Design of a Virtual Learning Environment Implementation Framework for State Universities in the Philippines: A Case of Mariano Marcos State University

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Abstract

Virtual Learning Environment (VLE) provides a unified platform for content delivery, communications, assessment, and course management with managed interfaces linked to the institution's central information systems and resources. A VLE is a web-based package designed to help teachers create online courses. It involves facilities for teacher-learner communication and peer-to-peer communication. Many universities nowadays are adopting VLE to support their respective teaching and learning process. With VLE, they can innovate the mode of the delivery of instruction as well as to introduce new pedagogy for learning and interaction among faculty and students. However, without a robust understanding of the user needs, the infrastructure and the technology requirements of the VLE, any implementation plans become futile. A well designed VLE implementation framework is, therefore, a vital precursor to the success of an effective implementation. The study presents a VLE implementation framework for State Universities in the Philippines specifically for the Mariano Marcos State University along three major elements: the users, the ICT infrastructure, and the VLE architecture along with their unique implementation requirements. The design of the VLE implementation framework was based on the various inputs and results of the assessments undertaken in the study. The assessments include a) ICT e-Readiness in terms of its existing ICT infrastructure and users' ICT profile, b) VLE functional requirements, components, features and capabilities and c) open source technologies for VLE implementation.

Keywords: *Virtual Learning Environment (VLE), e-Learning, ICT infrastructure*

Introduction

The use of technology for learning is influenced by developments in numerous fields: technology itself, global trends (market economy growth, changing immigration patterns, and intellectual shifts to emerging economies), societal trends and trends within educational research.

According to the Joint Information Systems Committee, the term VLE refers to the components in which learners and tutors participate in "on-line" interactions of various kinds, including on-line learning. However, not all interactions have to be online since a VLE can act as a focus for students' learning activities and their management and facilitation, along with the provision of content and resources required to help make the activities successful (Stiles, 2000).

The Mariano Marcos State University (MMSU) is a comprehensive institution of higher learning in the Ilocos region. At present, MMSU has ten academic units. Learning setting at MMSU is mostly face-to-face that is, through classroom discussion. Subsequently, traditional classroom setup has been observed not enough for teachers to deliver their lessons especially in cases where classes are suspended due to holidays, school activities, calamities, and other interruptions. That is why some faculty members use the Internet as an extension of the classroom setting. Blogs, personal websites, chat, and email are some of the tools that faculty members use to suffice students' needs.

The purpose of this study is to design a VLE implementation framework for MMSU that will innovate the university's mode of delivery of instructions to the students and introduce a new pedagogic model for learning and interaction with faculty and students.

Methodology

The study was conducted at the Mariano Marcos State University, Batac City, Ilocos Norte. The surveys conducted considered only the undergraduate faculty and students of the Batac campus. Respondents were randomly chosen with the use of the stratified random sampling technique. The population of faculty in each college was based on the list of the faculty provided by the Human Resource and Management Office. Also, the population of students in each college was based on the report of enrolment prepared by the Registrar's Office during the period of Second Semester for Academic Year 2010-2011. The total sample sizes considered are 160 faculty and 377 students for a total of 537 respondents.

To determine the e-Readiness status of MMSU ICT in terms of its ICT infrastructure, personal interview, interview through a questionnaire and analysis of secondary data were conducted. The ICT infrastructure assessment rubric by Mokhtar, et al. (2007) was utilized.

The researcher adopted the self-evaluation rubric developed by Mankato (Minnesota) Public Schools. This tool was designed to help staff understand their current level of skills with computer technologies. The self-evaluation rubric considers 13 areas: Basic Computer Operation, File Management, Word Processing, Spreadsheet Use, Database Use, Graphics Use, Internet Use, Telecommunications Use (E-Mail), Ethical Use Understanding, Information Searching, Video Production, Presentation Skills, and Technology Integration.

The VLE functional requirement assessment tool designed by JISC infoNet (n.d.) was used to understand the users' VLE needs of both students and faculty.

Series of comparative studies were made using the currently available free software and open source VLEs: Chamilo; Claroline; Dokeos; eFront; ILIAS; Moodle; and Sakai. The comparative studies undertaken are a comparison between the VLE products based on functions, a comparison between the VLE products based on features and capabilities, and assessment of the requirements for the VLE framework for MMSU.

The design of the VLE implementation framework was based on the different inputs and results of the assessment undertaken in this study. This includes assessment of MMSU ICT e-Readiness in terms of its existing ICT infrastructure and users' ICT profile, and review of the VLE functional requirements, components, features and capabilities, and open source platforms.

Results and Discussion

Status of MMSU ICT e-Readiness

Addom(2004) pointed out that e-readiness assessment is the first step in almost all approaches to the measurement of digital-divide problem to consider an organization's ability to integrate ICT.

Status of MMSU's ICT Infrastructure

The level of implementation of MMSU ICT infrastructure in terms of computers is moderate. Network and Internet manifests a moderate level of implementation. Display screen technologies and peripherals show that there is a moderate level of implementation. On the other hand, the software and information systems category interpreted as high level of implementation. The overall level of implementation of MMSU ICT infrastructure based on the results shows that the university has a moderate level of ICT implementation.

Status of MMSU Faculty ICT Profile

This section aimed to understand and define the professional profile of the faculty members of MMSU in terms of their ICT capabilities.

Table 1. MMSU faculty profile based on ICT skills.

Scale	No Capability		Beginner		Intermediate		Advance	
ICT Skills	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Basic Computer Operation	0	0.00	8	5.00	90	56.25	62	38.75
File Management	0	0.00	3	1.88	84	52.50	73	45.63
Word Processing	0	0.00	18	11.25	90	56.25	52	32.50
Spreadsheet Use	4	2.50	52	32.50	55	34.38	49	30.63
Database Use	60	37.50	67	41.88	18	11.25	15	9.38
Graphics Use	33	20.63	78	48.75	28	17.50	21	13.13
Internet Use	0	0.00	53	33.13	64	40.00	43	26.88
Telecommunications Use (email)	8	5.00	84	52.50	27	16.88	41	25.63
Ethical Use/ Understanding	3	1.88	99	61.88	32	20.00	26	16.25
Information Searching	3	1.88	98	61.25	34	21.25	25	15.63
Video Production	121	75.63	20	12.5	6	3.75	13	8.13
Presentation Skills	8	5.00	34	21.25	59	36.88	59	36.88
Technology Integration	5	3.13	64	40.00	78	48.75	13	8.13

As shown in Table 1, the respondents assessed themselves with an intermediate level of skills on the following areas: basic computer operation, file management, word processing, spreadsheet use, Internet use, telecommunications use, presentation skills and technology integration. Likewise, the respondents rated themselves beginner in terms of database use, graphics use, ethical understanding and information searching. However, majority of the respondents have no capability on video production skill.The survey's result reflects that the level of ICT skills of MMSU faculty members is intermediate. This shows that MMSU faculty members are capable or fit in handling such VLE to enhance their teaching method.

Evaluation of VLE

This section discusses the result of the evaluation as regards the priority level of users on VLE functional requirements and the evaluation of the VLE components, features and capabilities vis-a-vis open source platforms.

Users' Priority Level of Preference on the VLE Functional Requirements

Access and security functions marked with the highest level of priority on both faculty and students as regards to secure access, security on groups' communication tools, and organizing and managing groups. Tracking of learners' activity and achievements both marked the highest level of priority under audit function. Along with archiving and copy functions, respondents prefer archiving and copy of all materials.The users prefer learning materials should allow a variety of common formats, support inclusion of video and organization of materials. All the components of the enrolment function were marked with the highest level of priority. Learners' assessment records, assessment materials (integrated) and assessment question bank to enable reuse were considered as high priority. Users prefer module tasks and calendar. The survey function was not considered by users.

Users' priority level of preference on data output category marked high on both learning materials function and learners' assessment record. While the learners' survey result got medium priority. The links function for learning resources rated high level of priority.

The users' priority level of preference on communication is synchronous communication between tutors and learners and chat garnered the highest priority. While asynchronous communication on email integrated with institutional system got high priority.Users' priority level of preference on configuration category revealed that interface or front-end function was considered with the highest priority level in terms of the institutional logo and colour, learning system's name and personalization.Four out of 6 functions under usability category were marked highest priority by the users. The functions considered include search, views, legal requirements, and ease of navigation.

VLE Components, Features and Capabilities vis-a-vis Open Source Platforms

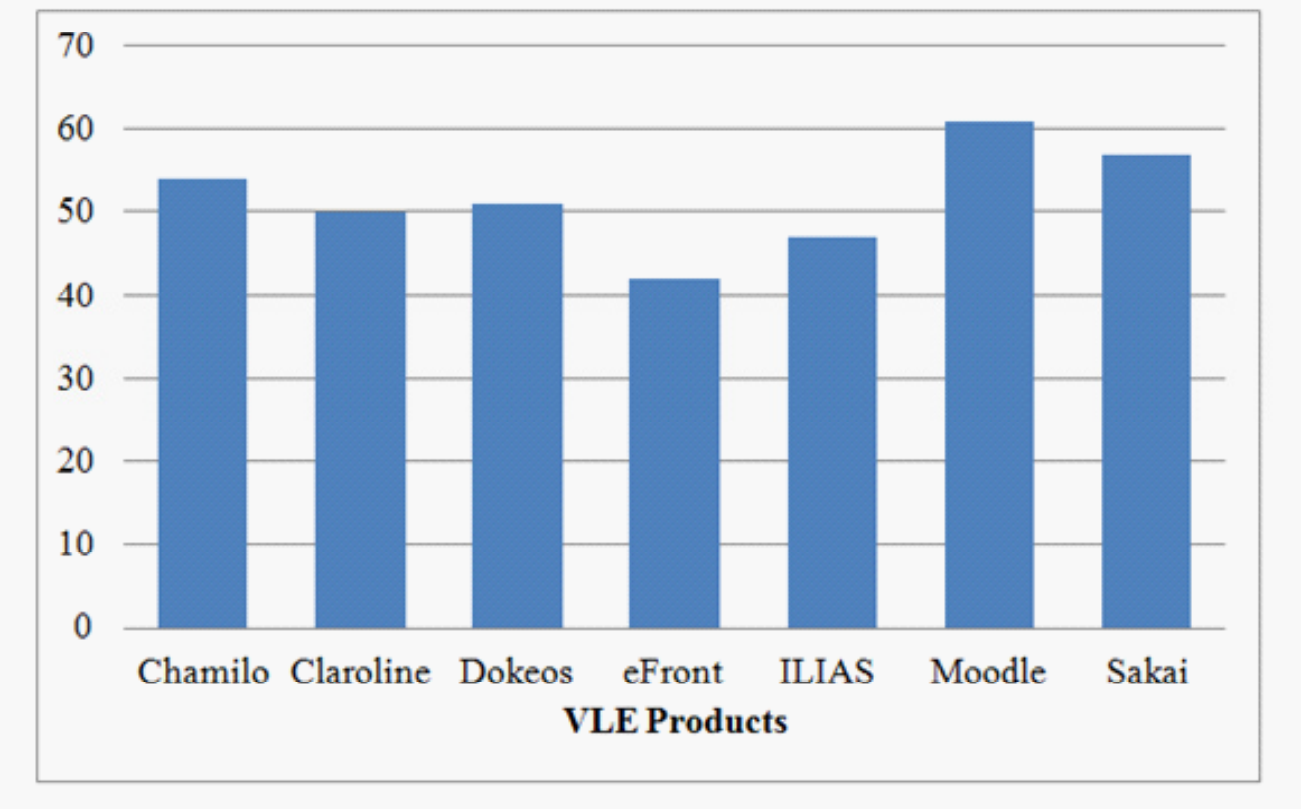
This section presents the features, capabilities and components of the selected currently available free software and open source VLE products. The VLE systems considered are: Chamilo; Claroline; Dokeos; eFront; ILIAS; Moodle; and Sakai.

Comparative Study Between the VLE Products Based on Functions

VLEs as an e-learning system have many functions. For simplicity, the researchers made use of the statement of requirements for VLE provided by JISC [4].

As presented in Figure 1, the best VLE product is Moodle as compared with the other six VLE products.

Figure 1.Total Functions Supported by Each of the Selected VLE Products



Requirements for the MMSU VLE

This section presents the requirements for the MMSU VLE. Table 1 shows the mapping of findings on Faculty ICT profile. Faculty ICT skills on basic computer operation, file management, word processing and spreadsheet is inadequate. It has been noted that faculty members have poor knowledge or level of skills on database, graphics and information searching. It was found out that there is an insufficient level of skill of Faculty members along Internet and telecommunications use. As to ethical understanding, the faculty admitted that they have too little understanding of copyright and fair use. Faculty members have no capability of video production. Also, faculty members have intermediate level of skill on presentation and technology integration.

Along with the findings on Faculty ICT profile, it is recommended that the identified problems or deficiencies of Faculty ICT skills be addressed. Faculty should undergo re-training programs and/or attend short-term courses. This will prepare them to engage in VLE.

Table 2. Mapping of Findings on Faculty ICT Profile

Indicator/ICT Skill	Findings	Program Requirements
Basic Computer Operation	Faculty have inadequate knowledge/level of skill on basic computer operation, file management, word processing and spreadsheet.	Faculty should undergo re-training programs and/or attend refresher courses on basic computer operations, file management, word processing and spreadsheet.
File Management		
Word Processing		
Spreadsheet Use		
Database Use	Faculty have poor knowledge/ level of skill on database and graphics.	Faculty should attend short-term courses on database and graphics.
Graphics Use		
Internet Use	Faculty have insufficient level of skill on Internet and telecommunications use.	Faculty should go through re-training programs on Internet and telecommunications.
Telecommunications Use		
Ethical Understanding	Faculty have too little understanding on copyright and fair use.	Faculty must be educated with the basic understanding of copyright and fair use through seminars/forums.
Information Searching	Faculty have poor knowledge/ level of skill on information searching.	Faculty should attend to enhancement trainings on information searching.
Video Production	Faculty have no capability on video production.	Faculty should enroll to short-term courses on video production.
Presentation Skills	Faculty have intermediate level of skill on presentation and technology integration.	Faculty should undergo re-training to enhance their skills in presentation and technology integration.
Technology Integration		

To support the VLE needs of the University, the University must have a sustainable ICT infrastructure. Table 3 shows the mapping of findings on the University's ICT infrastructure.

The University's computer resources are adequate as shown by the computer to student ratio and Internet-enabled computer to student ratio. The University should maintain or increase the ratio to achieve an ideal 1:1 ratio. But there is an inadequate number of computers to academic staff at the same time inadequate number of Internet-enabled computers to academic staff. They can be addressed by increasing the number of computers to support academic staff needs.

Along with the network and the Internet, the University's network specification is 100MB Ethernet, meaning that the university has a very low Internet bandwidth that causes slow network performance during peak or busy hours. It is, therefore, recommended that the University should increase its network specification to at least Gigabit and subscribe to higher Internet bandwidth for faster Internet access even at busy times. Though more than 50% of the learning areas are connected with wireless technology, there is still need to expand the wireless coverage to achieve 100% wireless connectivity.

As to the University's display screen technologies and peripherals, there are more than 50% of the classrooms equipped with display screen technologies. However, there is inadequate number of printers and other peripherals. There is a need to increase the number of printers and other peripherals to address this problem.

In terms of software and information systems, though there is available licensed and open source software, there is a need to acquire updated software to cope with the current state of technology. Other information systems should consider interoperability to provide an enterprise service oriented type of environment.

Table 3. Mapping of findings on ICT infrastructure.

Indicator	Findings	Program Requirements
Computers	Adequate number of computers to students.	Maintain or increase the number of computers to students to achieve a 1:1 ratio.
	There is 1:3 or better ratio of Internet-enabled computers to students.	Maintain or increase the number of Internet-enabled computers to students to achieve a 1:1 ratio.
	Inadequate number of computers to academic staff.	Increase the number of computers to academic staff.
	Inadequate number of Internet-enabled computers to academic staff.	Increase the number of Internet-enabled computers to academic staff.
Network and Internet	The network specification is 100MB Ethernet.	Increase the network specification to Gigabit or better.
	Very low Internet bandwidth.	Improve network infrastructure and increase Internet bandwidth.
	Wireless coverage is more than 50% of the learning area.	Expand the wireless coverage to 100% of the learning area.
	Slow network/Internet performance at busy times.	Subscribe higher Internet bandwidth for faster Internet access even at busy times.
Display Screen Technologies and Peripherals	More than 50% of the classrooms are equipped with display screen technologies.	Provide all (100%) classrooms with display screen technologies.
	Inadequate number of printers and other peripherals	Increase the number of printers and other peripherals such as scanners, speakers, camera, etc.

Software and Information Systems	There are available licensed and open source application software.	There should be a regular update on the latest versions of the available application software.
	There is an available customized LMS but used only for some time and not for University-wide use.	Development and implementation of a VLE for the entire University.
	Existing student information systems (enrolment/assessment systems) does not support interoperability standards	Migrate or redesign existing student information systems that allows interoperability to other existing information systems such as Library, student services, etc.

The following VLE functions were selected to compose the activated components of the VLE for MMSU at the same time these functions are supported and are available in the Moodle platform.

Under data management, the following were prioritized: access and security along secure access, groups' communication tools and organize and manage groups; tracking of learners' activity and achievement within audit function; archiving of all materials; and copying of all materials.

Along with data input category, users prefer learning materials to allow variety of common formats, inclusion of video, and organization of learning materials. In enrolment function, enrolment to available modules, tutor enrolment and learner enrolment records were considered. Learner assessment records, integrated assessment materials and assessment question bank to enable reuse were prioritized within assessment function. Also, calendaring function includes module tasks and calendar.

Data output category contains learning materials and assessment functions. Users marked high priority on timed release, learner and tutor access to learning materials and timed release of learner assessment records.

Links to learning resources was also prioritized to allow lists of resources available in shareable format to both learner and tutor. Synchronous communication between tutors and learners using chat and asynchronous communication using email integrated with the institutional system were considered by the users.

Interface or front-end function under configuration category includes institutional logo and colours, name of the learning system and personalization. Other priority functions incorporated are search, views, legal and navigation.

VLE Implementation Framework for MMSU

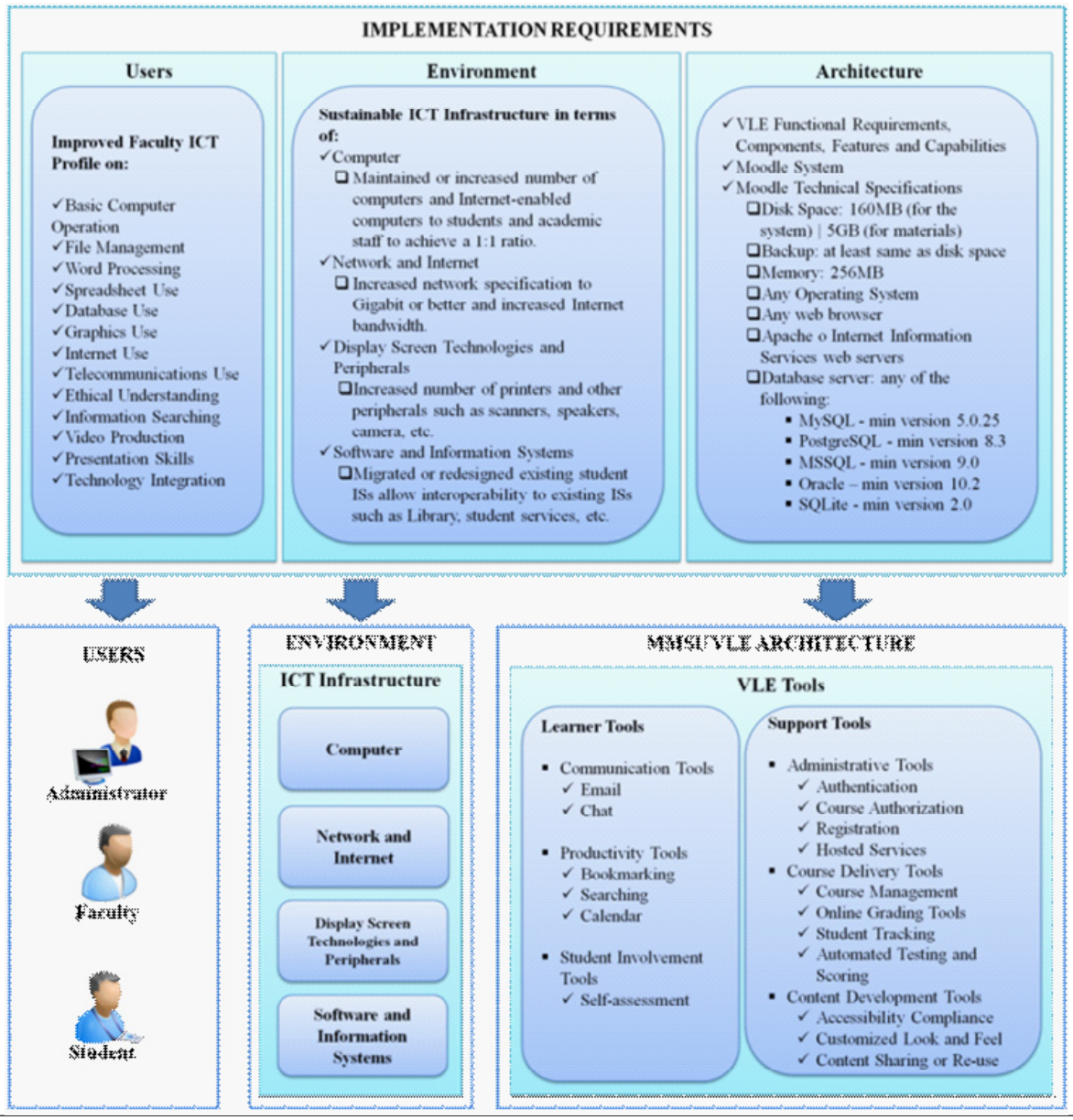
This section discusses the components integrated into the VLE framework suited for MMSU based on the results of findings on different areas considered. The assessment results of MMSU ICT e-Readiness in terms of ICT infrastructure and faculty ICT profile were used to determine the elements of the framework. The results of the comparative study on the different VLE products were also integrated into the framework.

Universities nowadays are investing in implementing different VLEs to support the teaching and learning process. However, without a successful implementation, many objectives and advantages are not realized. Therefore, a well-designed strategy to follow is vital to the success of an effective VLE implementation.

Introducing a VLE into the school environment can be a challenge because it requires some degree of changed management. First, the administrators, teachers, and students should acknowledge that this will affect the way they work, teach and learn. It is also important to realize that the implementation will take some time. However, if done properly, the VLE is a fantastic tool which has shown to raise attainment and to make content and learning materials available for students both while at school and at home.

Figure 2 presents the designed VLE implementation framework for MMSU. The elements included are users (Faculty ICT profile), environment (ICT infrastructure, Moodle technical specifications), the VLE architecture (VLE product and tools) and implementation requirements.

Figure 2. VLE Implementation Framework for MMSU Users



It has been noted that MMSU Faculty ICT skills are inadequate enough to engage them in VLE. Their level of skill in database use is low (beginners) where they understand the use of database and locate information from a pre-made database such as Library search. Graphics use skills garnered low because most faculty members can only open, create, and place simple pictures into documents using drawing programs. As to ethical use understanding skill, only a few understand the ethical usage of all software. Most faculty members are not capable of video production. All these can be solved by providing more training and workshop programs to prepare the faculty in using VLE.

The three types of users considered are administrator, faculty, and students. The administrator is the most important user and has the full permission to do anything in the VLE system. It has the responsibility to manage the site and control all users. Faculty users can do anything within a course. Faculty's responsibility is to control and manage the learner tools. And, student users have fewer privileges within a course.

ICT Infrastructure

The number of computers to academic staff is inadequate. With this, there is a need to increase the number of computers to academic staff to cater their needs. The University's Internet connectivity is very slow due to low bandwidth. To address this problem, the network infrastructure must be improved by subscribing higher Internet bandwidth for better Internet access. There is also a need to increase the number of printers and other peripherals such as cameras, scanners, etc.

There are different information systems used in the University such as Students Information System, Personnel Information System, Library System, and others. But there is a problem with interoperability standards. Addressing this issue needs the migration or redesigning of some of the information systems that will allow interoperability of other information systems including the VLE.

MMSU VLE Architecture

As a result of the comparative studies conducted, it turned out that Moodle is the suitable platform for the MMSU VLE. The MMSU VLE site architecture was patterned to the architecture of Moodle as shown in Figure 3. The VLE tools enable teachers to build resources fast and without the need to develop technical skills. VLE tools are criteria-based, and they enable developers to evaluate and select the most suitable VLE product. Moodle contains a wide range of activity modules that can be used to build-up any course. They provide the central point for information, discussion, and collaboration among users.

Learner and support tools were considered in the VLE architecture of the framework. Learner tools include communication tools, productivity tools, and students' involvement tools. While support tools consist of administrative tools, course delivery tools, and content development tools.

Learner Tools

Email is also the ideal tool for one-to-one communication. It can be used by teachers to remind students of deadlines and to distribute course materials. Students can also submit queries and assessments by email. With email, it is possible to set up a group mailing list, making one-to-many communication much easier. Messages posted on a mailing list can also be archived and accessed via a web browser.

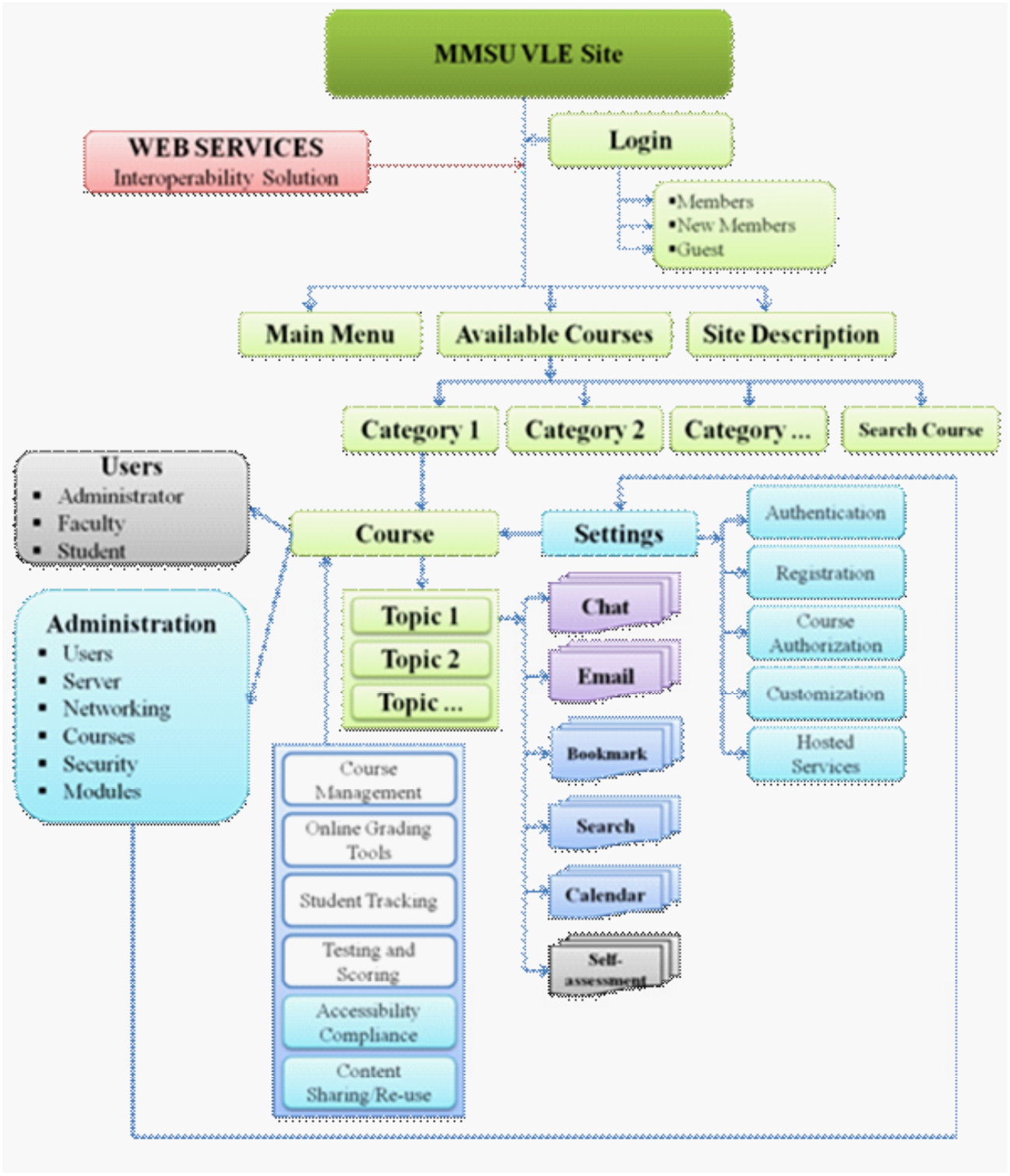
Chat allows both teacher and student to have a synchronous (or real time) conversation, as happens in a real classroom situation. The chat is conducted by the exchange of text based messages and where appropriate, the messages can be subject to a small time interval to enable moderation. Also, access to chat rooms can be controlled by allowing access to members of a course group.

Bookmarking is an item that a teacher can use to support learning, such as a file, link, folder, label or page. A teacher can add resources via a single link with an icon in front of it that represents the type of resource. The searching feature allows users to navigate through the system using a built-in search engine of resources, groups, and courses.

The calendar feature of the VLE displays the following events: Site (event viewable in all courses - created by admin users); Course (event viewable only to course members - created by teachers); Groups (event viewable only by members of a group - created by teachers); and User (personal event a student user can create - viewable only by the user).

The self-assessment module in Moodle allows the conduct of online quizzes or exams in various exam types such as multiple choice, essay, matching type, true or false and short answer type.

Figure 3. MMSU VLE Site Architecture



Support Tools

The administration has many tools related to course. An administrator can control the course through the administration tools but can only control these tools by the permission granted. Categories in the MMSU VLE site architecture enable the administrator and faculty to arrange their courses in levels of categories. Whereas, the login page enables all users to access their account.

An administrator can set the authentication method for the VLE site. Any authentication plug-in can be used to find a username or password match. Once found, a user is logged in and alternative plug-ins are not used. Therefore the plug-in which handles the most logins should be moved to the top of the page so that less load is put on authentication servers. The email-based self-registration authentication method enables users to create their accounts through the login page. They then receive an email at the address they specified in their account profile to confirm their account.

Hosted services feature allows server setting. An administrator can check that their site meets all system requirements for the current and future versions of Moodle. This feature also includes system paths, session handling, HTTP, maintenance mode, cleanup, environment and site registration. Courses are the spaces on the VLE where teachers add learning materials for their students. Courses are created by administrators or teachers. Teachers can then add the content and re-organise them according to their own needs. Course management feature allows teachers to add a new course, course categories, course settings, course formats, course homepage and course FAQ.

Teachers can set their preferences for the grader report via a grade book. The settings can be applied to all courses of each teacher. Students' performance can be tracked using the activity completion module which allows the teacher to set completion criteria in a specific activity's settings. Another module for student tracking is course completion. This module shows if a course has been completed. It also shows the progress of a student is making towards finishing the course according to specific criteria.

It is important to make the VLE-based materials accessible for a wider range of users. Accessibility compliance deals with the areas of navigation, keyboard dexterity, audio content, language, screen magnifiers, screen readers, and color. Customization of the look and feel considers the front page and themes. The front page is the initial page seen by users reaching a site. Typically, students see courses and some blocks of information displayed in a theme. A combination of site policies, user authentication, and front page settings determine who can get to the front page. Once they get there, they can see and what they can do. Themes provide a skin to completely change the look and feel of the site or even an individual course.

There are several ways to reuse a course or parts of a course. Most of them involve or are similar to a backup and restore process. Activity backup allows a copy or backup of individual activities in the VLE course and then re-use these activities in a different site or a different course on the same VLE.

Implementation Requirements

This element of the framework is divided into three components: users, environment, and architecture. As to users, an improved faculty ICT profile on the different areas of ICT skills should be considered. Among the areas of skills include basic computer operation, file management, word processing, spreadsheet use, database use, graphics use, internet use, telecommunications use, ethical understanding, information searching, video production, presentation skills and technology integration.

At the same time, a sustainable ICT infrastructure to fully support the implementation of VLE should be taken into consideration. The ICT infrastructure takes account of computers, network and the Internet, display screen technologies and peripherals, and software and information systems.

Lastly, to adopt a VLE, the VLE functional requirements, components, features and capabilities, the Moodle system and its technical requirements were carefully reviewed and evaluated.

Conclusion and Recommendations

The overall assessment of the faculty ICT profile marked intermediate. The status of MMSU faculty ICT profile is inadequate enough to engage them in VLE. This implies that faculty members still have room for improvement in terms of their ICT skills. The MMSU's ICT readiness status in terms of its ICT infrastructure manifests moderate level. This means that the University is capable of implementing VLE to support online learning.

The comparative study between Moodle and other VLE systems were based on features and capabilities of VLE tools, and another comparative study was based on the technical aspects of VLE systems. From these studies, Moodle turned out to be the best and most suitable choice of VLE platform that meets the requirements of MMSU. In this, Moodle has a great potential in providing an excellent and optimal VLE platform that could support online learning suitable to MMSU.

The designed MMSU VLE implementation framework can support MMSU needs. The framework consists of the four elements namely users, ICT infrastructure, MMSU VLE architecture and implementation requirements.

The following are the recommendations based from the findings:

1. Faculty members of the university must have a sufficient level of ICT skills to be able to engage with the system, or a development plan must be implemented to raise these skills to the required degree. It is recommended that a skills audit is carried out to identify the level of skill that each individual holds, allowing the university to identify development requirements. It is also recommended that a long-term program of faculty development focuses on raising all faculty members to a minimum level of ICT readiness and that a second-stage development plan focuses entirely on VLE skills development.
2. There should be a VLE system administrator in charge of the system. The administrator is responsible for administering the implementation and maintenance of the VLE system.
3. The university should allocate a budget for the implementation of the VLE. Wherein, this will be used for the purchase or improvement of ICT infrastructure needed to support the VLE. Also, this will be used to finance the faculty ICT skills training and development.
4. The university should ensure that the physical network is capable of handling the increasing demands that will inevitable occur.
5. Interoperability issues on the existing Information Systems of the University should be resolved to align the VLE system's resources.
6. The university should devise an implementation policy or plan on VLE implementation and utilization as part of the Information Systems Strategic Plan (ISSP) of the University.

7. On the other hand, this study could be used by other state universities as a basis in crafting their VLE implementation plan. Also, this could serve as reference material for other researchers for them to develop their studies about educational technology thereby helping in the refinement of the educational profession.

Acknowledgement

Special thanks to the Commission on Higher Education (CHED) for funding this research.

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