- Optional WYSIWYG or standard editors for posts and Private Messages
- Attachment images (.gif,.jpg, etc) are no longer in the database
(optional, via Admin CP)
- Quick reply box (with optional "forced" click on post to quote)
- Preview post option
- Post rating
- User reputation
- Polls
- Post Reporting - report posts to moderators
- User post count
- Admin tools for Posts - edit/delete/move/ etc
- Preview safe attachments

Members

- Member List
- Member Search
- User Style picker
- Private Messaging
- Buddy list
- Member Birthdays shown on Forum home

Calendar Features

- Supports multiple private and public calendars
- Viewable public and private events (adminCP option)
- Weekly, monthly and yearly views
- Jump to Today option
- Add single, ranged or recurring events
- Add all day events
- Option to show calendar event on forum home page (adminCP option)
- Show events to specific usergroups (adminCP option)
- Calendar Moderation
- Private events reminder
- Ability to add custom fields

General

- Who's online
- Search

4.3.3 User Control Panel Features

Editable user profile

This information can be viewed by other members from the member list. Custom user title, URL home page, date of birth, instant messaging medium, location, occupation, biography, interests, vB version, plus any other custom user fields that may be defined by the administrator

Profile pictures

Allows members to upload pictures that can be viewed in the users' profile.

Private Messaging

- Pop-up notification when new PM received
- Private Message Tracking
- Private Message filing in custom folders

User Options

These include Daylight Savings options, forum style chooser, selection of notification types for PM, emails etc, thread display options, WYSIWYG editor options, language chooser, vCard downloads to allow the user profile to be placed into an address book

Attachment Management

- View attachment statistics - shows limit and used space
- View the attachments you have posted (link or thumbnail views available)
- Remove attachments

Avatar Options

- Admin Defined Avatars
- Custom Avatars - upload from your own computer or specify a URL

General

- View and manage subscribed threads and forums
- Calendar event reminders for subscribed events
- Pop-up auto-refreshing buddy list with ICQ-style alerts when new buddies come online
- Signature Editor

- Email and password changes require current password
- Joinable Public User Groups

4.3.4 Admin Control Panel Features

Styling & Templates

- Template system
- Conditionals supported in the templates
- Ability to create multiple styles which can be applied to different forums and users
- Ability to upload / download styles and languages

Language & Phrase Management

- *Language manager* - allows you to easily translate you forums in any language
- *Multiple languages supported*
- *Phrase manager*

Users & User groups

- User registration options
- User banning (by name & IP)
- Global ignore user aka 'Tachy goes to Coventry' - when enabled all posts by the specified user will be ignored/unseen by other members. Automatically added to the all users ignore lists
- Unlimited Moderators and SuperModerators
- Permission system, based on user, user group or forums

Board Maintenance

- Task Scheduler

- Control Panel, Moderator & Task logs
- Board statistics
- Maintenance - Database backups, table repair
- Post Pruning

Moderation

- Moderation queues for user registration and posting
- Calendar moderation

Import Facility

- Import facility - import posts and members seamlessly upgrade from other bulletin board systems, including Infopop's Ultimate Bulletin Board, UBBThreads, OpenTopic, ezboard, and Ikonboard

Attachments

- Multiple attachments and types (types defined by admin in CP)
- Attachment thumbnails (requires PHP to have GD enabled)
- Storage type options for attachments (database or file system)
- Attachment moderation

General

- Multiple calendars supported
- Paid Subscriptions (PayPal, WorldPay, NOCHEX and Authorize.net)
- Private forums
- COPPA compliant
- Server Settings and Optimization options configurable via the adminCP
- Editable FAQ for your own boards
- Context sensitive help throughout the adminCP

Chapter 5 Project Design

5.1 Template based discussion system

The structure of online discussions is an important aspect involved with encouraging collaborative learning. It requires planning and management (Mason 1998, Laurillard 2002). To assist in this the following web-based online discussion model (Figure 1) is proposed.

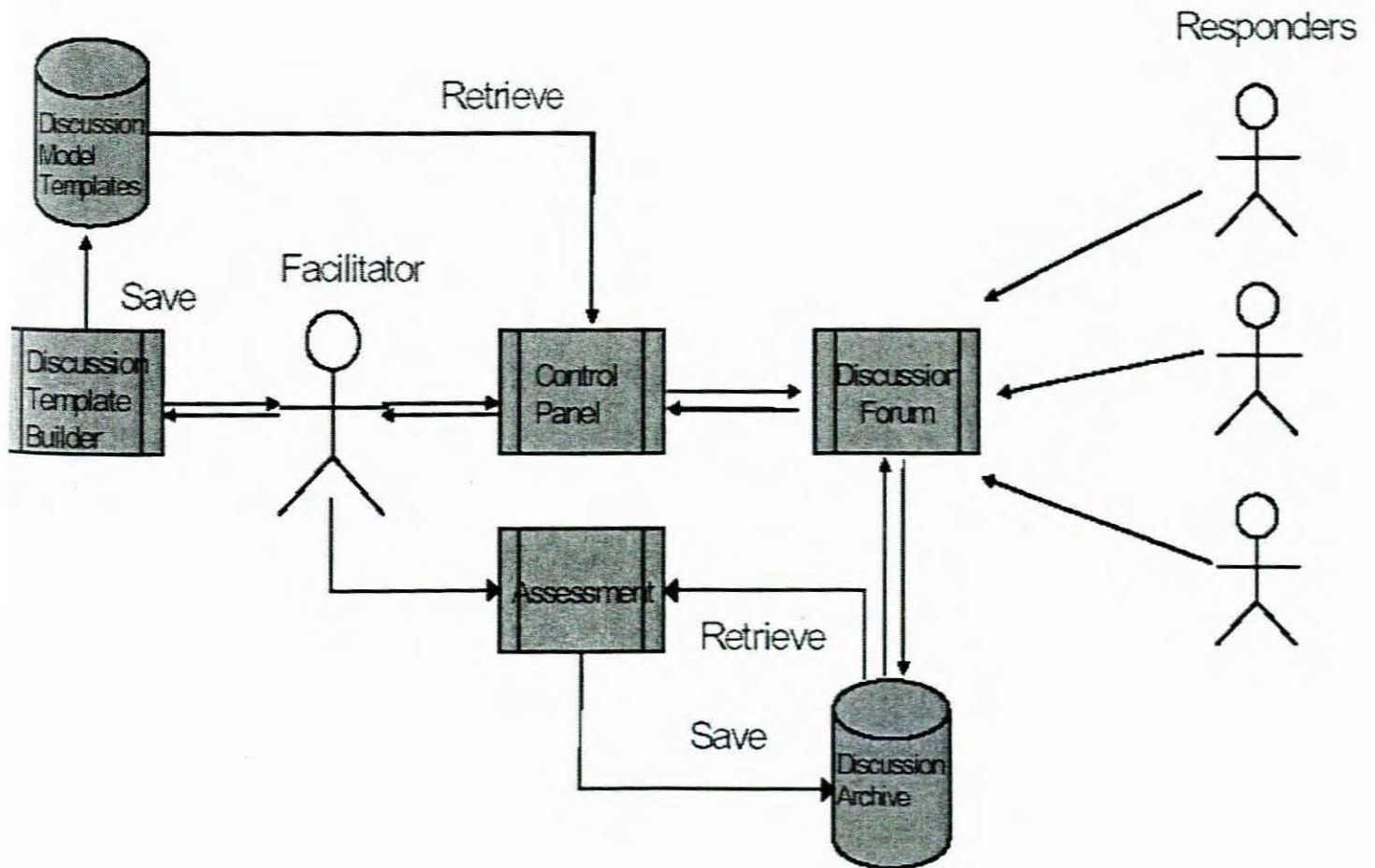


Figure 5-1 Proposed online discussion model

System: Actors & components

1. Facilitator: the instructor or moderator who controls the online discussion as controller.
2. Responders: students who responds to facilitator's question/task or other students' postings.
3. Discussion Template: discussion questions and stored settings from the control panel.
4. Control Panel: allows the facilitator to configure each discussion.
5. Discussion Forum: a password protected web interface where responders post their messages. On submission each message is automatically saved.

6. **Assessment:** allows the facilitator to access different responses and mark them.

5.2 Expected benefits

The proposed system should provide the following benefits -

5.2.1 Structured discussion objectives

In online discussions, the nature and structure of discussion questions is very important (Muilenburg & Berge 2002). The proposed model will help enforce this by providing a template-building environment for the facilitator. Rather than settle for questions that concentrate on recall, more creative examples can be built into the templates. These might include -

- Rating alternative information sources
- Evaluating a list of alternatives based on multiple criteria.
- Electronic Brainstorming for a specific question or issue. (Salter, 2002)
- Group outlining to generate or group ideas into a familiar hierarchical structure. (GroupSystems.com, 2002)
- Providing an annotated bibliography
- Voting and survey questions
- In particular, this will assist those teachers who are new to online discussions to set meaningful discussion questions that encourage evaluation and/or deep learning.

5.2.2 Students' interest and reusability of their work

Specific and well-structured discussions questions are more likely to hold students' interest especially when there is some assessment weighting

attached to it. Student work is not necessarily discarded when the semester is over. With permission, this work can be analyzed or built upon by students in future semesters. By supplying samples of good quality previous work the authors have noted anecdotally that the standard for subsequent semesters continues to increase. In other cases, students have analyzed the previous work in a new manner. For example, student ratings on an issue from a previous discussion can be collated and graphed.

5.2.3 Well managed discussions

Discussion management is a challenging aspect of online discussions, especially in an educational environment (Burford & Cooper, 2003). It is also a very time consuming job (Laurillard, 2002). For example, without a set ending date, discussions can be viewed as 'never-ending' and the purpose can be lost. Having set opening and closing times for a discussion helps avoid information overload and keeps students focused on the task (Salter, 2000). The proposed system allows the facilitator to have much more control over the management of the discussion.

5.2.4 Assessment

Assessment in discussion forums is gaining importance (Mochizuki, 2003). In educational environments, assessment is linked to learning outcomes which in turn are linked to learning activities (Burford & Cooper, 2003). The proposed system assists teachers if they want to include assessment weightings and provides a facility for marking. Rather than simply using a quantitative system for marking (eg. number of posts) a more qualitative approach can be taken. For example, students may have to submit a draft version for others to critique before producing a final version (Salter, 2000). Using the system both the final version and the critiques could easily be marked.

5.3 Architecture of the system

Understanding the architecture of Forum will help you get a grasp on the way that it works, and is easier than it may seem. The system can be broken down into four simple layers. The four layers are stacked on top of one another, and each layer is dependent on particular aspects of the layer below it.

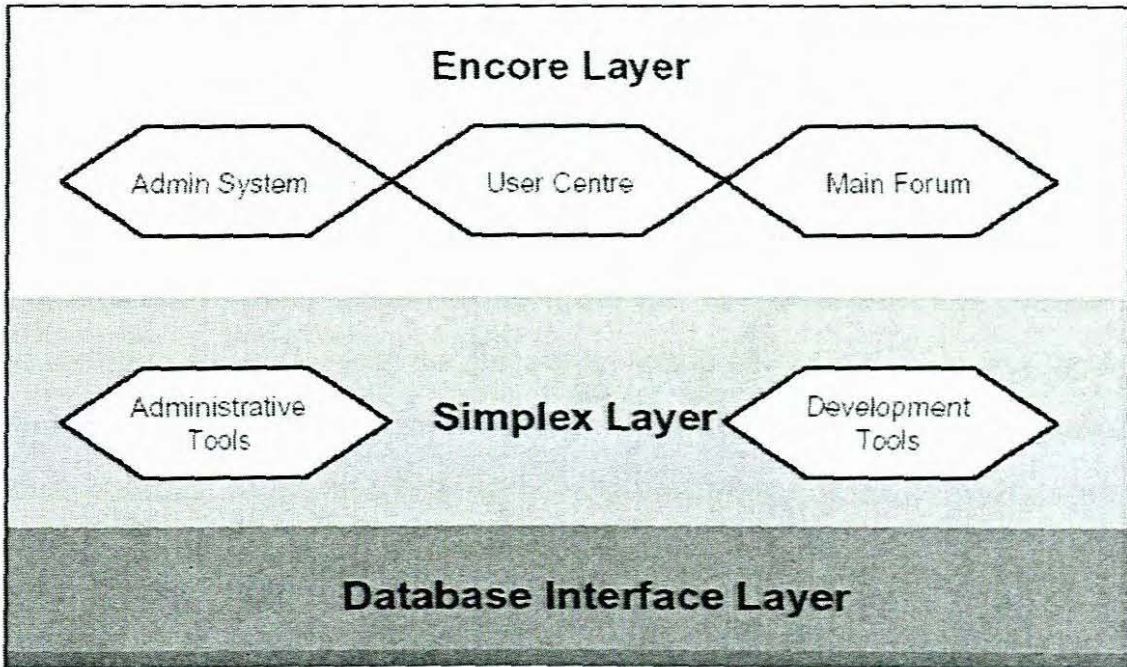


Figure 5-2 Architecture of the system

The bottommost layer is the database layer. This layer is the database that you are using, whether it is MySQL or SQL Server, Simplex's binary file database or another. The database is where all your forum messages, users and other data are stored. Sitting on top of this is an interface that allows programs to interact with the database. The details of this are fairly complicated, but suffice it to say that the next layer up, Simplex, needs this interface to communicate with your database.

Simplex is capable of adding, editing, deleting and extracting meaningful information from your database, and uses all that in conjunction with special

templates to create web pages for display. Simplex has its own administrative and development tools for creating entire applications based on these capabilities.

As such, we are led to the final layer, which is Encore layer. Encore is a set of files providing instructions to Simplex. These files include various settings, tables of data for the database, forms for interacting with the database and templates for Simplex to use when generating web pages to view.

Because of this close relationship, you will find that some tasks that you wish to perform must be done in the Encore layer and others in the Simplex layer. As a general, but not definitive rule, those in the Simplex layer tend to be lower level, database interaction type tasks, whereas those in the Encore layer are more forum organization and moderation tasks.

Simplex also gives you tremendous power to customize the system, giving you all the design and development tools that you need to modify the forum for your exact needs.

Encore consists of three major areas, which will be addressed in this section - the forum, user centre and admin system.

5.4 The forum

The forum area forms the bulk of the system, and is where discussion takes place.

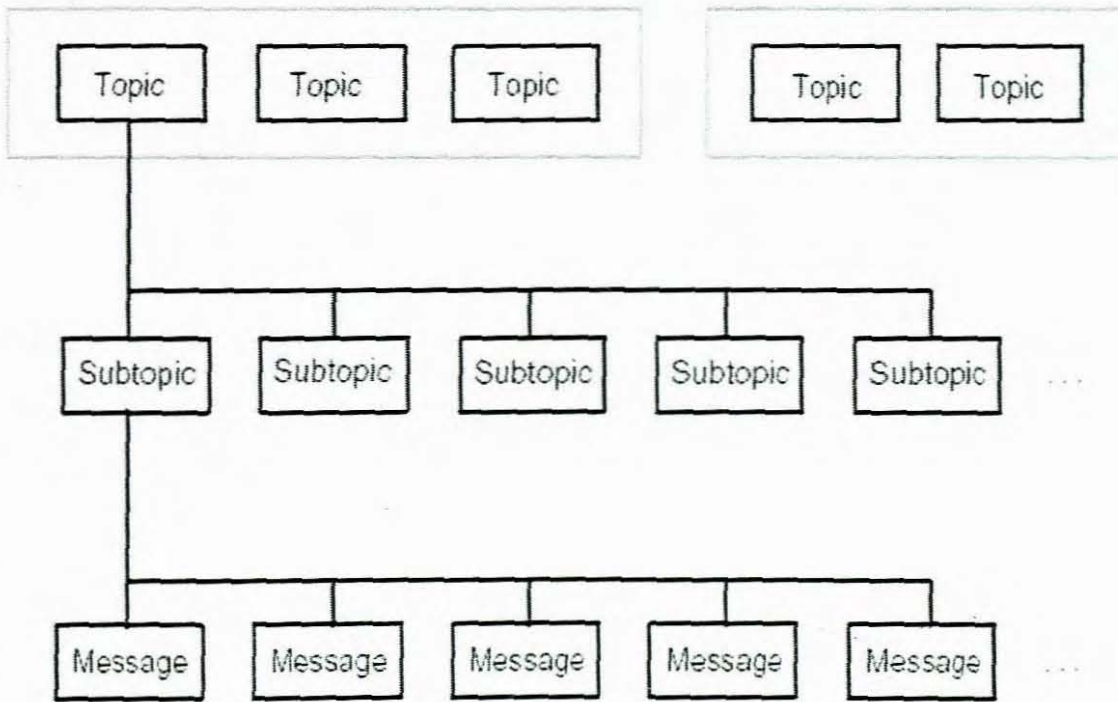


Figure 5-3 Message hierarchy

The opening page of the forum is the *Topic Index* page. This is usually the page that you will want to direct your users to. The topic index page lists a series of major subject areas for discussion, called *Topics*. Only administrators can create these topics. For organizational and display purposes, topics are grouped into *Categories*. A category may contain any number of topics, but each topic can belong to only one category.

Within each topic, users can post *Subtopics*. A topic can contain any number of subtopics, but each subtopic can belong to only one topic. Within each subtopic, users can post *Messages*, also called *Replies*. A subtopic can contain any number of messages, but each message can belong to only one subtopic. Subtopics are listed in their relevant topic ordered by the time at which the last message in them was posted, most recent first. Messages are listed in their subtopic ordered by the time at which they were posted, oldest

first.

When a user posts a reply to a subtopic, that subtopic moves back to the top of its topic page.

A member list, search page, rules page, help page and a few other features are also available through the forum area. These features are fairly self-explanatory, and are best learnt by exploration. If you do go exploring the forum area, you can hold your mouse cursor over any icon to see the function that it performs.

5.4.1 The user centre

The term *user* refers to any visitor to your forum who is reading or posting messages.

Registered users are those who have signed up for a user account in your forum. When registering, a user receives a unique username and a password for logging in. Each user has a *profile* and a *status*. A user's profile contains various snippets of information, such as their e-mail address, real name and location. The information here is usually entered by them, and can be changed by them. A user's status contains information that they are not usually able to edit themselves. This includes their number of posts, registration date, date of their last post and so on.

An *Unregistered user* is a visitor who is reading or posting messages, but who has not registered their own user account. Generally, these users have access to fewer features than registered users. They cannot participate in chats or

vote in polls, for example.

You may choose to make registration compulsory for a user to be able to read or post to the forum. You may also choose to disable registered users and stick to unregistered users if you wish. A spectrum of possibilities is available in between.

When a registered user logs in, their information is saved in a *cookie* in their browser. A cookie is a small snippet of information about them, in this case containing some login information. The cookie will automatically log them in to password protected areas, as long as it remains intact. If it is removed for any reason, the user will need to log in again, creating a new cookie for them.

Some users are also given moderation privileges. These privileges may allow them to do such things as edit messages on the board, modify the profiles of other users or even ban a user from accessing the forum. Such users are generally called *moderators*, and there will generally be only a few on a forum, perhaps just you. The task of moderators is to keep the forum in order, keep discussion on topic and make sure that no one is being mistreated.

The *user centre* is where registered users can visit to update their profile, send private messages to other users and make use of the many other features available. Moderators can also access their specially assigned areas through this section. When accessing this area, a user will be asked to log in if their details are not already saved to a cookie.

The first page of the user centre will be a menu listing all areas available. Only those areas that the user has permission to access are displayed. These may include mailing list newsletter subscriptions, subtopic subscriptions, the user's profile and private messaging. If the user is a moderator, they may include IP banning pages, message reports, pre-moderation pages and access to the forum's built-in mailing list.

5.4.2 The admin system

The *admin system*, called a *file interface* in Simplex jargon, is where you can set up and configure your forum and its various features. Only administrators can access this area, but they usually have full access to all of its features. The features available through the *admin system* are more permanent features that need only be accessed occasionally. For example, while the user centre is accessed for the purpose of completing regular tasks, the admin system is accessed for tasks more along the lines of adding and editing topics, rearranging user groups, performing maintenance tasks and changing your forum's colors and style – all things that tend to be set up once and only reviewed occasionally.

If your login details are not saved to a cookie, you will be asked to log in when trying to access this page. You should log in using your own

Finally, some administrative tasks that you may wish to perform are actually part of the Simplex admin system rather than the Encore system. These include such tasks as specifying acceptable HTML tags in posts, viewing log files and statistics, changing the date and time formats and specifying acceptable extensions and file sizes for attachments. All such tasks can be completed through the *File settings* and *Log manager* pages of the Simplex

admin system. Note that before accessing these pages, you will need to open your Encore file - named "Forum" by default.

5.5 Features

This section is meant to give a very brief introduction to some of the major features of Forum, and how they are used. It is not meant to be exhaustive, but rather to guide you as you familiarize yourself with the system.

5.5.1 Discussions, advertisements, polls and chat

When a user posts a subtopic, they must choose of which type that subtopic should be. User group and topic permissions govern which types a user is able to post.

Discussions are the standard subtopic type, and will presumably form the bulk of your forum.

When posting a discussion subtopic, an initial message is posted to begin discussion. Users can then post further replies to this initial message. Most users would be familiar with these as the standard of all message boards across the web.

Advertisements are a subtopic similar to a classified ad that you may see in a newspaper.

When posting an advertisement, an initial message is posted, as with a discussion, but a user may also attach a graphic to accompany their advertisement. Advertisement subtopics begin *locked*, meaning that other

users cannot post replies to them. It is, however, possible for a moderator to unlock such a subtopic to open it up for discussion.

Poll subtopics are similar to the discussion variety, but come with an extra user poll accompanied by voting form and graph of results. When posting such a subtopic, an initial message is posted, along with a question and up to twelve multiple-choice responses to make up the poll. Other users can then vote in the poll for their chosen option, as well as post replies to the initial message.

Chat subtopics are designed for real time conversation rather than the post-response model of the other subtopic types. A chat subtopic is posted with a simple introductory text to the subject of conversation. The subtopic then has its very own chat room in which users can discuss together. It is also possible to post replies to the subtopic, although no initial message is posted and the emphasis is on the real-time chat rather than the message replies. The reply system could be used to post useful excerpts from a conversation in the chat room, for example.

5.5.2 Mailing list

The *mailing list* allows you to communicate in bulk, by e-mail, to all users of your forum. The mailing list is arranged into *newsletters*. Each newsletter represents a regularly distributed news bulletin, forum update, topical article or any other sort of message that you may wish to send. Users are able to *subscribe* and *unsubscribe* from each of these newsletters through their user centre.

Users belonging to groups with appropriate permissions (by default, the

Administrator group only) can choose to send off a mailing list message at any time. Three types of mailing list message exist. An issue is a regular, usually planned, edition of one of your newsletters. It is sent only to those users who have subscribed to the relevant newsletter. An announcement is a message sent to all subscribers of a particular newsletter, but usually regards a one-off administrative matter rather than a planned, topical edition of the newsletter. A broadcast is sent to all members of the forum, regardless of how many or which newsletters they are subscribed to.

To receive e-mail from the mailing list, a user obviously needs to have a valid e-mail address entered into their profile. A user can also order back issues of any newsletter through the newsletters page of their user centre. These back issues are sent automatically and immediately. Back issues of announcements and broadcasts are not available.

5.5.3 Moderation

Once you have your forum up and running, the most common administrative task that you will need to perform is moderating messages and users. Moderation involves such tasks as editing messages with inappropriate content, moving messages to more appropriate topic areas, splitting off discussions to form new subtopics, banning users or deleting messages in extreme cases, and dealing with any incidents on the board that may require some authoritative intervention.

Also, when making a post you may notice that your posting form is larger and contains more options than that of standard users. Users belonging to groups with moderation privileges are able to use special icons, leave public and private notes on posts and moderate subtopics as they post to them. For example, when posting a reply to a subtopic, you could move it to another topic

at the same time. This is designed for convenience, and to let you achieve multiple tasks in one hit. It also allows you, for example, to lock a subtopic while posting a final reply explaining why it was locked.

When moderating subtopics, there are a few terms that you will want to become familiar with.

First, locking a subtopic will prevent users from posting any further messages in it. Similarly, closing a chat or poll will prevent users from chatting or voting in it, respectively. The terms lock and close are often used interchangeably, as they effectively have the same meaning in this context.

Condemning a subtopic will not prevent users from posting in it, but unlike a regular subtopic, new posts will not bring it back to the top of its topic. This sort of action is usually reserved for argumentative, disruptive or offensive posts. In addition, condemned subtopics are displayed with a special damaged or burnt icon, and are faded in their topic's list as if partially removed.

They will also not come up in search results. While discussion can continue in them, they should soon be out of the way of users interested in more fruitful discussion - as new posts in other subtopics will bring their listing above that of the condemned subtopic. In more serious cases, it is possible to both lock and condemn a subtopic, or even delete it entirely.

Making a subtopic persistent is on a more positive note. Persistent subtopics are displayed at the very top of their topic list, regardless of the time at which

their last post was made. They are also highlighted so as to attract a little more attention. Persistent subtopics are perfect for displaying announcements, or for creating a permanent chat room in each topic.

5.5.4 Message reports and pre-moderation

Two other useful tools are in your moderator arsenal. Users can assist you in moderation by reporting inappropriate or offensive messages, and you may also choose to view and approve all new posts before they are actually displayed publicly on the forum.

Message reports are a quick and anonymous way for users to pass pointers on to moderators. If enabled, all messages are accompanied by a message report icon. Clicking this icon will bring up a brief form for a user to fill in. The form only asks for a few general classification type details and a brief comment. Moderators with message moderation permissions can deal with outstanding message reports by following the appropriate link in their user centre. All message reports from users are recorded anonymously.

Pre-moderation of posts can be activated for all posts in a specific topic, or for all posts made by users of a specific user group. If a user posts a subtopic or message while under premeditation, their post will not immediately be displayed in the forum. Instead, it will join a queue of posts awaiting approval by moderators. These posts can be reviewed, approved and rejected by a moderator by following the appropriate link in their user centre.

5.5.5 Troublesome users

IP banning is available for assisting in banning troublesome users from accessing or posting to the forum. It is also possible to lock or delete individual

user accounts if you wish. IP banning can be made by individual IP addresses or by giving IP address patterns to block a large number of addresses.

IP banning is a fairly technical and in depth subject that is not addressed here.

5.5.6 Maintaining the forum

Another important part of running the forum is maintenance. Maintenance is usually in regard to validating post counts that may be a little out of whack, cleaning out broken database records and removing old messages from the forum to free up resources.

These sorts of activities are best run regularly, but not necessarily often, as they can be quite server intensive. *Running them every few weeks or months is perhaps quite sufficient, unless you notice problems that may be a little more urgent*

5.5.7 Subtopic subscriptions

Subtopic subscriptions allow a user to receive notification through their e-mail address when a new message is posted in reply to a subtopic. A user may subscribe to a subtopic in one of two ways. The first is to check the relevant box when posting in it, which asks whether the user would like to subscribe or not. The second is to click the subscribe link at the bottom of any subtopic page.

A user may manage their subtopic subscriptions through the Subtopic subscriptions page in their User Centre. *This page allows them to both visit and unsubscribe from any currently subscribed subtopics. Note that in order to receive any e-mail notification messages, a user must also have checked the*

option in their user profile to allow the sending of such e-mails.

When a user is sent an e-mail notification message for a subtopic, they are immediately unsubscribed from it. This ensures that they are not flooded with e-mails if many posts are made to a subtopic. They may resubscribe either by posting again, using the subscription link at the bottom of a subtopic page, or clicking the link provided in their e-mail notification message.

5.5.8 Linear and threaded views

The most popular discussion formats are the linear and threaded formats. It more naturally supports the linear format, but a threaded alternative is provided.

The linear format presents all messages in a subtopic one after the other, in chronological order. If a user posts a message, that message appears at the end of the list. The threaded, or tree format, presents messages in what looks like a directory structure. Users reply to individual posts, with their messages branching out underneath the message to which they replied, rather than being added to the end of the list. When reading in threaded view, only one message can be viewed at a time, whereas in linear view, messages will be divided into pages of around twenty, depending on your settings, and users can view one page at a time, rather like the results from a search engine.

Different users prefer the different formats, when clicking the title of a subtopic to view its messages, the linear format is used. A user may click the small tree icon nearby, however, to view the subtopic in threaded format.

On any subtopic page, there is also a link at the bottom of the page to obtain

the threaded view.

A note on how the linear and threaded views co-exist would not go astray. When in the linear view, clicking the Post reply link at the top or bottom of the page will mean that the post to be made is considered to be a reply to the original post in the subtopic. For the sake of the threaded view, this means that the post will come under the first post in the tree. Still when in linear view, clicking the Quote icon next to any message in order to post a reply will result in the reply coming under that message in the threaded view. When viewing in threaded mode, choosing to reply will result in your message coming under the post that you were viewing at the time you clicked the reply link. If you were not viewing any message at the time, it will be considered to have been made in response to the original message in the subtopic.

5.5.9 Searching

Searching features will be provided at three levels. Users may search through the posts of a single subtopic, a whole topic area, or the entire forum. Links are provided for searching topics and subtopics at the bottom of any of their pages. The link on the main menu bar at the top of the forum can be used for searching the entire forum.

5.5.10 Subtopic ratings

Subtopic ratings allow users to rate any subtopics that they have read for the benefit of other users. Users may rate a subtopic simply as "positive" or "negative", with links provided for this at the bottom of the subtopic's page.

Once at least three votes have been received for a subtopic, its rating will begin being displayed with its topic listing. The rating is given as a number of

ticks out of three. Zero ticks indicates that less than one sixth of votes have been positive, one tick that less than half have been positive, two that more than half have been positive and three that more than five sixths have been positive.

5.5.11 Member list

The member list is accessible through the link on the main navigation bar at the top of all forum pages. It lists all users who have chosen to be listed there, with three different sorting orders provided - alphabetical, number of posts and registration date. Contact and other details of each user are available if the user has made them so, and a link is available to the user's profile page for even more information.

5.5.12 View new posts

Many options are provided throughout the forum to "view new posts" or "view unread posts".

The two are different terms for the same feature. Such an option is provided for the forum as a whole, individual topics and individual subtopics, in a similar way to searching. Links are provided at the bottom of the topic index, topic and subtopic pages. Subtopic listings also provide a link, as does the welcome message to registered users when they visit the forum home page.

A post is considered new to the user if it has been posted since the user's last visit to the forum. The time used is that stored in the user's cookie. As such, a user must have cookies enabled in order to make use of this feature.

5.5.13 Form mailer

All users' e-mail addresses are hidden from public view. This stops the harvesting of member addresses for bulk e-mail campaigns or other arguably unethical behavior. However, users can still e-mail other users by using the form mailer provided. This method hides the e-mail address of the recipient from the sender, but reveals the e-mail address of the sender to the recipient, assuming that they have one entered in their profile.

The form mailer is only accessible by clicking the e-mail link on a user's member listing, profile page or one of their posts. A user may also choose not to have such a link displayed.

5.5.14 Tell a friend

The tell-a-friend feature allows users to invite their friends to join in discussions on the forum and send those links to posts that they may be interested in. The friend will receive an e-mail with a link to the page where the tell-a-friend link was clicked. You can customize the e-mail message yourself through the *Encore admin* system. While the inviting user can set the subject of the message themselves, they cannot customize the body of the message. The idea of this is to stop the tell-a-friend form from being used for commercial solicitations or spam.

5.5.15 private messaging

Private messaging is an alternative to e-mail if members wish to have any private contact. It is accessible through the User Centre. Users should find it very similar to their usual e-mail account, with an inbox and outbox, marking of unread messages, flagging of messages, forwarding, replying and other such things. Messages are addressed by forum username rather than any sort of

e-mail or private messaging address.

With the correct option enabled in their profile, users can also receive e-mail notification when they receive new private messages, in a similar way to subtopic subscriptions.

5.5.16 Rich message options

This option provides a range of rich text options for messages, including smiley faces, subtopic icons, a crude language filter, HTML formatting and automatic URL and e-mail hyperlinking. Note that it does not have any sort of "BB" code as other systems have. Proper handling of HTML has been implemented instead so as to provide formatting via a common language that many users will already be familiar with.

All rich text handling options are actually handled through Simplex rather than Encore. Simply log into your Simplex admin system, open the Forum file and access the File settings page.

This page contains a myriad of options, the rich text features included. The rich text features are towards the bottom of the page.

Some features, such as the crude language filter, smiley faces and subtopic icons, can also be managed through the Forum Settings page of the Encore admin system.

5.5.17 Printer friendly pages

All subtopic pages can be viewed in a format that is simpler and more

appropriate for printing.

5.5.18 File attachments

A single file may be uploaded and attached to a message when a user is posting. A field is provided for this on the posting form. For security reasons, it is possible to limit the allowable extensions and sizes of uploaded files. These security settings are available through the File settings page of the Forum file in the Simplex admin system.

5.6 System features and functionality

Feature	Purpose	User	Process	Outcome
Administrator Authentication	To verify an administrator's username and password Required Fields: 1. Username 2. Password	Administrator	1. Display a login page 2. Verify username and password submitted by administrator against the database	Re-display login page (requesting user to re-login) or list administrator
Feature Selection	To allow administrator to select a feature: 1. create/edit/delete a forum 2. delete forum messages 3. add/edit/delete a moderator 4. add/edit/delete an administrator 5. manage restricted word list	Administrator	1. Display a menu with feature options	Access the web page performing the selected feature
Create a New Discussion Forum	To create a new discussion forum Required Fields: 1. discussion forum name Note: more than one forum can have the same name	Administrator	1. Provide a form for administrator to enter data 2. Validate that all required fields have been entered 3. Enter new forum information into database	Display a success page
Edit Forum Properties	To change the appearance of forum and to add or delete a forum password Forum Properties: 1. Forum Name 2. Default Sort	Administrator	1. Provide a form for administrator to select a forum to edit 2. Provide a form for administrator to change forum properties 3. Change forum properties in database	Display a success page

	<p>3. Password</p> <p>4. Background Color</p> <p>5. Font Color</p> <p>6. Font Type</p> <p>7. Banner Background Color</p> <p>8. Banner Font Color</p> <p>Note: All forum properties are required except for password</p>			
Delete forum Messages	To delete forum messages	Administrator	<ol style="list-style-type: none"> 1. Provide a form for administrator to select a forum to delete messages from 2. Provide a form for administrator to select one or more messages to delete 3. Display a page to verify deletion of forum messages 4. Delete messages from database 	Display a success page
Delete a Discussion Forum	To delete a discussion forum Note: An administrator view cannot sort messages intended for deletion by subject, author, date or thread. Messages are automatically sorted by date. The sort feature will be added in a future implementation of Discussion Forum Management System.	Administrator	<ol style="list-style-type: none"> 1. Provide a form for administrator to select one or more forums to delete 2. Display a page to verify deletion of forums selected by user 3. Delete forum, forum messages, and forum moderators from database (moderators will not be deleted the database but their ability to moderate the deleted forum will be deleted from database) 	Display a success page
Add a moderator	To add a moderator to the Discussion Forum Management System Required Fields: <ol style="list-style-type: none"> 1. First Name 2. Last Name 3. Email 4. Username 5. Password 	Administrator	<ol style="list-style-type: none"> 1. Provide a form for administrator to enter new moderator information and to select forums that the moderator is responsible for moderating 2. If requested username is already in the database, continue to display duplicate username error page until administrator enters a username that is not already in database. 3. Enter new moderator information into database 	Display a success page
Edit a Moderator	To edit a moderator's information Required Fields:	Administrator	<ol style="list-style-type: none"> 1. Provide a form for administrator to select a moderator to edit 2. Provide a form for administrator to 	Display a success page

	<ol style="list-style-type: none"> 1. First Name 2. Last Name 3. Email 4. Username 5. Password 		<p>edit moderator information</p> <ol style="list-style-type: none"> 3. If administrator changes username and the new username is already in the database, continue to display duplicate username error page until administrator enters a username that is not already in database. 4. Change moderator information in the database 	
Delete a Moderator	To delete a moderator from the database	Administrator	<ol style="list-style-type: none"> 1. Provide a form for administrator to select a moderator to delete 2. Display a page to verify deletion of moderator 3. Delete moderator from database 	Display a success page
Manage Restricted Words List	<p>To add or delete words from the restricted word list</p> <p>Note: Words in message subjects, bodies and authors containing a word added to the restricted word list will be replaced with "XXX"</p>		<ol style="list-style-type: none"> 1. Provide a form for administrator to select words to delete from restricted words list and to add at least three words to the restricted words list 2. Delete words from restricted words list in database 3. Add words to restricted words list in database 4. Replace new restricted word(s) found in any message subjects, authors, or bodies with "XXX" 	Display a success page
Add an Administrator	<p>To add a administrator to the Discussion Forum Management System</p> <p>Required Fields:</p> <ol style="list-style-type: none"> 1. First Name 2. Last Name 3. Email 4. Username 5. Password 	Administrator	<ol style="list-style-type: none"> 1. Provide a form for administrator to enter new administrator information 2. If requested username is already in the database, continue to display duplicate username error page until administrator enters a username that is not already in database. 3. Enter new administrator information into database 	Display a success page
Edit an Administrator	<p>To edit an administrator's information</p> <p>Required Fields:</p> <ol style="list-style-type: none"> 1. First Name 2. Last Name 3. Email 4. Username 5. Password 	Administrator	<ol style="list-style-type: none"> 1. Provide a form for administrator to select an administrator to edit 2. Provide a form for administrator to edit an administrator's information 3. If administrator changes username and the new username is already in the database, continue to display duplicate username error page until administrator enters a username that is 	Display a success page

			not already in database. 4. Change administrator information in the database	
Delete an Administrator	To delete a moderator from the database	Administrator	1. Provide a form for administrator to select an administrator to delete 2. Display a page to verify deletion of administrator 3. Delete administrator from database	Display a success page
Moderator Authentication	To verify a moderator's username and password Required Fields: 1. Username 2. Password	Administrator	1. Display a login page 2. Verify username and password submitted by moderator against the database	Re-display login page (requesting user to re-login) or list moderator features
Enter Moderator Forums	To view moderator forums	Administrator	1. Provide a list of forums that the moderator moderates 2. Display message view of messages in forum (see Message Forum View feature below)	Display Forum Message View of select forum
Enter All Forums	To view all forums	Moderator	SEE FORUM SELECTION BELOW	
Delete Forum Messages	To delete forum messages using different sorts Sort types: 1. Sort by Date 2. Sort by Author 3. Sort by Subject 4. Sort by Thread	Moderator	1. Provide a form for moderator to select a forum to delete messages from 2. Provide a form for moderator to select one or more messages to delete using different sort views 3. Delete messages from database	Display a success page
Edit Forum Properties	To change the appearance of forum and to add or delete a forum password Forum Properties: 1. Default Sort 2. Password 3. Background Color 4. Font Color 5. Font Type 6. Banner Background Color 7. Banner Font Color	Moderator	1. Provide a form for moderator to select a forum to edit 2. Provide a form for moderator to change forum properties 3. Change forum properties in database	Display a success page

	Note: Only the Administrator can change the forum name. All fields are required except for password			
Update Moderator Personal Information	Allow authenticated user to change his or her personal information. Required Fields: 1. First Name 2. Last Name 3. Email Note: Only the administrator can change the moderator's username and password	Moderator	1. Provide a form for moderator to edit his or her information 2. Change moderator information in the database	Display a success page
Forum Selection / Authentication	Allow user to select a forum to read and post messages	Administrator, Moderator, Forum User	1. Provide a list of forums that the user can choose to enter 2. If forum is password protected, provide a form for user to enter forum password 3. Verify password submitted against the database 4. Go to Forum Message View	Re-display login page (requesting user to re-login) or go to Forum Message View for select forum (sorted by default sort)
Forum Message View	To view forum messages by thread, date, subject, or author on forum message view page	Administrator, Moderator, Forum User	1. Display all messages in forum select by user sorted by the default sort. Provide links for user to select a different sort view.	Display page according to sort selected
Post Message	To allow forum user to post a new message to the forum Required Fields: 1. Author 2. Subject 3. Message Body	Administrator, Moderator, Forum User	1. Display a page with a form to enter a new message 2. Validate that all required fields have been entered (The date field will be automatically generated) 3. Validate that all words in the authors, subject, and message body are not on the restricted words list 4. If message author, subject or body contains a word on the restricted word list, replace word with XXX 5. Add message to database	Display "Thank You" page with options to post another message or return to forum message view page
Post Reply	To allow forum user to post a reply to a message in the forum Required Fields: 1. Author	Administrator, Moderator, Forum User	1. Display a page with a form to enter a reply to message 2. Validate that all required fields have been entered (The date field will be automatically generated)	Display Thank You page with options to post another message or

	<p>2. Subject</p> <p>3. Message Body</p>	<p>3. Validate that all words in the authors, subject, and message body are not on the restricted words list</p> <p>4. If message author, subject or body contains a word on the restricted word list, replace word with XXX</p> <p>5. Add message to database</p>	<p>return to forum message view page</p>
--	--	--	--

Table 5-1 System features and functionality

Chapter 6 Case Study

6.1 Introduction

The Discussion Forum is a communication tool that can be used to enhance a course site. It is designed for asynchronous use (users are not present at the same time to converse on-line). An additional advantage of the discussion board is that student conversations are logged and organized. Conversations are grouped into threads that contain a main posting and all related replies.

Discussion is a very important factor for success in education and to cultivate this habit. The discussion forum talks on various issues and is managed by students themselves. The discussion forum also serves as a useful resource generator since students may raise queries regarding educational subjects and students or their instructors may again answer these. In simple words the discussion forums acts like a FAQ on various issues of interest. Since these discussion forums are split into sections and subjects, it is easy for someone to locate something that interests them. Once a student replies to a particular message on a discussion forum, all registered users of that forum are intimated through the web mail facility, thus keeping the discussion active and interesting for all involved.

6.1.1 What is KEWL

The Knowledge Environment for Web-based Learning (KEWL) was developed at the University of the Western Cape to facilitate research into online learning by Derek Keats and a team of developers. We wanted to have a comprehensive learning management tool that we could modify and use to investigate the online learning process. Although it was initiated and funded as a research

project, it soon became apparent that KEWL could serve the online learning needs of the University of the Western Cape. A number of courses at UWC are now run either fully online using KEWL, or use KEWL to supplement traditional teaching-and-learning. KEWL is used for marks administration by all courses at UWC, irrespective of whether they are online or not. Aside from UWC itself, KEWL is already in use by the NetTel@Africa project, a consortium of eight universities in Africa and four in the USA that are offering an online masters in ICT policy and regulation (<http://www.nettelafrica.org>; <http://elearn.nettelafrica.org>). It is also the basis for the International Ocean Institute Virtual University, an incipient global programme in Ocean Policy, Law of the Sea and Coastal Management (<http://www.ioivu.org>). Experimental KEWL installations have been done in Ghana, Nigeria, Kenya, Tanzania, Turkey, China Canada and the UK (AVOIR Concept Proposal - Keates UWC)

The KEWL.NextGen application framework is based on a close approximation of the model, view, controller (MVC) design pattern, which separates an application's data model, user interface and control logic into three separate components. This enables changes to be made to one component without impacting on the others. Since the model is usually stable, separating it from the view and controller logic that a changed often during development leads to more robust applications that are easier to maintain.

In the case of KEWL.NextGen, the model represents the data as the main application object that is manipulated. The framework provides a data connection base class that can be extended by table-specific module classes to act as the code for manipulation of the model (data). The data model class for a module resides in the `/modules/modulename/classes/` folder, and as a naming convention should be called `dbTablename_class_inc.php`, where

Tablename is the name of the table to which it connects. There will often be more than one model class used to support a module, and one model class may connect to more than one table via SQL joins and unions.

The constructor for the data connection class, and any other classes that extend the framework, is a method that must always be called `init()`. This method executes any code that is required to be executed during construction, such as creating instances of commonly required objects. Below is an example of the `init` constructor from the `helloworld` example application:

```
24: function init()
25: {
26:     $this->objUser =& $this->getObject('user', 'security');
27:     $this->objHelp=& $this->getObject('helplink','help');
28: }
```

It instantiates the `user` class and the `help` class that will be used in the module.

The controller consists of at least one file, `controller.php`, that extends the controller base class. The controller resides in `/modules/modulename/` and must be called `controller.php`. The class defined in the controller main file must be the same as the name of the module. For example, a module named `blog` will have a `controller.php` file that contains the following code:

```
class blog extends controller
{

}
```


The controller may make use of additional classes that make up the module, and assist the controller in doing its work.

Before delving deeper into the MVC architecture, it is necessary to discuss the *modular framework structure of KEWL.NextGen*. This is just an overview, we will return to this in the chapter on building modules with the KEWL.NextGen application framework. The MVC architecture is implemented in the framework using the "front-controller" web application style. This means that every URI that references the application is processed by a single front script, which then dispatches the code to the appropriate module code depending on the URI path/parameters. The benefit here is that all requests go through a single point, allowing global modifications to behaviour and output. Thus, a typical URI for a KEWL.NextGen application will have the form:

`http://localhost/index.php?module=_default` or

`http://localhost/index.php?module=blog`, etc.

The only file ever called directly is `index.php`, which has passed to it the module code of the module to execute.

The view aspect of the MVC approach to the application framework is provided in the form of a three-level template system that uses only PHP templates and does not at this stage support a templating engine. There are three levels of templates in the KEWL.NextGen view, a page template, a layout template and a content template. These can be thought of as having a nested structure, in which the page template sets up the page, puts in a banner and closes the page. The layout template defines any additional layout elements for the page, and the content template controls the display of the output of the controller onto the page. The framework itself provides default page and layout

templates, allowing most modules to only be concerned with the content template.

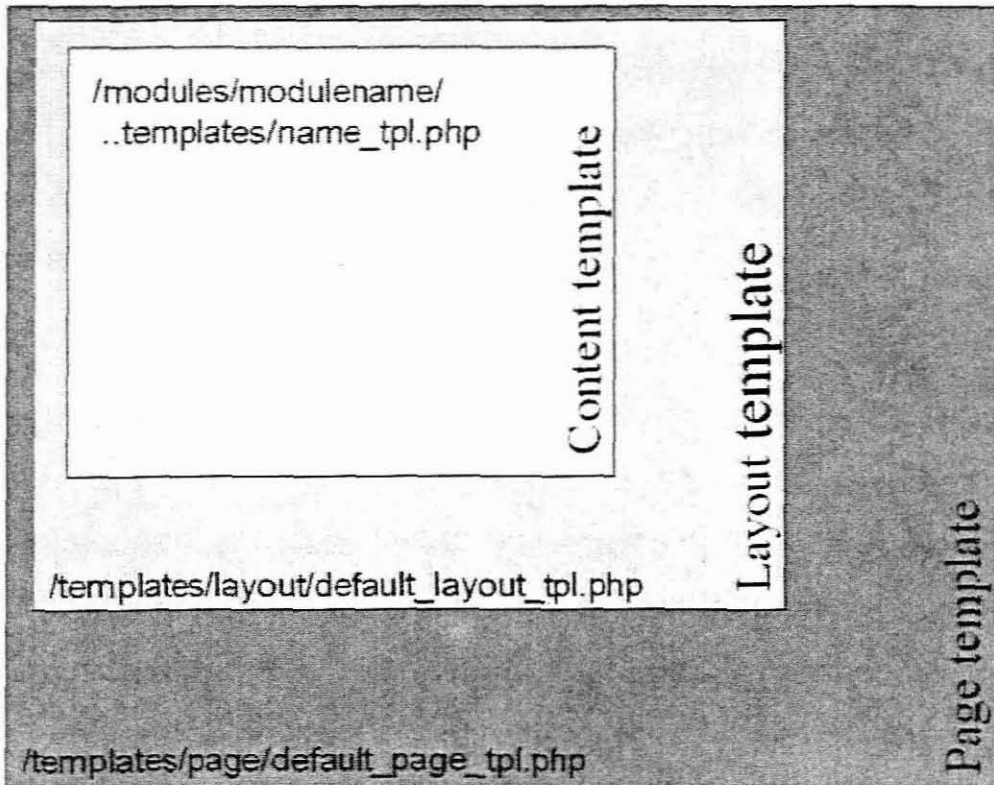


Figure 6-1 MVC approach

However, there will be times when the default page template is not adequate, for example, if you want to display output without using a banner such as on a popup window. For such cases, you can over-ride the default page or layout templates by including the following line of code in the constructor [`init()`] method of the controller for your module, or alternatively, inside one of the switch statements that control programme flow:

```
$this->setPageTemplate("somename_page_tpl.php");
```

```
$this->setLayoutTemplate("somename_layout_tpl.php");
```

The KEWL.NextGen framework provides four files that act as the glue that holds the framework together. They implement various aspects of the MVC and front-controller implementation. These files are located in `/core/classes/` and are `controller_class_inc.php`, `dbtable_class_inc.php`, `engine_class_inc.php`, and `object_class_inc.php`. The engine class provides core functionality needed to run modules, and other functions, and is not normally extended or referenced in a module. An understanding of the other three are, however, vital to module developers.

The file `dbtable_class_inc.php` contains an abstraction of the PEAR.DB data access class, and is thus the base class for the data model of any KEWL.NextGen application. It must be extended by your model class, which should always reside in the `/modules/modulename/classes` folder. It is vital that you use its methods rather than raw SQL whenever possible, and always when data are being written to the database whether new data or updates of existing data. This is vital because this is the basis for active dynamic mirroring. No code will be allowed into a KEWL.NextGen module or application that does not follow this requirement. We will discuss how to implement a data model class that extends this base class in the chapter on building modules.

The file `controller_class_inc.php` is the base class for a controller, and must always be extended by the controller of a module. It provides access to some of the core functionality provided by the core of the framework, in particular access to loading other classes and making them available.

The file `object_class_inc.php` is the base class for some of the other framework classes, and is available to extend classes that are not the main

controller of your module, but that require access to framework elements. This class may also be extended by helper modules that are conceptually part of the framework, such as the modules that make up the `htmlElements` set of classes.

The framework includes modules that are always available, and that are conceptually part of the framework even though they are just collection of modules. At the time of writing, some of these modules are still under development so a comprehensive list is not provided. There are a set of these modules for providing HTML rendering, and they reside in the module folder `/modules/htmlElements/`. Their documentation is typically available as PHPDocumentor generated files, or can be generated from the modules by PHPDocumentor or an application such as PHPEdit that supports generation of documentation from source code.

The correct use of the framework and the helper modules is vital to the creation of *stable modules and a stable application* for KEWL.NextGen. All code should be built from the framework and its helper modules. Wherever there is a helper module to render *HTML* output it should be used rather than writing *HTML*. Indeed, every *HTML* tag is a bomb that can explode at any time and destroy our beautifully crafted application. Similarly, every `echo` or `print` statement is also a bomb, and should only be used in templates and only when everything has been prepared for output.

In developing for KEWL.NextGen, it is important to keep in mind a vital attitude: do not wait for someone to build a framework element that you need, you do it. If the framework presentation elements cannot do something, extend

the framework. To extend the framework, use the mailing list to make a proposal and discuss ideas for such extensions. In the early days, extending the framework is almost a daily activity, but as we proceed to a more stable code base, such extensions should only be made after discussion and should only be incorporated after a period of testing under a variety of conditions. When extending the framework, it is crucial to make sure that your code has not broken something because it is in such extension that changes that impact everyone. For example, imagine you add the line:

```
$str=$this->objUser->usermane;
```

to a core element such as the layer class, and then commit your code to CVS. Anyone who updates from CVS will have a completely broken site. This is an easy error to make, so testing of changes before committing is vital to help preserve the sanity of the other developers and avoid flame wars among ourselves. (The KEWL.NextGen Application Framework An introduction for developers)

6.2 Module Design:

Unified Modeling Language (UML) is the most comprehensive requirement, design and computing-capable language, that has been developed and user worldwide hence I used it to design the forum model for KEWL.

6.2.1 Introduction to UML

'UML stands for Unified Modeling Language. It is a visual technique for diagramming the requirements, actions and physical distribution of software systems. (It might also be used for diagramming manual flows such as paper handling in a court or hardware.)' (Lawrence Leff)

6.2.2 Use Case Diagrams

Use case diagrams are often the first type of diagrams we create after we've gathered the requirements for our application from the client. A use case diagram is composed of several use cases, actors and relationships between the actors and the use cases.

Use case

A use case is a description of a set of actions in the application from the point of view of one or more users. A use case must have a name. A use case specifies only what actions are carried out, not how they are carried out on a technical level. Everyone needs to be able to understand what is going on.

Actor

An actor is a specific user of the application. Actors do not have to be human. If part of the system invokes an action on itself, then that can very well be defined as the actor.

The use case diagram for the forum module of KEWL follows below (Figure 1).

Discussion Forum
Use Case

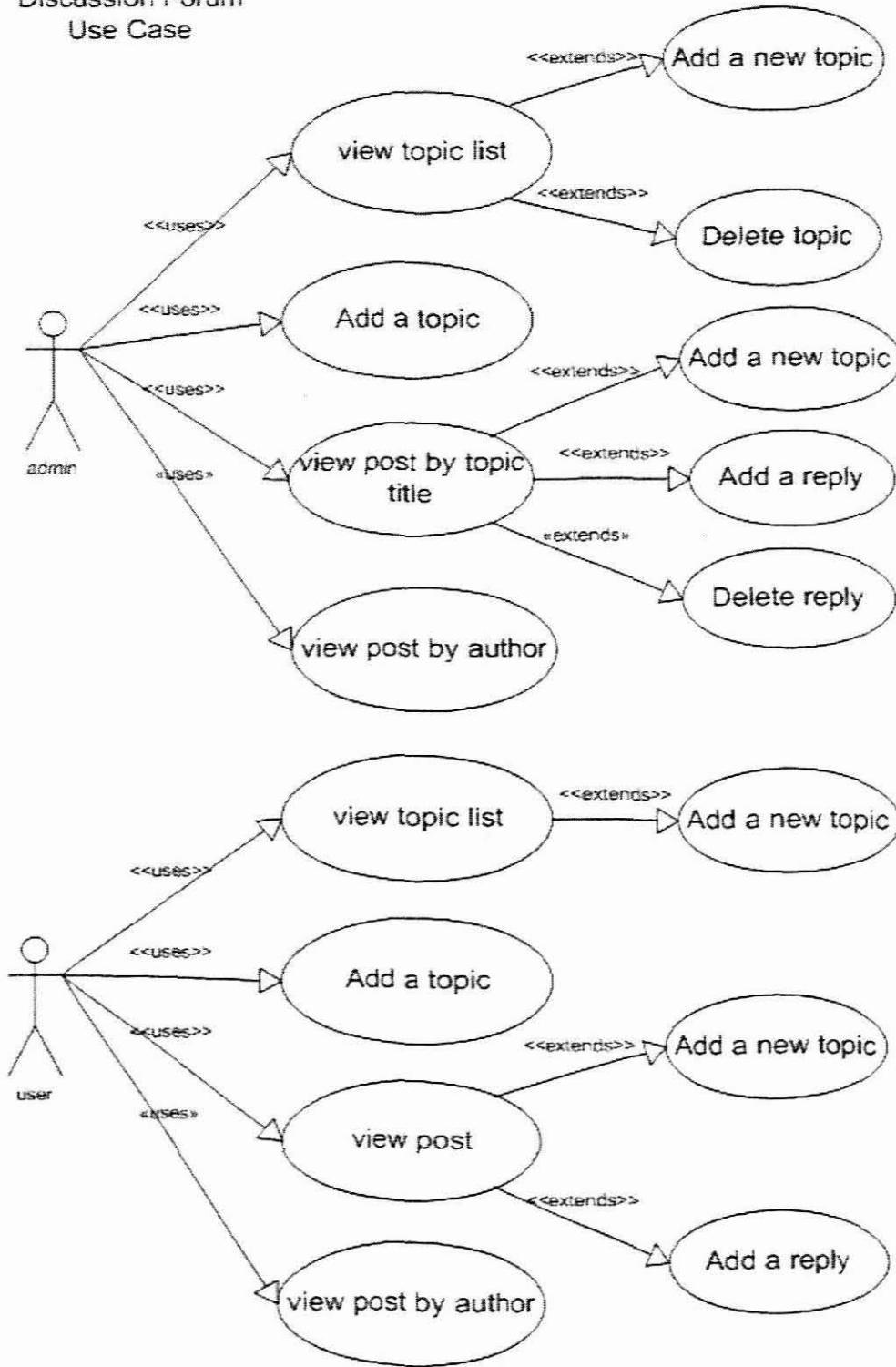


Figure 6-2 the forum module use case diagram

6.2.3 An actual use case

Use case number

The use case number is used to uniquely identify the use case.

Author's name and date

The author's name is simply the person writing the use case, and the date is obviously the first date the use case was written. Once a use case is revisited, it is useful to put the author's name and the date of revision in this part as well.

Use case name

The description of the use case usually consists of a short phrase that represents what the use case is about, as discussed in the section on use case diagrams. The use case name should ideally be unique, so the use case can be identified easily by its name. This is comfortable when discussing a particular use case. If a use case name looks suspicious in the sense that it might represent more than one task, this is often an indication that you might want to split up the use case into several use cases, so each represents one task only.

Actor(s)

The actors mentioned in a use case should be the actors that can actually trigger the use case.

Use case description

The use case description is a brief, informal description of what the use case does. There should not be any technical details in it, as everyone should be

able to understand the use case.

Preconditions

Preconditions describe which conditions in the application apply before the actions in this use case can take place.

Postconditions

Postconditions describe which conditions in the application apply after the actions in the use case are carried out.

6.2.4 The actual use case of forum module

According to figure 1 the actual use case of the forum module follow below:

Number: 1.1

Author's name: Zhangyu Wang

Date: 2004 -08-10

Name: View Topic List

Actor(s): Forum Administrator

Description: This use case describes the process of viewing all the topics' title in the forum.

Preconditions:

The forum administrator is logged into the application as a shop administrator

The topics' title is available in the database

Check how many posts relate to the topic.

Postconditions:

The topic's title, author, topic create time and how many posts in the topic are shown in the main page according to topic created time.

The default system defined 15 topics in a page using an auto-increase page number for index.

Event sequence:

Topic list appears as default when the user logs in.

Number: 1.1.1

Author's name: Zhangyu Wang

Date: 2004-08-10

Name: Add a new topic

Actor(s): Forum Administrator

Description: This use case describes the process of adding a new topic (includes title and contents) to the forum.

Preconditions:

The forum administrator is logged into the application as a forum administrator.

Postconditions:

Add the topic owner, topic title and topic create time to the database, and get topic id back.

Add the topic contents to the database with the topic id.

Go back to the topics' list page and the topic is visible in the forum.

Event sequence:

The administrator chooses to add a new topic.

Add the topic title and contents in topic add page.

The administrator chooses to submit.

Number: 1.1.2

Author's name: Zhangyu Wang

Date: 2004-08-10

Name: Delete topic

Actor(s): Forum Administrator

Description: This use case describes the process of deleting a selected topic from topics list.

Preconditions:

The forum administrator is logged into the application as a shop administrator

The topics' title is available in the database.

The topic is visible in the forum.

Postconditions:

The topic is removed from the database.

The topic title is invisible in the topic list.

All the posts relative to the topic will no longer be visible in the posts list.

Event sequence:

The administrator chooses to view the list of topics.

The administrator selects a topic title to delete

The topic and all related posts are removed from the database.

Number: 1.2

Author's name: Zhangyu Wang

Date: 2004-08-10

Name: Add a topic

Actor(s): Forum Administrator

Description: The use case is same as 1.1.1.

Number: 1.3

Author's name: Zhangyu Wang

Date: 2004-08-10

Name: View post by topic title.

Actor(s): Forum Administrator

Description: This use case describes the process of viewing the posts in the forum according to topic title.

Preconditions:

The forum administrator is logged into the application as a shop administrator

The topics' title is available in the database.

The topic is visible in the forum.

There are relative posts in the forum.

Postconditions:

All the posts related to the selected topic will appear with author name and created time order by the post created time.

Event sequence:

The administrator selects a topic title.

The administrator chooses to view the post of the topic according to topic title.

All the relative posts will appear.

Number: 1.3.1

Author's name: Zhangyu Wang

Date: 2004-08-10

Name: Add a new topic

Actor(s): Forum Administrator

Description: This use case is same as 1.1.1.

Number: 1.3.2

Author's name: Zhangyu Wang

Date: 2004-08-10

Name: Add a reply

Actor(s): Forum Administrator

Description: This use case describes the process of add a reply to the select topic.

Preconditions:

The forum administrator is logged into the application as a shop administrator

The topics' title is available in the database.

The topic is visible in the forum.

Postconditions:

Add the post owner, post created time and post contents to database according to the id of the select topic.

The post is visible in the post list of the topic.

Event sequence:

The administrator chooses to add a reply to the select post.

The administrator add contents to the post

The administrator submits the post.

The post appears in the post list.

Number: 1.1.3

Author's name: Zhangyu Wang

Date: 2004-08-10

Name: Delete post

Actor(s): Forum Administrator

Description: This use case describes the process of deleting a selected post from a post list.

Preconditions:

The forum administrator is logged into the application as a shop administrator

The post is available in the database.

The post is visible in the forum.

Postconditions:

The post is removed from the database.

The post title is invisible in the topic list.

Event sequence:

The administrator chooses to view the list of post.

The administrator selects a post to delete

The post is removed from the database.

Number: 1.4

Author's name: Zhangyu Wang

Date: 2004-08-10

Name: View post by author.

Actor(s): Forum Administrator

Description: This use case describes the process of viewing the posts in the forum according to author.

Preconditions:

The forum administrator is logged into the application as a shop administrator

The author has posts in the forum.

Postconditions:

All the posts that the selected author posted will appear.

Event sequence:

The administrator selects a author.

The administrator chooses to view the post of the author.

All the posts will appear.

The use case of user is very similar to that of the administrator use case.

6.2.5 Activity diagrams

Activity diagrams are used to describe the dynamic behaviour of an application.

The most common elements of an activity diagram are the following:

A starting point

A starting point indicates the start of an activity diagram and is represented by a filled circle.

Activities

An activity is a task that the application does. Activities are represented by a rectangle with rounded edges. The name of the activity goes inside the rectangle.

Decision points

Decision points represent a condition in the application. Based on whether the condition is true or false, transitions can be made to the relevant activities. Decision points are represented by a diamond in an activity diagram. A description of the decision point appears right next to the diamond.

Transition arrows

A transition arrow is used to indicate the transition of one element in the diagram to another. This is often a transition between 2 activities or an activity and a decision point. In the case of a transition from a decision point to an activity, the transition will have the result of the usual "Yes" or "No". A transition arrow is represented by an arrow pointing from the starting point to the ending point.

An ending point

An ending point indicates the end of an activity diagram and is represented by an empty circle with a filled circle in it.

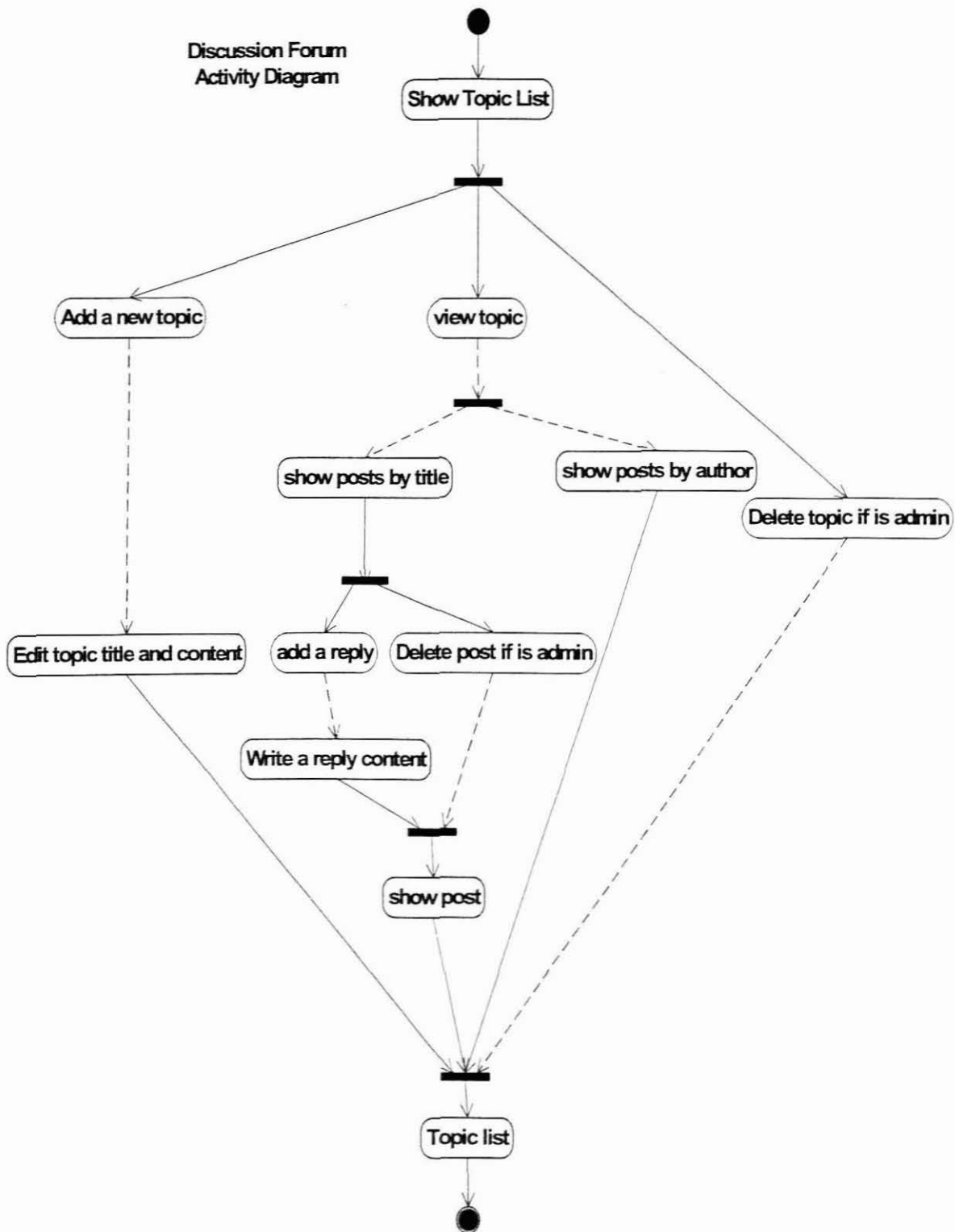


Figure 6-3 the forum module activity diagram

6.3 Database Design

Think of the basic components of a forum: topics and posts. A forum should have several topics, and each of those topics will have one or more posts by users. Knowing that, the posts are tied to the topics through a key field. This key forms the relationship between the two tables.

Think about the requirements for the topics themselves. The forum definitely needs a field for the title, and the creation time and the identification of the user who created the topic. Similarly, think of the requirements for the posts: the forum needs the text of the post, the time it was created, and the person creating it. Most importantly, the forum needs that key to tie the post to the topic.

The forum module needs two tables to stores the data from user input. One table will be named `tpl_forum_topics` that stores the title of topic, the create time of topic, and the owner of topic. An auto-increased id of topic is the key relation with table `tpl_forum_posts`. The table `tpl_forum_posts` stores the contents of post, the create time of post, the owner of post, an auto-increase id of post and the id of topic that got from `tpl_forum_topics`.

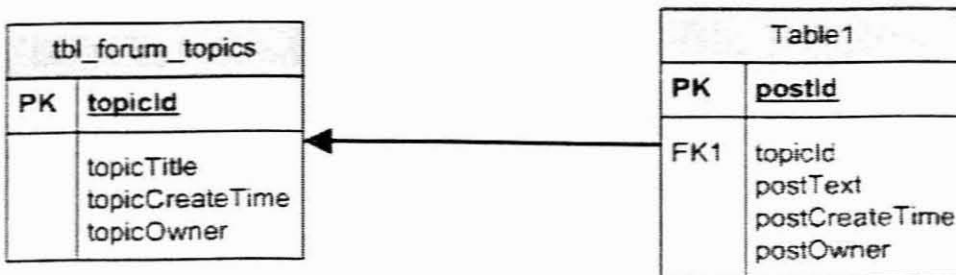


Figure 6-4 Database architecture

6.4 Module Implementation

The KEWL.NextGen application framework is based on a close approximation of the model, view, controller (MVC) design pattern, which separates an application's data model, user interface and control logic into three separate components. This enables changes to be made to one component without impacting on the others. Since the model is usually stable, separating it from the view and controller logic that are changed often during development, leads to more robust applications that are easier to maintain.

Making the forum module with the KEWL.NextGen application framework

The forum model is based on the database abstraction class, which is a class called `dbTable` that resides in the file `dbtable_class_inc.php`. My database connection class named after the table that it connects to and resides in `/modules/kngboard/classes/` and begins with the letters `db`. `dbforum_tooics_class_inc.php` is the name for a model class file to connect to the `tpl_forum_topics` database table. The class itself named `dbforum_topics` is inside the file. `dbforum_posts_class_inc.php` is a class to connect to the `tpl_forum_posts` table. The class itself named `dbforum_posts` is inside the file.

As far as the view is concerned, unless you are overriding the default page and layout templates, you only need to consider the content templates, which reside in `/modules/modulename/templates/content` and can take any filename as long as the convention `_tpl.php` is used, though the names should be meaningful. My content templates are called `main_tpl.php`, `show_tpl.php`, `addTopic_tpl.php`. The controller base class is the file `controller_class_inc.php`, and this file is extended by the controller class of the module. The controller must be a class with the same name as the module, and must reside in the file `controller.php` in the module's root

	methods to control the forum module.	showPost() listTopics()
/classes/dbForum_topics_inc.php	Extended the dbTable class to connect to tbl_forum_topics table, and save the topics' information to the database.	init() save()
/classes/dbForum_posts_inc.php	Extended the dbTable class to connect to tbl_forum_posts table, and save and delete data from database.	init() deleteTopic() save()
/templates/content/addTopic_tpl.php	A formative output page using htmlelements class to input topic information.	
/templates/content/show_tpl.php	A formative output page using htmlelements class to show all the posts of select topic.	
/templates/content/main_tpl.php	A formative output	

	page using html elements class to list all the topics in forum.	
--	--	--

Table 6.1 Coding repository

6.5 Enhancement:

At this stage the forum module has a basic discuss function. User can post a topic and discuss around the topic. For more adventure feature the forum will have more functions for users.

Topic initiation

The lecturer should be able to decide whether only the lecturer can start topics, or whether anyone can start topics. This is configured with the course setup, but can be changed any time in the setup area by the lecturer.

Discussion type

When initiating a topic, the initiator should be able to set a topic type from a dropdown list of configurable topic types (configurable by the site admin). Topic types include: comment, question and answer, analysis, debate, reaction, brainstorming, general, chitchat, etc. When configuring the topic types, the administrator should be able to set some topic types not for assessment, for example, chitchat.

E-mail integration

Users should be able to choose to receive an email when someone replies to the topic they have created. Users should be able to subscribe to the entire context or a particular topic by email. Users should be able to reply by email and have the text go into the correct topic in the discussion.

Attachments

Discussion forum post should be able to allow attachments, but attachments should not be duplicated if they exist already, rather the poster should be given the option to link to an existing attachment. There should also be an option to link an attachment that is a file, in the documents folder.

Rates

Users should be able to rate each post on a qualitative scale.

Chapter 7 Conclusion

The first results of applying Discussion Room module were quite successful. The module supports the standard functionality of Web-based discussion forum, but it also provides the means for conceptual structuring of contribution from the discussion forum. The efforts on the users' side to create this conceptual structure might be seen as minimal. Users only need to assign their contributions to concepts from the already existing conceptual schema. This can be seen as a very easy task to accomplish, since the user interface to the conceptual schema is the same as the user interface for the discussion part of the tool.

On the other side, the benefits of having a discussion forum structured according to the conceptual schema are numerous. Extracting useful information by simple "conceptual" browsing or searching by using key words from the schema might be very easy for a wide range of users, to say the least. However, the developers believe that such a tool might have more potential than it might be visible at first. For example, the module might be easily applied as a general knowledge extraction tool. The developers can easily imagine a situation where a number of experts in a particular subject field come together to discuss certain topics in a Discussion Room. The result of this discussion and the attached conceptual schema might be seen as a structured excerpt of the knowledge that these expert possess about these topics.

References

Atkinson L. *Applying patterns to PHP*, (2001).

Burford, S., & Cooper L "FAQs: Collaborative Learning Online [online],
<http://www.ssn.flinders.edu.au/innovations/faq.shtml#grade>.

Conallen J., *Building Web Applications with UML*, Addison-Wesley (2003)

Converse T., Park J., *PHP Bible 2nd Edition*, John Wiley & Sons (2002)

Dillenbourg, P.(1999) *Collaborative learning: cognitive and computational approaches: Pergamon*.

Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides. *Design Patterns: Elements of Reusable Object-Oriented Software*, Addison Wesley (1994).

Eastmond, D. V. (1995) *Alone but together: adult distance study through computer conferencing: Cresskill, N.J.*

Frank Kappe. *Hyperwave information server 4.1 - technical whitepaper*, 1999.
<http://www.master-info.org/demo/public/technical.doc>.

Fujitani, S., Mochizuki, T., Kato, H., Isshiki, Y., & Yamauchi, Y. (2003).
"Development of Collaborative Learning Assessment Tool with Multivariate Analysis Applied to Electronic Discussion Forums", page 200-203.

GroupSystems.com. (2002) *GroupSystems Interactive Tools.*

<http://www.groupsystems.com/demos/tools.htm>

Garrido A., Rossi G., and Schwabe D.. *Patterns Systems for Hypermedia*, Proceedings of PloP97 (1997),

Helic D., Maurer, H., Lennon, J., Scerbakov, N.: *Aspects of a Modern WBT system*, In *Proc. Intl. Conf. on Advances in Infrastructure for Electronic Business, Education, Science, and Medicine on the Internet*, paper 38, August 2001.

Helic D., Krottmaier H., Maurer H., Scerbakov N.: *Implementing Project Based Learning in WBT Systems*, to appear in *Proc. of ED-Media*, AACE, 2003

Helic D., Maurer H., Scerbakov N.: *Aspects of Collaborative Authoring in WBT Systems*, In *Proc. Intl. Conf. on Advances in Infrastructure for Electronic Business, Education, Science, and Medicine on the Internet*, paper 37, January 2002.

Lam J. *Introduction to Design Patterns Using PHP*, (2003),

LÄammel R., Visser J. *Design Patterns for Functional Strategic Pro-gramming* *Proc. of Third ACM SIGPLAN Workshop on Rule-Based Programming RULE'02*, ACM Press (2002).

Lyardet F., Gustavo Rossi and Schwabe D.. *Patterns for Dynamic Websites*, *Proceedings of PloP98* (1998).

Michael J. Flynn. *Introduction to "Issuance of Programming Techniques on the Design of Computer"*, 3, March 1997.

Rossi G., Schwabe D. and Garrido A. *Design Reuse in Hypermedia Applications Development, Proceedings of ACM International Conference on Hypertext (Hypertext97)*, ACM Press (1997).

Rossi G., Schwabe D., Lyardet F. *Improving Web Information Systems with Navigational Patterns*.

H2OProject. (2003). *H2O Project, 2004*, <http://h2oproject.law.harvard.edu/index.html>

Harasim, L. M.(1995) *Learning networks: a field guide to teaching and learning online*.

Kearsley, G. (2000) *Learning and Teaching in Cyberspace*
<http://home.sprynet.com/~gkearsley/chapts.htm>

Laurillard, D. (2002). *Rethinking university teaching: a conversational framework for the effective use of learning technologies (2nd ed.)*: RoutledgeFalmer.

MacKnight, C. B. (2000) *Teaching Critical Thinking through Online Discussions. EDUCAUSE QUARTERLY*(Number 4), 38-41.

Mason, R.(1998) *Models of Online Courses*
<http://www.aln.org/publications/magazine/v2n2/mason.asp>

Muilenburg, L., & Berge, Z. L. (2002) *Framework For Designing Questions For Online Learning*
<http://www.ssn.flinders.edu.au/innovations/teacherresources.shtml>

Mochizuki, T., Fujitani, S., Isshiki, Y., Yamauchi, Y., & Kato, H. (2003). *Assessment of Collaborative Learning for Students: Making the State of Discussion Visible for their Reflection by Text Mining of Electronic Forums.*" page 285-288.

Resta, P., Menchaca, M., & Adams, W. (2003). *Peer and Self Assessment Systems for Students and Instructors in On-line Collaborative Learning.* Page 2379-2381.

Rossmann, M. H. (1999) *Successful Online Teaching Using An Asynchronous Learner Discussion Forum, Journal of Asynchronous Learning Networks, 3(2), 91-97.*

Sae-Chin, J., & Resta, P. E. (2003). *Student Expectations of a Web-Based Collaborative Learning Environment.*

Salter, G. (2000) *Making use of online discussion groups, Journal Of The Australian Council For Computers In Education, 15(No 2), 5-10.*

Salter, G. (2002) *Strategies for the use of synchronous computer-mediated communication in education.* New Zealand.

Appendix A: Learning Management System Overview

Learning Management System (LMS)

A Learning Management System (LMS) is defined as a learning software application or Web-based technology used to plan, implement, and assess a learning process. Typically, a learning management system provides an instructor with the tools to create learning resources, deliver content, monitor student participation, and assess student performance. Figure 1 shows typical LMS communications.

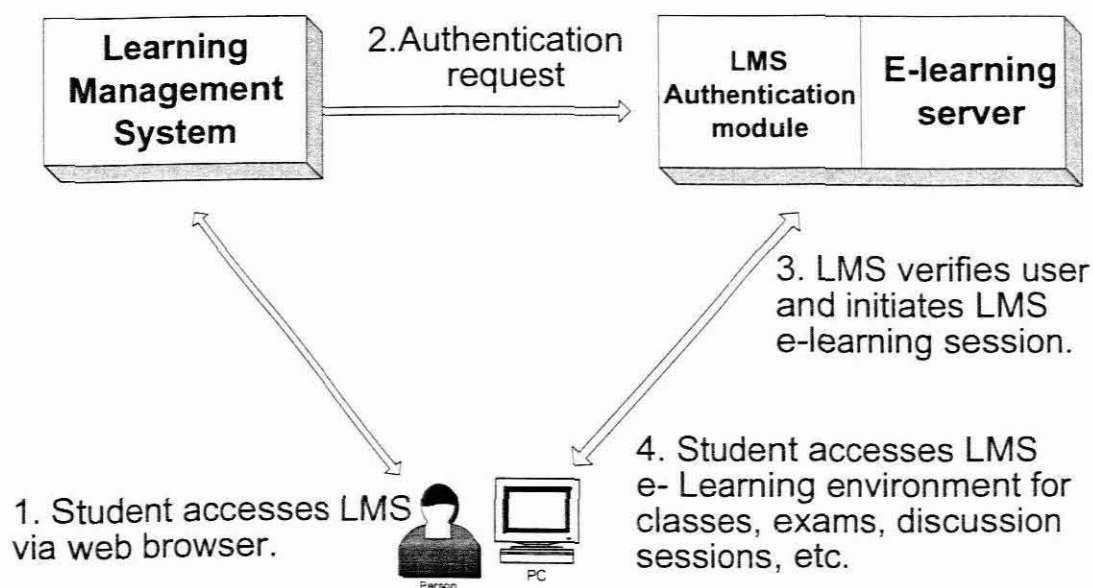


Figure 1 Typical LMS Communications

A learning management system provides an online learning environment by enabling the management, delivery and tracking of learning. Furthermore, an LMS should support a collaborative learning community, offering multiple modes of learning from self-paced coursework (Web-based seminars and classes, downloadable, CD-ROM and video content) to scheduled classes

(live instruction in classroom settings or online) to group learning (online forums and chats). Optimally, an LMS will consolidate mixed-media training initiatives, automate the selection and administration of courses, assemble and deliver learning content, measure learning effectiveness and integrate with other enterprise applications.

An LMS is a Web-based software solution to simplify the administration of learning programmes. It creates efficient processes for both learners and administrators. For learners, an LMS tracks their progress through a programme of study or provides a forum for collaboration with peers. An LMS provides administration functionality that simplifies the enrollment and participation in a learning programme. It provides a catalogue for courseware and learning materials, it offers notification options and the ability to collaborate online with instructors or fellow students. For administrators, using an LMS reduces or eliminates the management headaches of running a learning programme. For testing and assessment, as well as for competency certification, it standardises the process and evaluation. It tracks the success of individual students or specific courses. It integrates the marketing and accounting function to enable simple cost-benefit analysis. It controls resources – from materials to curricula, to programme offerings, to course scheduling.

Learning management Systems are used today in many organisations (universities, schools, and corporations). Traditional LMSs provide a content repository for course materials as well as facilities for student (trainee) tracking and management. Additionally, some LMSs provide authoring tools, assessment tools and communication tools, such as e-mail and discussion groups. A learning management system optimally should:

- Consolidate training initiatives on a scalable, low-cost, Web-based

platform;

- Assemble and deliver learning content rapidly in multiple languages;
- Measure the effectiveness of training initiatives;
- Mix classroom and online learning;
- Integrate with other target group application solutions;
- Centralize and automate administration;
- Use self-service and self-guided services as much as possible;
- Personalise content and enable knowledge re-use.

The Knowledge Environment for Web-based Learning (KEWL)

The Knowledge Environment for Web-based Learning (KEWL) was developed at the University of the Western Cape to facilitate research into online learning by Derek Keats and a team of developers. The development centered around a comprehensive learning management tool that could be used to investigate the online learning process. Although it was initiated and funded as a research project, it soon became apparent that KEWL could serve the online learning needs of the University of the Western Cape.

KEWL.NextGen is a web-based training platform built on PHP and MySQL. KEWL.NextGen has most of the features common to commercial learning management systems. The following features are included: learner desktop containing information about courses visited, new mail and forum entries; learning environment with notes, tests, glossary, and search engine; course management; communication and collaboration tools including mail, forums and chat, group work systems, integrated authoring environment, support for metadata, context sensitive help; and interfaces for both learning and administrator.

The short list was systematically evaluated using hands-on testing offered

through demonstration user accounts to understand the product features and also followed up by inspecting the online help, user and instructor documentation, and commentary of the user community in order to rate the short list candidates.

The following table describes the findings of a survey-style evaluation of KEWL and the other classical LMSs.

#Number means the name of LMS.

#1---Moodle

#2---LON-CAPA

#3---ILIAS

#4---dotLRN

#5---Atutor

#6---KewlNextGen

Note: Each features is marked as *, if it exists.

Criteria	Moodle	LON-CA	ILIAS	dotLRN	Atutor	KewlNe	Notes
Security Features							
Encryption							None offer SSL
Authentication	*	*	*	*	*	*	Only basic login.
Access Features							
Login/pwd	*	*	*	*	*	*	Password reminder exists
Roles/assignable privileges	*	*	*	*	*	*	
Browser-accessible	*	*	*	*	*	*	

Course Authorization	*	*	*	*	*	*	Instructor approves enrolment
Registration Features	*		*	*		*	Basic student contact data is retained.
Course Design, Development, Integration Features							
Customize look	*	*	*	*	*	*	User can choose appearance
Both Classroom Distance Ed Support			*	*			No synchronous learning features- but content could be used to supplement classroom teaching.
Templates	*		*	*			Appearance templates, not pre-structured course skeletons
Web authoring	*		*	*		*	Simple content construction can be performed.
Multimedia support	*	*	*	*	*		Includes as links.
Accessibility	*	*	*	*	*	*	
Instructional Specification Support	*		*				
Easy Navigation	*	*	*	*	*	*	Menu and icon-based
Easy Course Structuring	*	*	*	*	*	*	
Style Sheets	*	*	*	*	*	*	
Course Monitoring							

Course Listing	*	*	*	*	*	*	
Course Description	*	*	*	*	*	*	Based on Author's contribution
Schedules and Availability control	*	*	*	*		*	Set course start data.
Assessment Features							
Creates test question and facilitates test administration	*		*	*	*	*	Can include tests anywhere in course.
Automated testing and scoring	*		*	*		*	
Learner Profile Management				*			
Self-assessment					*	*	
Online Grading	*			*	*	*	
Collaboration Features							
Messaging						*	
Email	*	*	*	*		*	
Chat	*		*	*	*	*	Integrated
Bulletin boards	*	*	*	*	*	*	Notice board
Newsgroups		*					
File exchange	*	*	*	*	*	*	Post files
Whiteboard			*				
Forums	*	*	*	*	*	*	
Productivity Features							
Bookmarks			*				

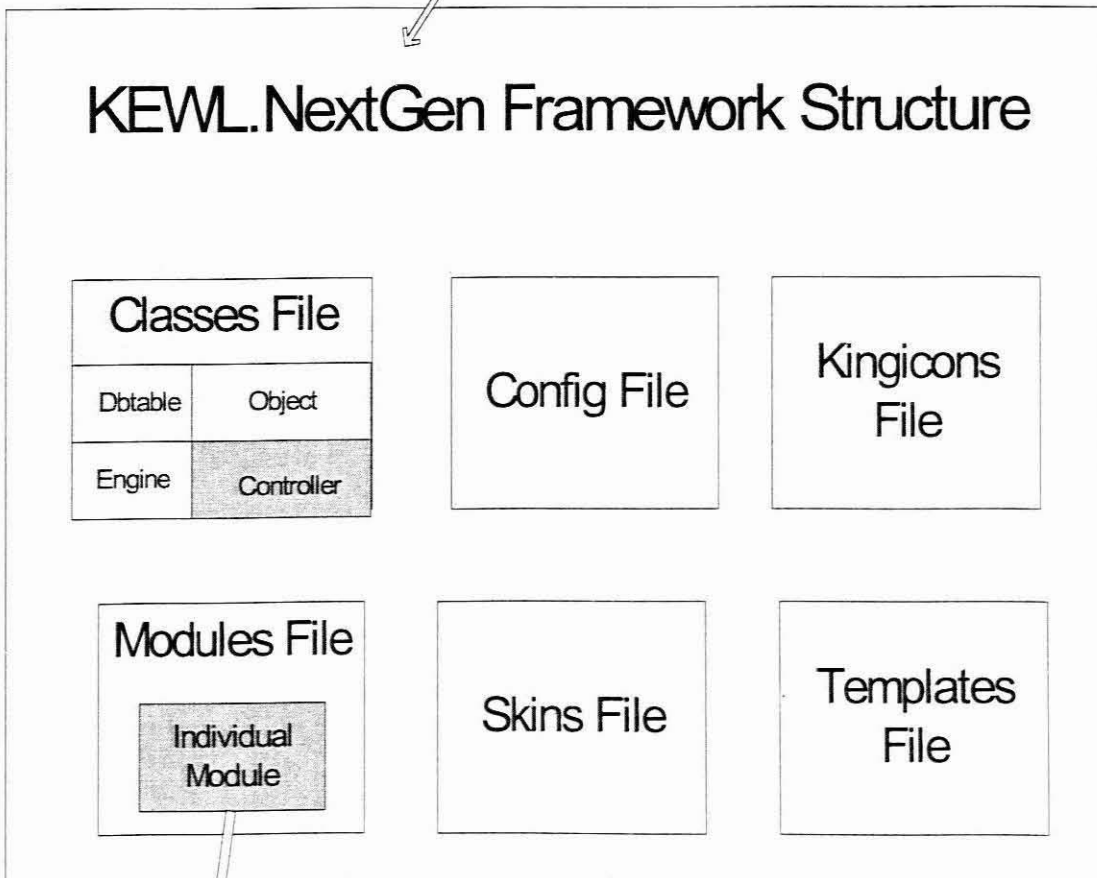
Calendar	*	*	*			*	
Orientation/Help	*	*	*		*	*	
Searching			*		*	*	Forum search

Table 1 Feature of LMS

The KEWL.NextGen application framework is based on a close approximation of the model, view, controller (MVC) design pattern, which separates an application's data model, user interface and control logic into three separate components. This enables changes to be made to one component without impacting on the others. Since the model is usually stable, separating it from the view and controller logic that a changed often during development leads to more robust applications that are easier to maintain.

The UWC developers built KEWL.NextGen framework, and see its structure diagram 1. The main part is **Classes File**; it contains four classes, namely dbtable, object, engine and controller. The project work is to write **modules file**, which inherit attributes and methods from Classes File.

UWC developed
framework



This our work (inherit attributes and methods from super-class, namely Classes File)

Diagram 1 what work would be done in
KEWL.NextGen Framework

Diagram 2 shows what will be done in detail in modules file. **Module Name** file
Should be three files at lest, namely

- **Controller File**: control logic;
- **Classes File**: an application's data model;

- **Template File:** including Content File that is user interface.

So individual module can be built tables itself, and the model represents the data as the application object that is manipulated.

The KEWL.NextGen application framework is based on a close approximation of the model, view and controller (MVC) design pattern, which separates *an application's data model, user interface and control logic* into three separate components.

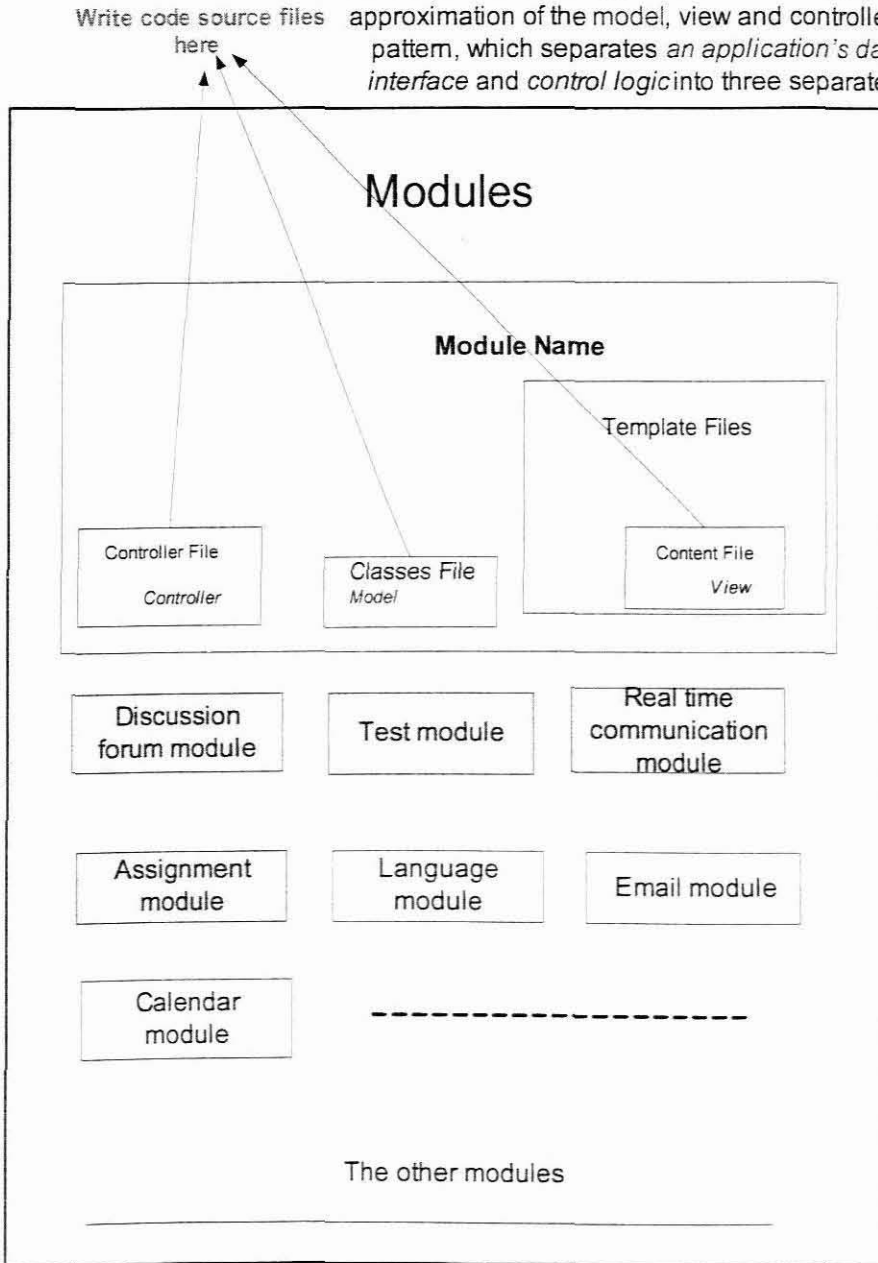


Diagram 2 how to design module as per the framework

Appendix B: An Evaluation of the Development of a Discussion Forum Module against the Information Management Body of Knowledge (IMBOK) Framework

Introduction

The Knowledge Environment for Web-based Learning (KEWL) was developed at the University of the Western Cape to facilitate research into online learning by Derek Keats and a team of developers. The development centred on a comprehensive learning management tool that could be used to investigate the online learning process. Although it was initiated and funded as a research project, it soon became apparent that KEWL could serve the online learning needs of the University of the Western Cape. To design and implement a discussion forum module object to function within the architectural constraints of KEWL, that is, a web-based environment for online discussions where the facilitator can structure each discussion according to its nature, and where learning requirements are using already designed templates.

IMBOK

IMBOK provides an easily understood framework that relates business needs to new information technology opportunities in a relatively simple, staged way. It allows us to position and isolate problems, and to grasp opportunities. It allows ideas to move more easily from one domain to another - from consideration of raw technologies right through to issues of business practice and business strategy.

IMBOK is intended to provide a reference framework for those who are concerned to bridge any actual or perceived divides between information technology "specialists" and business "generalists". So, it should be useful for:

- Researchers who are anxious to position their IT-related work in a context of some kind.
- Students who are looking for a simple contextual framework within which to organise their ideas.
- Managers who wish to choose appropriate management tools to deal with the many opportunities and problems presented by information technology.

The Framework

The Framework is presented as five areas of knowledge and four areas of process:

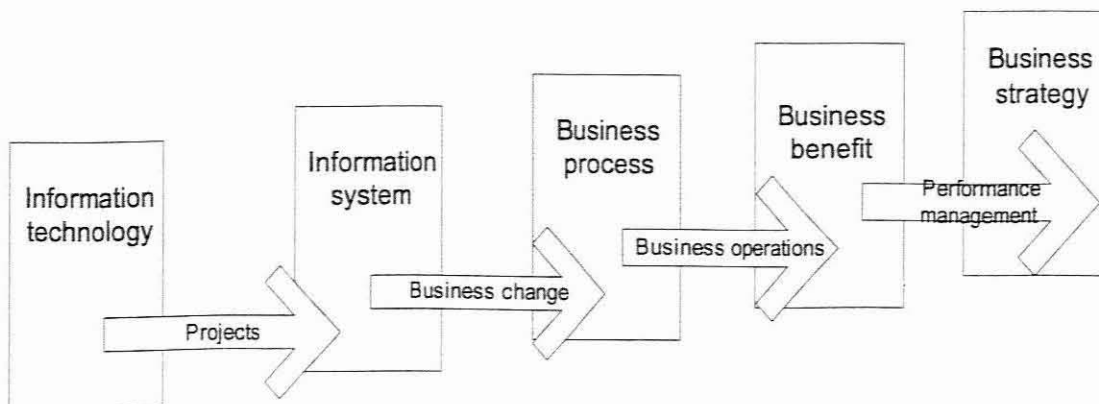


Figure 1: The IMBOK Framework

Information Technology is a phrase used to refer to specific technical components, normally organised as hardware, software and communications, which are used to make up an information system.

Information System

An information system is not the same as the technology upon which it is based: it is the totality of technological and human components that work together to produce the information systems and services that a business needs, and that processes information for some organisational purpose.

Business Process

A business process is a logical envelope that co-ordinates and gives purpose to business activities; generally where an activity delivers an output, a process delivers an outcome – a result that is evident to stakeholders outside the business as well as those within.

Business Benefit

The process of organising and managing - so that the potential benefits of an investment of time and effort are actually realized.

Business Strategy

Strategy is about change. Without change, there is no real need for strategy. With change in mind, we can argue that the simplest definition of strategy is: knowing where you are, knowing where you could choose to be, and knowing how you intend to get there (roughly speaking) (Bytheway, 2004).

Developing Technology

KEWL.NextGen is a web-based training platform built on open source software (OSS). The main technologies to be used include UML for design, PHP as the cross-platform scripting language, and PostgreSQL or MySQL as the primary back end database. JavaScript will be used to provide significant client side functionality, with limited use of Java applets where necessary. XML will be used to separate logic from layout, and integration with other platforms and tools will be provided via web services.

Hardware	Software	Communications
Workstation	Linux(operating system)	Network card
Printer	Apache	Communication line
Web server	PHP(programme language)	Network Switch
Document server	MySQL(database)	
Database server	Perl	
	CVS	

Table 1: Examples of information technologies

Many IT managers start out wanting to use open source software because it reduces development effort and costs, thereby saving the business money. However, after practical implementation, they soon realise there are several other benefits that are perhaps more significant and lasting. In fact, the majority of OSS is actually aimed at speeding up enterprise software development, simplifying system management and maintenance, and improving software quality. Enterprises that learn to think about OSS as a solution to their holistic enterprise development needs will find several

opportunities to improve the efficiency of their business and IT organisations, and lower the cost of building and operating enterprise systems.

System Features

KEWL.Nextgen has most of the features common to commercial learning management systems. The following features are included: learner desktop containing information about courses visited, new mail and forum entries; learning environment with notes, tests, glossary, and search engine; course management; communication and collaboration tools including mail, forums and chat, group work systems, integrated authoring environment, support for metadata, context sensitive help; and interfaces for both learning and administrator.

The discussion forum includes the technology and its design usability and functionality, the administrator and “response team,” the prospective students who may interact as customers and current students who may decide to contribute. To develop a system that works, one must understand how each of these elements interacts with the others. For example, the administrator may have a response team on an e-mail list. An e-mail goes out to all members of the list when a question arises that is best answered by a current student. But the students on the response team know if they are not the right people to answer the question, to forward it to another, non-team-member student who can address the issue. This behind-the-scenes action is invisible to the original poster. That person only sees a fast and thoughtful response from someone who has a really good perspective.

The KEWL.NextGen application framework is based on a close approximation of the model, view, controller (MVC) design pattern, which separates an application's data model, user interface and control logic into three separate components. This enables changes to be made to one component without impacting on the others. Since the model is usually stable, separating it from the view and controller logic that a changed often during development leads to more robust applications that are easier to maintain. To apply the discussion forum module in KEWL, it is necessary to have a forum category that includes a forum-related course that is the interface to the whole system and a forum ID to identify the forum that user are using. The basic components of a forum are – the topics field and the posts field. A forum should have several topics, and each of those topics will have one or more posts by users. The posts are tied to the topics through a key field. This key forms the relationship between the two fields. Discussions are the standard subtopic type, and will presumably form the bulk of the forum. When posting a discussion subtopic, an initial message is posted to begin discussion. Users can then post further replies to this initial message. Most users would be familiar with these as the standard of all message boards across the web. The database structure of discussion forum is blow:

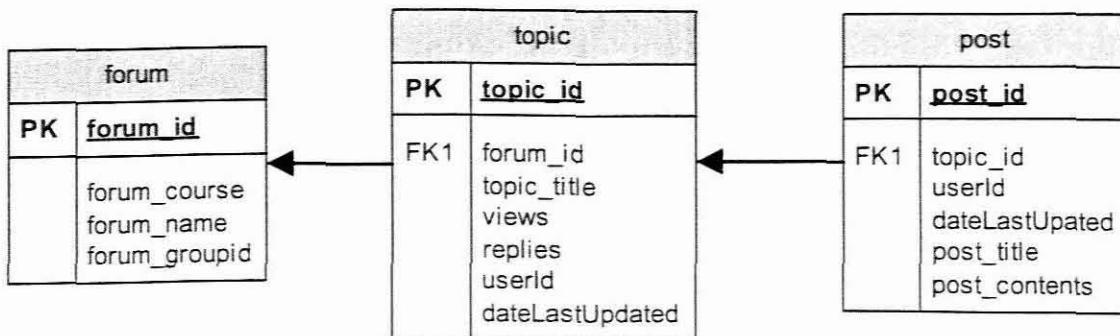


Figure 2: Database Structure

Instructional Design as a Process

Instructional design as a process is a cyclical process that, in the context of creating an e-learning course within a learning management system such as KEWL includes:

1. Defining the problem or knowledge gap that the instruction is meant to address,
2. Defining the audience that the instruction is meant to serve,
3. Developing objectives and assessment strategies,
4. Selecting and sequencing content,
5. Selecting and sequencing learning activities,
6. Creating the course and populating it with sequences content and activities,
7. Engaging learners in the course and guiding learning,
8. Evaluating the course and its design, and
9. Revision.

It is therefore crucial to build into KEWL.NextGen a process for instructional design that provides an end-to-end process of course design development, delivery, evaluation and revision.

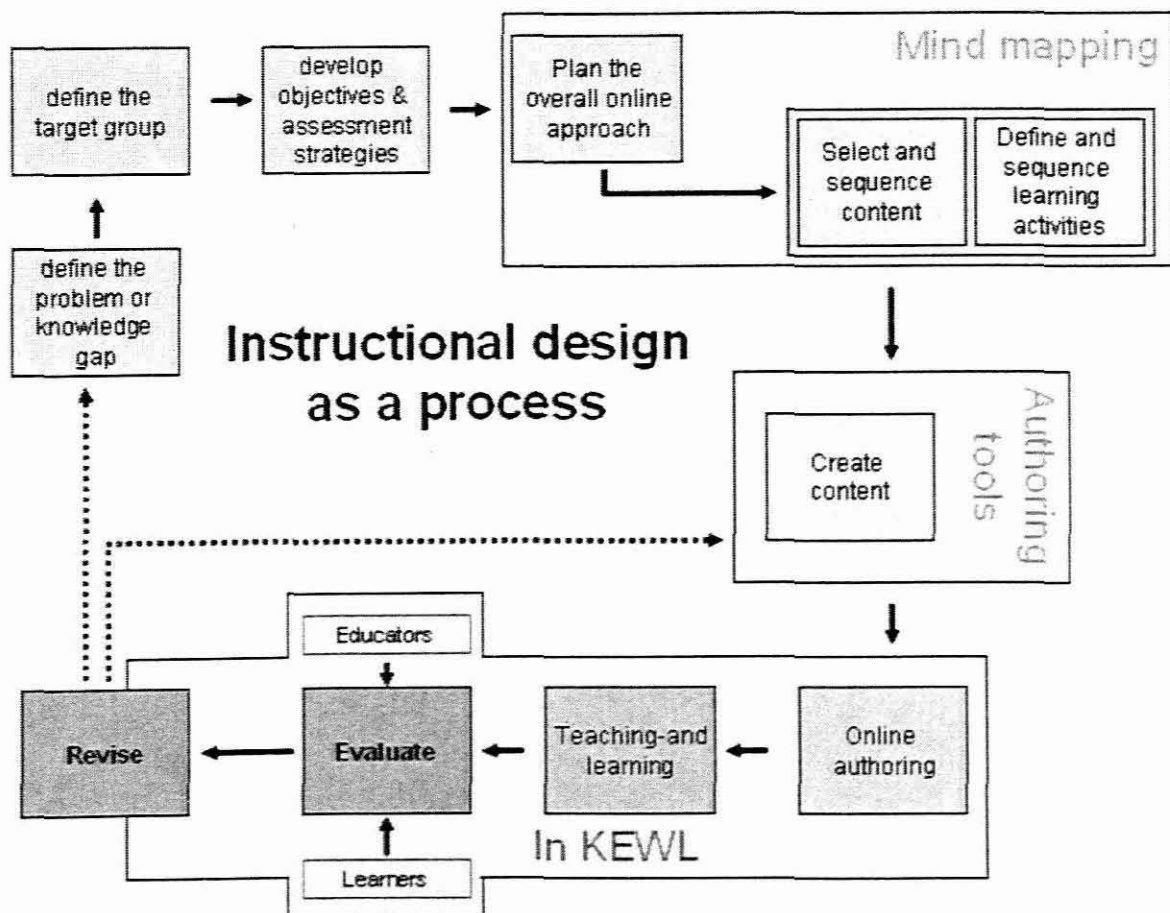


Figure 3: Instructional Design Process Model

Successful e-learning programs and courses incorporate a strong, modern instructional design approach. Although the language is one of instruction, instructional design is not limited to an intuitivist perspective on teaching-and-learning. Constructivist courses also benefit from this discipline despite its unfortunate name. Many institutions that specialize in online learning provide a whole instructional design team that may include an instructional designer, a graphic designer, a subject matter expert, and a pedagogical expert, for the creation of online courses. These teams use instructional design as a process, and typically operate within a set menu of common practices.

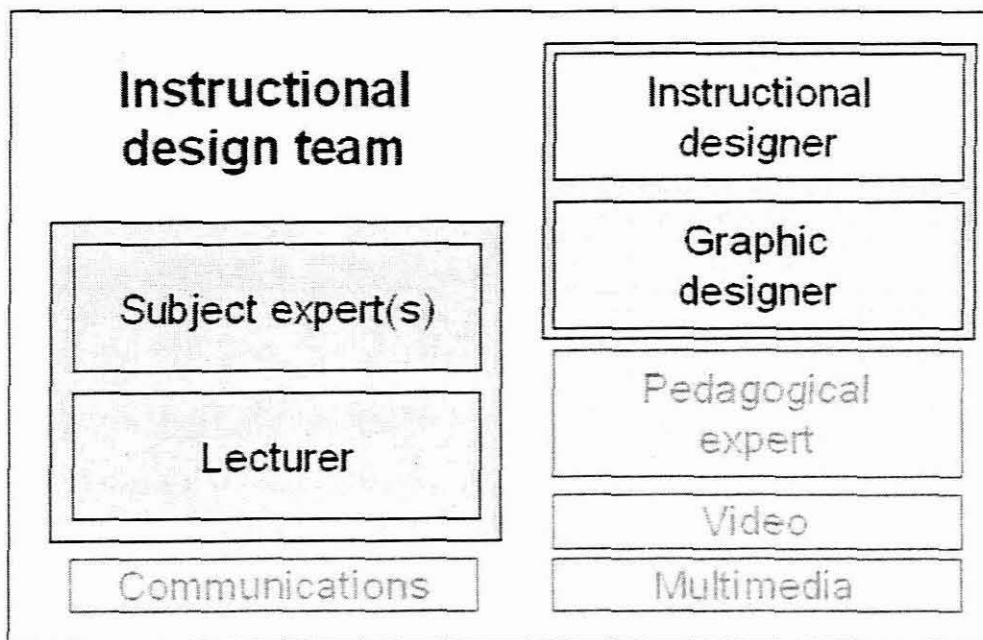


Figure 4: The Instructional Design Team

The instructional design process is usually undertaken by a team that normally has a number of functions, some of which may reside in the same person. Core functions within the instructional design team include subject matter expert and lecturer, which are often the same person. Other core functions include instructional designer and graphic designer, both functions sometimes residing with one person depending on a number of factors related mainly to project scope, size and budget. Other functions may include pedagogical expert, a function related to the development and delivery of online courses, as well as functions to deal with video, multimedia, communications, and others.

If an online course is being developed without separate people providing these functions, it is essential that the owner of the course have skills related at least to the main core functions. Failure to allow for the instructional design process in online teaching-and-learning is an almost certain recipe for frustration on the part of the course author, other responsible persons, and students.

KEWL.NextGen should automate some of the processes that would be found in such a team, and allow for the incorporation of the skill set through design patterns and possibly some form of advice provision or expert system. In this way, expert advice would be available to the lecturer through a combination of built in processes (wizards) and the use design patterns.

Discussion forums are applied extensively as an easy-to-use and yet powerful communication tool in numerous Web-based applications in general and in learning management systems (LMS) in particular. For example, in scientific digital journals and digital libraries discussion forums are heavily used to discuss different articles, to comment ideas presented in these articles, or simply to write "letters to the editor". In software development discussion boards programmers come together to exchange their views on different programming techniques, software design methods, project management concepts, etc. Also, the existence of numerous Web-based communities and communities of practice, such as Open Source communities, scientific communities, and many others rely mostly on discussion forums, which are usually the essence of such communities. The list of Web applications built with and around discussion forums goes on and on.

Similarly, in LMS systems, discussion forums are applied with the highest user acceptance for many different purposes. Usually, each LMS course offered in the system is associated with a specific discussion forum that provides the place for context-dependent discussion of issues related to that LMS course (Helic, Maurer, Lennon, Scerbakov, 2001, 38). Learners taking a part in the course work use the associated discussion forum to ask their questions about presented learning material, to discuss topics from the course, to publish their examples, and so on. Also, in problem-solving or project-related LMS courses

learners may use discussion forums to discuss the actions they take on each particular step of their work (Helic, Krottmaier, Maurer, Scerbakov, 2003, 55).

On the other hand tutors, authors and teachers may use special discussion forums offered by the system to discuss issues related to implementing different training sessions in the system. For instance, they may discuss the content of a particular LMS course that they need to prepare, or a particular training strategy for the training session that they are conducting (Helic, Maurer, Scerbakov, 2002, 37).

Benefits of Application of Discussion Forum

Online discussions offer a number of potential benefits that can help engage students in activities that contribute to their intellectual growth (MacKnight 2000). For example, composing a response in online discussions often requires greater reflection than in face-to-face discussions (Harasim 1995). Other benefits include promotion of team building, promotion of critical thinking (Muilenburg & Berge 2002) and supporting collaborative work (Salter 2000).

The facilitator may actively control the discussion through means such as selectively releasing responses, limiting who can view them, or by active participation in the forum. On the other hand, the facilitator may take a more hands off approach and leave the students to themselves after posting a question or task. Unfortunately, simply asking students to respond to a topic or question given by the instructor is not likely to generate an effective collaborative learning environment. It may help students to interact with information but not with the instructor or other students.

The use of discussion forums in learning management system promotes a deeper association with the course. The community engagement and the knowledge course participants develop through engagement encourages them to remain part of it. Discussion forums establish a level of trust between participants. This trust can manifest in a variety of ways, including – remaining more attuned to the issues of the marketplace and to participants' needs. The instructor can be proactive – by being alerted to problem areas, or take advantage of an immediate opportunity, and gauge and adapt strategies on an ongoing basis that may help to increase yield.

Strategy of Learning Management System

Compared with traditional instructor-led classroom instruction, KEWL.NextGen offers numerous advantages, including:

- Knowledge delivered globally at internet speed,
- Access to individualised learning, anywhere, anytime,
- Interactive technology-based learning tools, including Web-based platforms, video, and satellite broadcast,
- Convenience that can be customised to specific needs,
- Integrated delivery to audiences worldwide,
- The ability to deliver new courses quickly, and
- Flexibility to set your own learning pace.

Appendix C: code of the module

```
<?php
/* -----Forum class extends controller -----*/
// security check - must be included in all scripts

if (!$GLOBALS['kewl_entry_point_run']) {
    die("You cannot view this page directly");
}

/**@author Zhanyu Wang
class kngboard extends controller
{

    var $objUser;
    var $objButtons;

    function init()
    {

        $this->objUser = & $this->getObject('user', 'security');
        $this->objLanguage = & $this->getObject('language', 'language');

        $this->href = & $this->getObject('href', 'htmlelements');
        $this->objButtons = & $this->getObject('navbuttons',
'navigation');

        $this->table = & $this->getObject('htmltable', 'htmlelements');
        $this->objDbTopics = & $this->getObject('dbforum_topics');
```

```

$this->objDbPosts = & $this->getObject('dbforum_posts');

}

function dispatch($action)
{

switch ($action) {

    // go to main page that list all the topics in the forum
    case null:

        $this->setForShow();

        return "main_tpl.php";

        break;

    //show the contents of topics and replies
    case "show":

        $this->setForshow();

        return "show_tpl.php";

        break;

    //add a new topic
    case "add":

        return "addTopic_tpl.php";

        break;

    //add a reply for topic
    case "post":

        return "addTopic_tpl.php";

        break;

    //delete topic and all the replies of this topic reserved for
administrator only
    case "deletetopic":

        $topicId=$this->getParam('topicId', NULL);

```

```

//delete topic

$this->objDbTopics->delete('topicId',$topicId);

//delete posts related of the topic

$this->objDbPosts->deleteTopic($topicId);

//return topics list

$this->setForShow();

return "main_tpl.php";

break;

//delete post

case "deletepost":

    $postId=$this->getParam('postId',NULL);

    $this->objDbPosts->delete('postId',$postId);

    $this->setForshow();

    return "show_tpl.php";

//add post

case "save":

    $Id=$this->objDbTopics->save();

    $this->objDbPosts->save($Id);

    $topicId=$this->getParam("topicId",NULL);

    //add a new topic

    if($topicId){

        $this->setForshow();

        return "show_tpl.php";

        //add a reply

    }else{

        $this->setForShow();

        return "main_tpl.php";

    }

```

```

        break;

        default:
            echo
$this->objLanguage->languageText("phrase_unrecognizedaction");
        break;

    }
}

function setForShow()
{
    //define the output varchar
    $this->setvar('ownerShow', $this->ownerPost());
    $this->setvar('topicList', $this->listTopics());
    $this->setvar('postShow', $this->showPost());
}

//this function is for check post by the author
//it can show all the post this owner posted
function ownerPost(){

    $postOwner=$this->getParam("postOwner", NULL);
    $sql="SELECT postText,postCreateTime from tbl_forum_posts where
postOwner = '$postOwner' order by postCreateTime desc";
    $rs=$this->objDbPosts->getArray($sql);

    foreach ($rs as $line){

        // $postOwner=$line['postOwner'];

```



```

$postCreateTime= $line['postCreateTime'];
$postText=nl2br(stripslashes($line['postText']));

$this->postOwner      =&      $this->newObject('layer',
'htmlelements');

$this->postOwner->id = "blheadline";
$this->postOwner->align = "center";
$this->postOwner->str      =
"Posted"."&nbsp"."&nbsp"."by"."&nbsp"."&nbsp".$postOwner;
$ownerShow.=$this->postOwner->addToLayer();

$this->postText      =&      $this->newObject('layer',
'htmlelements');

$this->postText->id = "blog-content";
$this->postText->align="center";
$this->postText->str      =
"<br>"."&nbsp"."&nbsp"."&nbsp"."&nbsp"."&nbsp"."&nbsp".$postText;
$ownerShow.=$this->postText->addToLayer();

$this->postTime      =&      $this->newObject('layer',
'htmlelements');

$this->postTime->id = "date";
// $this->postTime->align="center";
$this->postTime->str      =      "&nbsp"."&nbsp"."Post
Time"."&nbsp"."&nbsp".$postCreateTime;
$ownerShow.=$this->postTime->addToLayer();

// $newTopic=$this->href->showLink($this->url,array('action'=>'add

```



```

$this->postTitle->id = "bltitle";

$this->postTitle->align= "left";

$this->postTitle->str          = "<font                size=3>"
."Topic"."&nbsp;".":"."&nbsp;"."&nbsp;".$topicTitle."</font>";

$postShow.= $this->postTitle->addToLayer();

$sql="SELECT  postId,postOwner,postText,postCreateTime  from
tbl_forum_posts where topicId= '$topicId' order by postCreateTime asc";

$rs=$this->objDbPosts->getArray($sql);

foreach ($rs as $line){

    $postId=$line['postId'];

    $postOwner=$line['postOwner'];

    $postCreateTime= $line['postCreateTime'];

    $postText=nl2br(stripslashes($line['postText']));

    $this->postOwner          =&          $this->newObject('layer',
'htmlelements');

    $this->postOwner->id = "blheadline";

    $this->postOwner->align = "center";

    $this->postOwner->str          =
"Posted"."&nbsp;"."&nbsp;"."by"."&nbsp;"."&nbsp;".$postOwner;

    $postShow.= $this->postOwner->addToLayer();

    $this->postText          =&          $this->newObject('layer',
'htmlelements');

    $this->postText->id = "blog-content";

    $this->postText->align="center";

    $this->postText->str          =

```

```

"<br>". "&nbsp;". "&nbsp;". "&nbsp;". "&nbsp;". "&nbsp;". "&nbsp;". $postText;

$postShow.= $this->postText->addToLayer();

$this->postTime      =&      $this->newObject('layer',
'htmlelements');

$this->postTime->id = "date";
// $this->postTime->align="center";

$this->postTime->str      =      "&nbsp;". "&nbsp;". "Post
Time". "&nbsp;". "&nbsp;". $postCreateTime;

$postShow.= $this->postTime->addToLayer();

$userId=$this->objUser->userId();

if($userId==1){

    $deletePost=$this->href->showlink($this->uri(array('action'=>'del
etepost','postId'=>$postId,'topicId'=>$topicId),
"knngboard"),"Delete",'');

    // $newPost=$this->href->showlink($this->uri(array('action'=>'pos
t'), "forum"),"Add a Replay",'');

    $this->edit =& $this->newObject('layer', 'htmlelements');

    $this->edit->align="right";

    $this->edit->str      =

$deletePost. "&nbsp;". "&nbsp;". "&nbsp;". "&nbsp;". $newPost;

    $postShow.= $this->edit->addToLayer();

}

return $postShow;

}

```



```

//this function is for list topics in the forum

function listTopics()
{
    $head =array('Topic Owner','Topic Tiltle', 'Topic Create
Time','Replies');
    //defined the table fot use
    $this->table->border=1;
    $this->table->cellpadding=4;
    $this->table->cellspacing=0;
    $this->table->width="90%";

    $str.=$this->href->showlink($this->uri(array('action'=>'add'),
"knngboard"),"Add a Topic",'');
    $str.=$this->table->addHeader($head,"heading","align=center");

    $sql="SELECT  topicId,topicTitle,  topicOwner,topicCreateTime
from tbl_forum_topics order BY topicCreateTime desc";
    //srs=$this->objDbTopics->getArray($sql);

    //defined 15 topics in a page
    $pageNumber=$this->getParam("pageNumber",NULL);
    if(!$pageNumber){$pageNumber=1;}
    $max=15;

    $rs1=$this->objDbTopics->getArray($sql);
    $first=($pageNumber-1)*$max;
    //fine the topics for the first page
    $rs=$this->objDbTopics->getArrayWithLimit($sql,$first,$max);

```

```

$rowcount = 0;

// $button = $this->objButtons->linkedButton("edit",
$this->uri($editArray, "forum")); . "\n";

foreach ($rs as $line){

    $topicId=$line['topicId'];

    $paramArray = array('action' => 'show', 'topicId'=>$topicId);

    $topicTitle=$line['topicTitle'];
    $title=$this->href->showlink($this->uri($paramArray,
"ngboard"), $topicTitle, '');

    $topicOwner=$line['topicOwner'];
    $paramArray = array('action' =>
'show', 'postOwner'=>$topicOwner);
    $owner=$this->href->showlink($this->uri($paramArray,
"ngboard"), $topicOwner, '');

    $topicCreateTime=$line['topicCreateTime'];
    // $button = $this->objButtons->linkedButton("edit",
$this->uri($editArray, "forum")); . "\n";

    $oddOrEven = ($rowcount == 0) ? "odd" : "even";

    $filter="where topicId='$topicId'";
    $count=$this->objDbPosts->getRecordCount($filter)-1;

```

```

    $userId=$this->objUser->userId();

    // if the user is administrator have the delete button

    if($userId == 1){

        $paramArray          =          array('action'=>
'deletetopic','topicId'=>$topicId);

        $delete=$this->href->showlink($this->uri($paramArray,
"knngboard"),'Delete','');

        $row=array($owner,$title,$topicCreateTime,$count,$delete);
    }else{

        $row=array($owner,$title,$topicCreateTime,$count);}

    $this->table->addRow($row,$oddOrEven,"align=center");

    $rowcount = ($rowcount == 0) ? 1:0;

}

$stable = $this->table->show();

return $stable;

}

?>

```

```

<?php
class dbforum_posts extends dbTable
{
    /**
     * Constructor method to define the table
     */
    function init() {
        parent::init('tbl_forum_posts');

        $this->objUser =& $this->getObject('user', 'security');
        $this->objLanguage =& $this->getObject('language', 'language');
        $this->USE_PREPARED_STATEMENTS=True;
        $this->objDbTopics = & $this->getObject('dbforum_topics');
    }

    //delete all the post with the $topicId
    function deleteTopic($topicId){
        $sql="select      postId      from      tbl_forum_posts      where
topicId='$topicId'";
        $rs = $this->getArray($sql);
        foreach($rs as $line){
            $postId=$line['postId'];
            $this->delete('postId', $postId);
        }

        //save the post
    }

    function save($topicId){

```



```
$sql="select topicOwner topicTitle from tbl_forum_topics where  
topicId='$topicId'";
```

```
$rs=$this->objDbTopics->getRow('topicId',$topicId);
```

```
$topicTitle=$rs['topicTitle'];
```

```
$topicOwner=$rs['topicOwner'];
```

```
$postText="<b>". "Re:". $topicTitle. "&nbsp;". "&nbsp;". "&nbsp;". "By". "&  
nbsp". $topicOwner. "</b>". "<br>". "<br>".
```

```
$this->getParam('postText',NULL);
```

```
$postOwner = $this->objUser->fullname();
```

```
$postCreateTime =date('Y-m-d H:m:s');
```

```
$postId=$topicId;
```

```
$this->insert(array(
```

```
    'postId'=>'',
```

```
    'topicId'=>$topicId,
```

```
    'postText'=>$postText,
```

```
    'postOwner'=>addslashes($postOwner),
```

```
    'postCreateTime'=>$postCreateTime,
```

```
));
```

```
}
```

```
}
```

```
?>
```

```

<?php

/**
 * Class for the forum topics table in the database
 */

class dbforum_topics extends dbTable
{

    /**
     * Constructor method to define the table
     */

    function init() {

        parent::init('tbl_forum_topics');

        $this->objUser =& $this->getObject('user', 'security');
        $this->objLanguage =& $this->getObject('language', 'language');
        $this->USE_PREPARED_STATEMENTS=True;

    }

    function save(){

        $topicId=$this->getParam('topicId',NULL);

        if(!$topicId){

            $topicTitle= $this->getParam('topicTitle',NULL);
            $topicOwner = $this->objUser->fullname();
            $topicCreateTime =date('Y-m-d H:m:s');

            $this->insert(array(

                'topicId'=>'',

```

```
'topicTitle'=>$topicTitle,  
'topicCreateTime'=>$topicCreateTime,  
'topicOwner'=>addslashes($topicOwner),  
));
```

```
$topicId = $this->getLastInsertId();
```

```
}
```

```
return $topicId;
```

```
}
```

```
}
```

```
?>
```

```
<?php
```

```
$this->table = & $this->getObject('htmltable','htmlelements');  
//Create the centered area for display  
$this->center = $this->objConfig = & $this->getObject('layer',  
'htmlelements');  
$this->center->align="center";  
$this->textArea = & $this->getObject("textarea","htmlelements");  
// Add the heading to the content  
$this->form=& $this->getObject("form","htmlelements");  
$this->button=& $this->getObject("button","htmlelements");  
  
$this->objH =& $this->getObject('htmlheading', 'htmlelements');  
$this->objH->type=2;  
  
///// $this->objH->str=$objLanguage->languageText("keyboard_name");  
$this->objH->str = "Discussion Forum";  
  
$this->center->addToStr($this->objH->show());  
// add the post  
$topicId=$this->getParam('topicId',NULL);  
$this->form->form("formInput",  
$this->uri(array('action'=>'save','topicId'=>$topicId),'kngboard'));  
  
$topicId=$this->getParam('topicId',NULL);  
//check if it is add the new topic or reply to a topic  
if(!$topicId){  
$this->textArea->textarea("topicTitle");  
$textInput->size = 20;
```



```

    $id="<br>".$this->objH->str="Topic
Title<br>". "&nbsp;". "&nbsp;".$this->textArea->show();
    $this->form->addToForm($id);
    $this->form->addToForm('<br>');
}

$this->textArea->textarea("postText");
$this->textArea->setRows(8);
$this->textArea->setColumns(50);
$res1="Post Content<br>". "&nbsp;". "&nbsp;".$this->textArea->show();
$str1="<br>".$this->objH->str = $res1;
$this->form->addToForm($str1);
$this->form->addToForm('<br>');

$this->button->button("submit", "Submit") ;
$this->button->setToSubmit();
$button=$this->button->show();
$this->form->addToForm($button);

$this->center->addToStr($this->form->show());

echo $this->center->addToLayer();

```

?>

```
<?php
```

```
$this->table = & $this->getObject('htmltable', 'htmlelements');
$this->href = & $this->getObject('href', 'htmlelements');
//Create the centered area for display
$this->center = & $this->getObject('layer', 'htmlelements');
$this->center->align="center";

// Add the heading to the content
$this->objH =& $this->getObject('htmlheading', 'htmlelements');
$this->objH->type=2;

///// $this->objH->str=$objLanguage->languageText("kewlboard_name");
$this->objH->str = "Discussion Forum";
//Add the main content
$this->center->addToStr($this->objH->show());

$link=$this->href->showlink($this->uri(array('action'=>'add'),
"kgboard"), "Add a New Topic<br><br>", '');

$this->center->addToStr($link);

$this->center->addToStr($topicList."<br />");

$this->objDbTopics = & $this->getObject('dbforum_topics');
//get how many topics in the forum for defined how many pages will be
$recordCount=$this->objDbTopics->getRecordCount();
$max=15;
```

```

$pages=ceil($recordCount/$max);

$i=1;

$this->center->addToStr("PAGE"."&nbsp"."&nbsp");

//make a index base on page number

while($pages--){

$this->href = & $this->getObject('href','htmlelements');

$paramsArray = array('action' => '', 'pageNumber'=>$i);

$link.= $this->href->showlink($this->uri($paramsArray,
"kingboard"),$i,'');

$i++;

}

$this->center->addToStr($link);

$this->center->addToStr("<br>". "<br>".$link);

echo $this->center->addToLayer();

//Output the content to the page

?>

```


<?php

```
$sqldata[]="CREATE TABLE `tbl_forum_posts` (  
  `postId` int(11) NOT NULL auto_increment,  
  `topicId` int(11) NOT NULL default '0',  
  `postText` text,  
  `postCreateTime` datetime default NULL,  
  `postOwner` varchar(150) default NULL,  
  PRIMARY KEY (`postId`)  
) TYPE=INNODB AUTO_INCREMENT=123 ";  
?>
```

<?php

```
$sqldata[]="CREATE TABLE `tbl_forum_topics` (  
  `topicId` int(11) NOT NULL auto_increment,  
  `topicTitle` varchar(150) default NULL,  
  `topicCreateTime` datetime default NULL,  
  `topicOwner` varchar(150) default NULL,  
  PRIMARY KEY (`topicId`)  
) TYPE=INNODB";  
?>
```

MODULE_ID: kngboard

MODULE_NAME: Discussion Forum

MODULE_DESCRIPTION: a forum for discussion

MODULE_AUTHORS: zhanyu wang

MODULE_RELEASEDATE: 2004 09 11

MODULE_VERSION: 0.1

MODULE_PATH: kngboard

MODULE_ISADMIN: 0

MODULE_ISVISIBLE: 1

MODULE_HASADMINPAGE: 1

MODULE_LANGTERMS: kngboard

TABLE: tbl_forum_topics

TABLE: tbl_forum_posts