

## Development of an Interactive Learning Management System for Malaysian Distance Learning Institutions

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**Abstract:** Several types of learning management systems (LMSs) are used in distance learning courses to facilitate the learning process by delivering the course content and opening new paths of communication between instructors and learners. The LMSs used in most institutions have generally been developed based on e-learning requirements or for training purposes but not based on the user needs of distance learners. User needs change as technology developments, but not all LMSs are suitable for all users and all environments because of the differences in users' needs and the varying functionalities and features of LMSs. Thus, there is a need for more system enhancements and a better understanding of the requirements that must be met to satisfy user needs. The prototype proposed in this paper is called the DLMS because it is an LMS based on the needs of the distance learning institution. This paper discusses a structural model for the DLMS stakeholders (administrators, instructors and students) in the DLMS process and features are designed that are considered important for the DLMS user, such as a Short Message Service (SMS) and plagiarism detection. Finally, a heuristic evaluation was used to evaluate the prototype. The usability of the DLMS was tested by six participants who reported having a good experience with the prototype. From the evaluation results obtained, it is obvious that the DLMS is usable and suitable for delivering, measuring and managing the distance learning process for academic staff, technicians and students. A prototype was constructed to provide distance learning users a usable and effective DLMS and to illustrate to developers how to build future DLMSs.

**Key words:** Learning management system • Distance learning • Heuristic evaluation

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### INTRODUCTION

E-learning encompasses a wide range of technological applications and refers to the use of information and communications technology (ICT) to encourage the process of learning, to support communication in learning settings, to assess learning activities, to manage resources and to create education materials. Malaysia's vision of achieving fully developed nation status in the global economy by 2020 has made ICT an important agenda item for transforming the country from a production- to a knowledge-based economy. The government recognises e-learning as a phenomenal tool for improving education and ensuring Malaysian students' competitiveness in the era of globalisation. Future development calls for greater collaborative efforts from government agencies and industries and for more creative innovations that can advance the field of e-learning [1].

E-learning is widely applied at Malaysian universities using the available technologies, which can support and encourage distance learning activities. These universities have used Internet technology to make their application forms available to students around the world and to publish their websites, which can be accessed by anyone anywhere [2]. Distance learning is a very popular mode of study around the world and the number of students keeps increasing [3]. Universities have used Learning Management Systems (LMSs) adopted from other universities or companies, though some universities have developed their own LMSs. An LMS needs to be updated from time to time because user needs change as technology changes [4]. Furthermore, the LMSs currently in use have primarily been developed for regular learning in general or for administrative purposes [5] and not specifically for distance learning use. Ibrahim and Silong (1997) noted that the available LMSs developed in western institutions are not always appropriate for other

countries and cultures [6]. Meanwhile, LMSs are primarily designed to address the basic needs of some institutions but not the more advanced needs of other institutions [7]. An LMS is a software program that automates the administration of training events. The LMS manages the registered user's login, records data from students, provides reports to management and manages course content. Additionally, the LMS provides high accessibility for a large number of users that may include administrators, content creators or instructors and students. LMSs play an important role in the implementation of e-learning. An LMS should be able to handle various modes of delivery, automate the complex process of enrolling students, facilitating registration and provide reports, records, schedules and transcripts and it should integrate evaluation, testing capabilities and assessments [8, 9]. An LMS facilitates the learning process by providing instructors with tools that allow them to manage the courses and to share information with learners during the distance learning course.

Distance learning uses LMS technology to provide users with different ways of interacting and communicating with each other. In addition, distance learning uses LMSs to facilitate user access to learning resources. Furthermore, LMSs give the distance learning actors a useful and easy way to use the technology's environment to collaborate and direct the learning process. There are five elements that are considered to be very important for building an effective and efficient LMS: a good framework or design, tailored curriculum/intelligent analysis, implementation, security and high availability [10]. An LMS must be capable of handling various delivery modes; it must automate the learner enrolment and registration processes and the process of providing records, transcripts, schedules and reports; and it must incorporate evaluation, assessment and testing capabilities [11]. The importance of the evaluation and assessment is that it introduces the changes to existing instructional systems and addresses the needs of all learners, instructors and administrators, not just the learner. The assessment of web-based distance learning is significant for every new program [12]. LMSs combine many administrative, organisational and technological components, making them very complex systems.

With the availability of LMSs, it is not surprising that there has been growing interest in identifying the design principles and features that can improve user satisfaction. Satisfaction with technology associated with distance and collaborative learning applications has

been found to be significantly associated with usability, that is, the effectiveness, efficiency and user satisfaction. This learning application is related to LMS functions used to make distance education more effective and efficient [13].

The LMS should allow adaptivity, recovery of history and state, comparison of outcomes, monitoring of educational research, a shared reference database and a problem scenario database. For the next generation of LMSs, a standard extension is necessary. Therefore, the extension must include a user interface to define and edit the database. Because learning objects need to access the database, the extension must also include a search engine and security should be included [14]. In addition, it is not easy to develop an LMS based on international standards, as the analysis, design and implementation involve requirements for a variety of interactions and types of communication between LMS users and between user interfaces and database designs that involve high costs and a high level of responsibility from the developer or the organisation. Additionally, the LMS must include high-security access to all the available resources, tools and features and must be able to be integrated with other tools, such as Microsoft Word, PowerPoint, SCORM and content management systems (CMSs). Creating a user-friendly environment where users can easily enter the LMS platform and use it without a long waiting period is an important issue in LMS design. Because users may be from different countries, the LMS must provide a multi-language environment. Furthermore, the LMS is usually part of the university system or another system, so it is obvious that when the organisation needs to integrate these systems, it is not easy to change the code regularly. In contrast, using an open source (OS) LMS can allow independence and, with some changes, the organisation will be able to adapt the learner side to the LMS of the main system [15].

In 2005, the Organization for Economic Co-operation and Development (OECD) reported that many universities around the world use an LMS. The most common LMSs are Blackboard, WebCT and Moodle, which are used merely for administrative purposes; LMSs have had very little impact on pedagogy. Some instructors may use the discussion board to generate class discussions among students and themselves, but the lack of immediate feedback with the discussion board in LMS software has resulted in a lack of satisfaction among users. Although a virtual classroom, with its capacity for live chat, the utilisation of a collaborative whiteboard and group web

browsing is available in the LMS, its appeal to instructors may be limited because of the demands placed on both instructors and students to be available during a specific time frame [5]. However, LMSs do not offer personalised services and students are being given access to the same set of educational resources and tools; differences in their knowledge level, interests, motivations and objectives are being ignored [16].

Distance learning institutions use several types of LMSs to deliver the course contents and to communicate with the university's users. The LMSs used in these institutions have generally been developed based on e-learning requirements or for training purposes, but not based on distance learning user needs. Different users require different features and not all LMSs are suitable for all users and all environments due to their different features and functionalities, which has led to a need for a better understanding of the requirements and for more system enhancements [17]. Thus, these improvements and enhancements will increase the success of LMSs, which will increase the level of acceptance among distance learning users. However, before introducing the distance learning user to the new LMS, the improved and enhanced LMS should be evaluated by experts to ensure that it will satisfy the user's needs and desires. With these issues in mind, the aim of this study is to develop an LMS prototype for distance learning institutions. The new prototype is called DLMS because it is an LMS based on the distance learning institution's needs. The DLMS was developed based on the DLMS requirement model introduced by Almarashdeh *et al.* [18], which catalogued all related requirements of distance learning users to provide them with a fully functional LMS and update the LMS with new technologies based on their needs and desires.

Prototyping is used to save money and time while developing a working or real system that can be used and tested by the end users. The designer or developer can limit the prototype compared with the real system by either reducing the level of functionality of the features such that they seem to work but do not actually do anything or minimising the number of features in the prototype [19]. In this study, the DLMS user interface prototype was designed using Adobe Dreamweaver CS5. Rational Rose 2004 was used to document the DLMS. Finally, the researchers evaluated the usability of the DLMS prototype heuristically using an expert review to ensure the prototype met standards and was usable for distance learning users.

**Structure Design:** The name DLMS (Distance Learning Management System) was chosen to describe a special platform for distance learners that satisfies all their needs. The DLMS was developed based on distance learner and instructor needs. The designed prototype has three different user views for administrators, learners and instructors. Instructor access to specific features will be authorised by the system administrators and learner use will be monitored by both the instructor and administrator. All DLMS functions will be available for any system user and those with administrator privileges. The instructor can choose any required feature to use in his/her class and can hide any unrequired feature. The DLMS prototype presents all features in efficient and user-friendly interfaces that can interact.

Figure 1 shows the login page for all DLMS users. Additionally, a guest user can view the list of courses and programs, the instructor's information and the course syllabus without logging in. All users and guests can use the help button to request any information they need from the administrators.

The DLMS includes several features considered to be important for the future DLMS. The researchers removed features that, in the researchers' view, were not important for the current learning process, such as a bookstore, which needs to be implemented in a different system and photos haring, which is an option available to the user in the file-sharing feature. Furthermore, the researchers focused on the supported language to allow students from different countries who speak different languages to study via the DLMS. The DLMS must be a multi-language platform that can support many languages, such as Malay, Tamil, Mandarin, English and Arabic. All these languages are important to Malaysian universities because a high percentage of international students come to study in Malaysia. This feature will benefit both the universities and the students because they will be able to understand the platform news, information, study process and activities at their universities.

The main pages for the DLMS were designed differently to cater to students and staff. Each user has a different main page. The system is divided into three modules: a student module, an instructor module and an administrator module. Figure 2 shows the system structure for the student module. The learners have the ability to access all available resources and course content, check for plagiarism, enter chat rooms and more on the student course page.

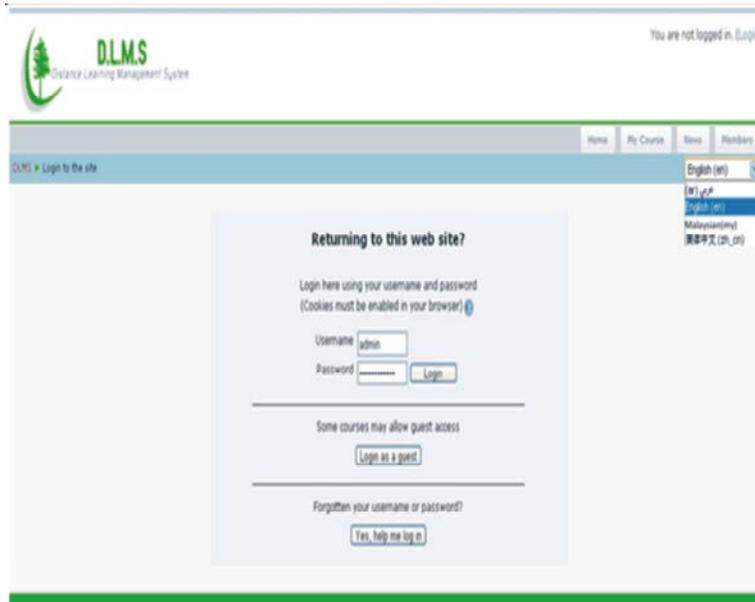


Fig. 1: User Login

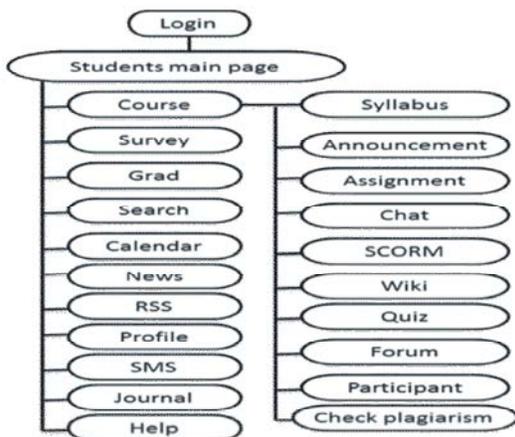


Fig. 2: Student module

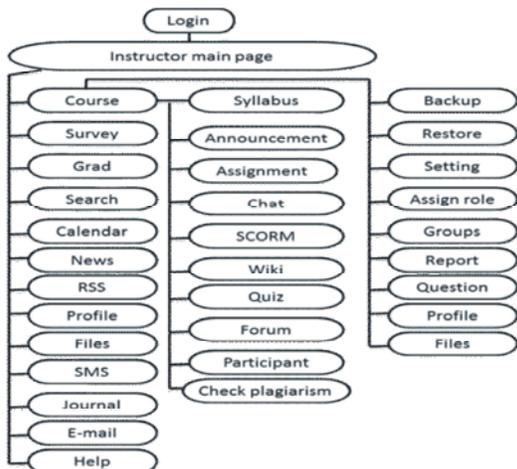


Fig. 3: Instructor module

Figure 3 shows the system structure for the instructor module. Instructors are able to create and view tests or exams, organise the course content, manage online discussions or forums, use a grade tool, view student information and more, as shown in Figure 3. The prototype includes a variety of templates to build core course elements, including assignment, announcement and syllabus templates, that will facilitate the course development process for the instructor, especially when the instructor teaches a number of courses or a user moves from one course to another. These templates are important to ensure the presentation format is consistent.

Figure 4 shows the system structure for the administrator module. The DLMS administrator is able to register students, monitor resource use, add/remove courses and change user passwords (Figure 4). The system administrators can use several features to promote active learning and facilitate course delivery, such as sending SMS messages to the DLMS users and checking for plagiarism. The system also provides an online journal to record lists and reports.

Previous research has noted that LMSs are not yet suitable for modern mobile devices because of the reduced display size and the need to optimise the user interface [20]. Because students are studying online, the DLMS prototype must be capable of working on smartphones and common mobile phones. The DLMS provides users with a mobile interface that gives students

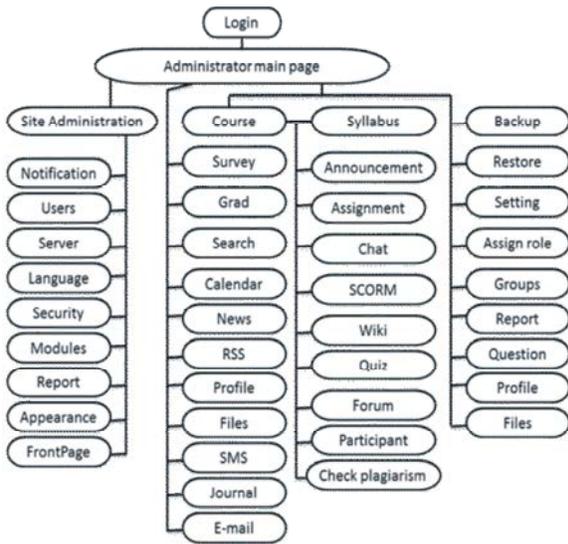


Fig. 4: Administrator module



Fig. 5: Mobile Interface

the ability to study using mobile technology. Figure 5 shows the DLMS capabilities in terms of the display size and optimisation of the user interface on a mobile phone tested with Adobe Dreamweaver CS5.

**DLMS Features:** In this section, we discuss some of the most important and newest features added to the DLMS prototype, such as the ability to send SMS messages and detect plagiarism, an online journal and video chatting, which can replace video and voice conferences and save time and money for the users and organisations.

The survey tools in DLMS offer the users many survey templates, which allow them to use multiple-choice questions, open-ended question, yes or no questions and tick box questions. The DLMS students can use the survey tools in the course with permission from the instructor. Thus, if the instructors or students want to administer their survey outside the course on the worldwide network, the administrator can provide them

with a link for distribution. The administrator can use the survey tools to evaluate instructor performance and the overall success of the course. However, universities currently still use external plagiarism detector systems (i.e., OUM), which cost the university more money and the quality cannot be guaranteed [21]. The plagiarism detection tool is used to avoid duplicating an idea or work and it shows DLMS stakeholders how to avoid plagiarism and how to correctly cite sources. This tool provides users a place to upload their work and check it, or they can copy and paste their work into the plagiarism detector. The plagiarism detector searches documents on the Internet and displays the total plagiarism percentage to show the researcher how similar the document is to the original source. This tool is displayed on the course's main page and all DLMS stakeholders can use it during the learning process.

The search tool is designed to help users by giving them the ability to search for information on the Internet and on File Transfer Protocol (FTP) servers. This tool allows users to search course content forums, chat rooms, user profiles, wikis and blogs and displays the search results in a list. The results may consist of profiles, web pages, information, images and many other file types, such as PDF, ZIP and video files.

Nowadays, students can respond to communication from the university, but they do not have the option to communicate individually with their instructors or administrators using SMS. If students do need to communicate regarding an assignment, they must go to the LMS or to a Facebook forum to share their knowledge; they cannot respond immediately via the SMS tool. To effectively utilise the SMS feature, the tool should allow the instructor or administrator to contact students individually or as a group. An important part of this feature is the ability to notify the students when there are content updates or schedule changes. Furthermore, the administrator can use the SMS feature to notify the instructors and students about site updates, content and important announcements and to notify distance learners about registration and exam dates. Students can also discuss content with instructors using the SMS tool and instructors can provide immediate feedback to the students without having to come back to his/her personal computer. SMS tools can be used as a backup plan if users lose their Internet connection and they can report any problems or errors they face. The SMS feature allows the instructor to contact students individually or as a group. This feature is important for notifying students

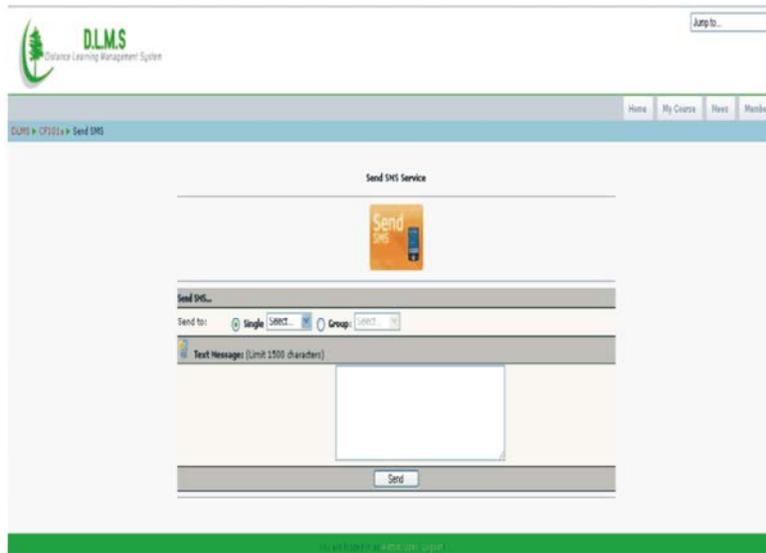


Fig. 6: Send SMS Page

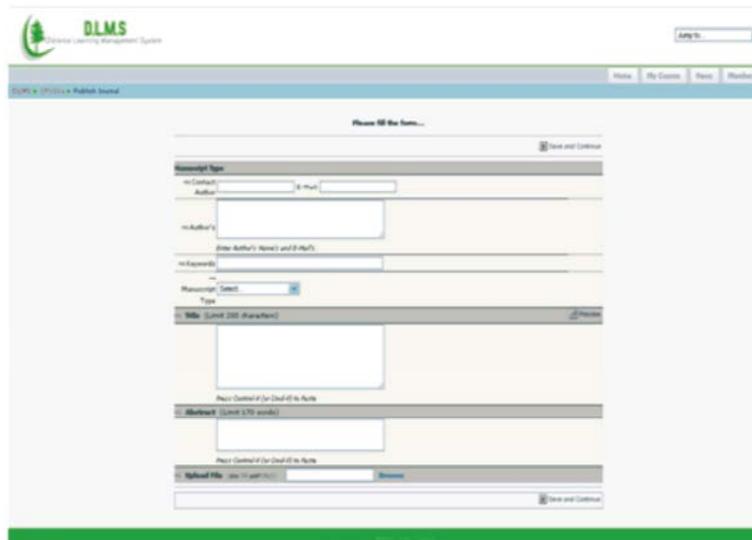


Fig. 7: Online Journal Page

about content updates and schedule changes. Furthermore, the administrator can use the SMS feature (Figure 6) to notify the instructors and students about site updates, content, important announcements and registration and exam dates.

The online journal (Figure 7) is a tool for publishing research studies and reports. The DLMS provides this feature to the users to make the distance learning environment complete and to provide all the tools required for learning. The online journal tool includes a place to indicate the authors' names, contact information, abstracts, author emails, keywords and titles. The user can also upload a variety of file formats, including PDF

and Microsoft Word files. This feature allows the students and instructors to upload their work and the administrator can send the papers to the reviewers.

Distance learning institutions currently use video conferences to communicate face-to-face with distance learners. The DLMS chat room offers the distance learning institution a good tool that can replace video conferencing and save money and time because the chat tool will be available in the course at all times. Thus, the DLMS users can communicate or perhaps make a presentation during class without needing to leave the course page. Chat tools available in the DLMS prototype include voice, video chat and a whiteboard, which

provides the stakeholders a good environment in which to communicate and interact. With this tool, the administrators and instructors can manage the chat report and the instructor can simultaneously create a chat room for each course or even each subject.

**System Modelling and Component Diagram:** System models play an important role in system development. Modelling is a way to address unstructured problems. In this study, models are built to document the requirements. The models are used to represent items and ideas the author wants to document and to allow the researcher to create different views of a system from different perspectives. Models constructed from an analysis perspective aim at determining whether the requirements meet the user's needs. In this phase, the models were constructed based on the requirements that had been approved in a previous study [18]. The Unified Modelling Language's (UML) notations are used in this study to model the user's requirements. These notations can be used to visualise, specify, construct and document the developing system [22, 23]. The implementation diagrams of UML were made to model the system implementation. The component diagrams were used to model the different software components within the system and how they communicate with each other. Figure 8 shows an overall view of the components with DLMS and how they are connected. The system consists of a database and three subsystems for students, instructors and administrators. These subsystems are dependent on the main database. To administer the database, every user in the DLMS has a specific job.

Each component within the DLMS implementation is made up of a group of subcomponents. The subcomponents and their functionality and relationships are defined and described in the component diagrams in Figure 9.

The general representation of the student and instructor system shows the components involved in the whole system, which is the top layer in their interface. Figure 10 show the student and instructor component diagrams.

**Evaluation of the DLMS Prototype:** Learning evaluations are best performed by learning specialists (e.g., educational psychologists, teachers, youth workers) [24]. To ensure that the prototype has met the user and system requirements and to ensure that the DLMS has

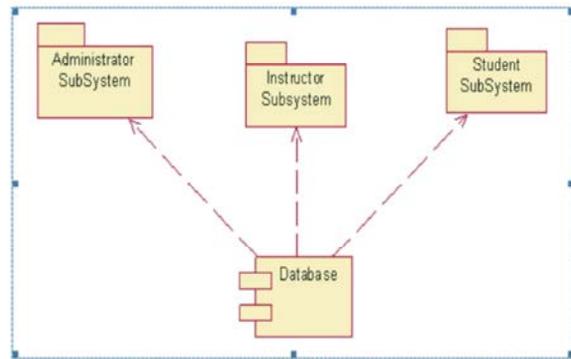


Fig. 8: Component diagram for the stakeholder database

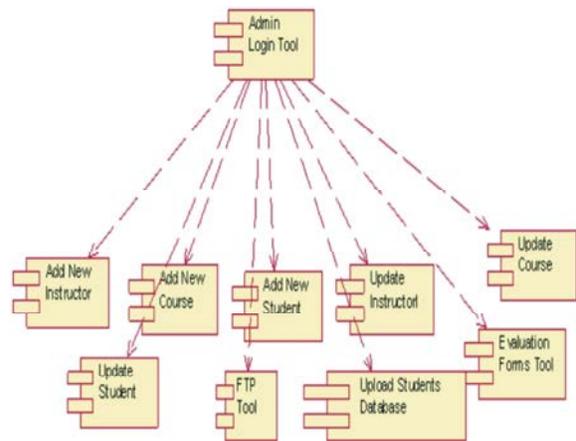


Fig. 9: Component diagram for administrators

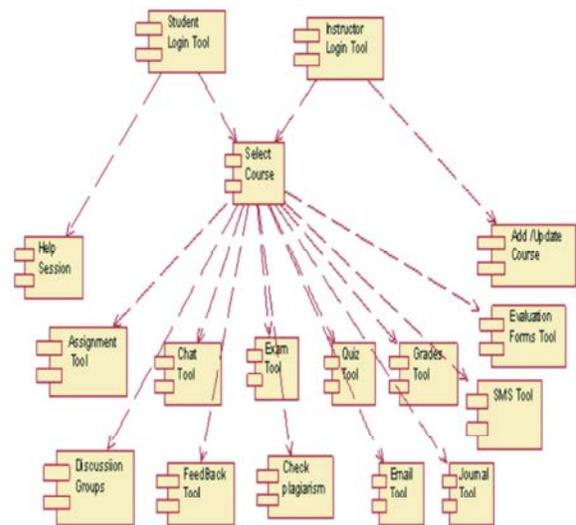


Fig. 10: Component diagram for instructors and students

met the general usability principles, we performed a heuristic evaluation to evaluate the DLMS prototype. A heuristic evaluation (usability audits or expert reviews) is a professional method for evaluating a system's

usability. Previous studies have recommended using two to three judges or experts to provide valid recommendations for the system evaluation and to assess the system design and functionality based on guidelines provided by the system developer and on the general usability principles [19, 25]. The evaluation aims to review, check, test, inspect, establish and document whether processes, services, documents, or items fulfil the requirements [26]. Based on a literature review, the DLMS evaluation began by developing an expert form that consisted of four main parts: what the DLMS interface achieved, what the DLMS interface did not achieve, recommendations and severity rating. Thus, six experts with experience in distance learning, LMS development, software engineering and system quality reviewed the usability of the DLMS. The evaluation concluded that the DLMS is obviously usable and met the requirements. The DLMS prototype fulfilled the requirements. The value of the expert's severity rating shows that there is no major problem in the DLMS prototype, with 33.3% indicating a minor usability problem, 50% indicating a cosmetic problem only and 16.7% indicating the DLMS had no problem at all. However, the DLMS still needs to be improved to further enhance the features of the future DLMS, especially the nonfunctional features. Compared with existing LMSs used in many institutions, the DLMS provides academic staff, students and technical staff with usable and suitable tools to manage and deliver distance learning courses.

### CONCLUSION

In Malaysia, a wide range of distance learning courses have been provided by local universities in accordance with Malaysia Vision 2020. The number of students is increasing and LMSs have become the most popular system used in higher education. The universities have used distance technology, especially LMS (adopted from other universities or companies) and some of them have developed their own LMSs. The current LMSs and distance learning technology in general need to be updated from time to time because user needs change in parallel with the changes and advances in technology. A well-designed LMS is one that helps the user access and browse the LMS effectively. Content sharing, photo/video sharing and social networking should be integrated into the current LMS. In this paper, the researchers designed a DLMS

prototype based on distance learning user requirements. The LMS prototype was called the DLMS because it is an LMS designed specifically for distance learning. Adobe Dreamweaver CS5 was used to design the user interface. The researchers selected the characteristics of the prototype, designed the user interface and developed the DLMS features. This study addressed 37 features that were considered important for the DLMS user, such as plagiarism detection, SMS, online surveys, an online journal and RSS. The DLMS was constructed to provide distance learners with a usable and effective prototype and to show developers how to build a DLMS. The heuristic evaluation (expert review) concluded that the DLMS is suitable for delivering and managing course content and for providing distance learners, instructors and administrators the most needed features to facilitate the learning process and save money and time.

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