

## A Suggested E-Learning Model Based on Moodle-LMS for Implementing a Course in Biomedical Engineering

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**Abstract:** Planning for the implementation of e-learning programs requires an understanding of the impact of information and communication technology on the higher education. The implementation of the information and communication technology in education with e-learning management system allows improving effectiveness of the education. E-learning models are attempts to develop frameworks to address the concerns of the learner and the challenges presented by the technology so that e-learning can take place effectively. The Management System of Education allows better cooperation among the learners, the tutors and the students. The accessibility, usability and student collaborative learning are improved. Higher motivation among the students and the teachers is achieved. The study suggests an e-learning model based on the MOODLE Learning Management System (LMS). The aim is to identify the issues to be addressed in a strategic planning process for the implementation of e-learning in Palestinian universities.

**Key words:** E-learning, LMS, MOODLE, suggested model, biomedical instrumentation

### INTRODUCTION

No one can deny that advances in information technology coupled with the changes in society, are creating new paradigms for education and training. These changes will affect our education and training systems. Participants in this educational and training paradigm, require rich learning environment supported by well-designed resources (Khan, 1997). Therefore, there is a great demand for affordable, efficient, easily accessible, open, flexible, learner-centered and facilitated learning environment. Hall (2001) reports that e-learning is the fastest growing and most promising in the educational industry.

Actually, there is a great debate about whether it is the use of a particular delivery technology or the design of the instruction that improves learning (Clark, 2001; Kozma, 2001). It has long been recognized that specialized delivery technologies can provide efficient and timely access to learning materials; however, Clark (2001) has claimed that technologies are vehicles that deliver instruction, but do not they influence student achievement. Similarly, some researchers suggested that learning is influenced more by the content and instructional strategy in the learning materials than by the type of technology used to deliver instruction.

According to Bonk and Reynolds (1997), to encourage thinking on the Web, online learning must create challenging activities that enable learners to link new information to old, acquire meaningful knowledge and use their abilities; hence, it is the instructional strategy and not the technology that influences the quality of learning. Kozma (2001) argues that the particular attributes of the computer are needed to bring real-life models and simulations to the learner; thus, the medium does influence learning. However, it is not the computer per se that makes students learn, but the design of the real-life models and simulations and the students interaction with those models and simulations. The computer is merely the vehicle that provides the processing capability and delivers the instruction to learners (Clark, 2001).

### THE ISSUE OF E-LEARNING

With the internet's and digital technologies rapid growth, the web has become a powerful, interactive, global and dynamic medium of learning and teaching at a distance (Khan, 1997). The internet provides an opportunity to develop learning-on-demand and learner-centered instruction and training. There are many names for the e-learning activities including Web-Based

Instruction (WBI), Web-Based Learning (WBL), Distributed Learning (DL), Online Learning (OL) and so on.

E-learning can be viewed as an innovative approach for delivering well-designed, learner-centered, interactive and facilitated learning environment to anyone, anyplace, anytime, by utilizing the attributes and resources of various digital technologies along with other forms of learning materials suited for open, flexible and distributed learning environment. Increasingly, organizations are adopting online learning as the main delivery method to train employees (Simmons, 2002). At the same time, educational institutions are moving toward the use of the internet for delivery, both on campus and at a distance. However, for organizations and institutions to make this often expensive move, there must be a perception that using online learning provides major benefits.

For learners, e-learning knows no time zones and location and distances are not an issue. In asynchronous online learning, students can access the online materials at anytime, while synchronous online learning allows for real time interaction between students and the instructor. Learners can use the Internet to access up-to-date and relevant learning materials and can communicate with experts in the field in which they are studying. Situated learning is facilitated, since learners can complete online courses, while working on the job or in their own space and can contextualize the learning. Also, e-learning encourages students to peruse through information by using hyperlinks and sites on the worldwide Web. Students are able to find information relevant to their personal situations and interest. E-learning allows students to select learning materials that meet their level of knowledge, interest and what they need to know to perform more effectively in an activity. E-learning is more focused on the learner and it is more interesting for the learner because it is information that they want to learn. E-learning is flexible and can be customized to meet the individual needs of the learners. E-learning helps students develop knowledge of the internet. This knowledge will help learners throughout their careers. E-learning encourages students to take personal responsibility for their own learning. When learners succeed, it builds self-knowledge and self-confidence in them.

For the instructor, tutoring can be done at anytime and from anywhere. Online materials can be updated and learners are able to see the changes at once. When learners are able to access materials on the internet, it is easier for instructors to direct them to appropriate information based on their needs. If designed properly, online learning systems can be used to determine learners

needs and current level of expertise and to assign appropriate materials for learners to select from to achieve the desired learning outcomes.

### **LEARNING MANAGEMENT SYSTEMS (LMSs)**

The goal of any instructional system is to promote learning. Therefore, before any learning materials are developed, educators must know the principles of learning and how students learn. This is especially true for e-learning, where the instructor and the learner are separated. The development of effective online learning materials should be design online learning materials. As there is no single learning theory to follow, one can use a combination of theories to develop online learning materials. In addition, as research progresses, new theories are evolving that should be used in developing online materials. The online developer must know the different approaches to learning in order to select the most appropriate instructional strategies. Learning strategies should be selected to motivate learners, facilitate deep processing, build the whole person, cater for individual differences, promote meaningful learning, encourage interaction, provide feedback, facilitate contextual learning and provide support during the learning process.

Success in an e-learning system involves a systematic process of Analysis, Design, Development, Implementation and Evaluation phases (ADDIE Model, Strickland, 2006). This model is very generic, very successful, dynamic and flexible. Each phase has systematic feedback related steps. In the ADDIE model, each step has an outcome that feeds into the subsequent step.

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

**Open source code:** This type can be used free of charge i.e., no license is required and the institution can change the source code as required. Examples of this type like: Moodle, Claroline (Dokeos) and ATutor.

**Commercial LMS:** These types need a license from the author and the source code can't be changed. These types are more stable than the previous. Examples of this type like: WebCT, blackboard and harf. For many organizations like the Palestinian universities and those in the developing countries, acquiring a commercial LMS could be very costly in order to host the contents. Therefore, preferring the open source code LMS systems.

**Moodle-LMS:** Moodle (created by Martin Dougiamas, a computer scientist and educator) is an acronym for modular object-oriented dynamic learning environment. It is a Course Management System (CMS) that is free and open source software package designed using sound pedagogical principles to help educators create effective online learning communities. Moodle is multilingual with a support to >70 languages and its ease of installation and maintenance has been the main reason for >100,000 official registered users of Moodle over 150 countries. Moodle has got one of the best support systems and with its online communities any question could be answered easily and promptly. It is easily customizable for different use and application. The system Moodle supports learning objects test item according to IMS QTI 2.2. The system does not support creation of SCORM compatible learning objects, but they could be imported in the learning material. The learning content could be presented in different formats- .pdf, .txt, .html, .doc, graphical files, flash movie, presentations, interactive simulations etc. In Moodle, there are three different formats for the course-weekly, Topic and Social. The weekly format organizes the class into weeks, with assignments, discussion boards, tests, etc, all residing in a week-by-week block. The Social format is built around a forum (bulletin board), which is good for announcements and discussions. The Topic format organizes everything by topics (or units), regardless of how long they take. Moodle is learning-centered open source course management system that incorporates social constructivism, i.e., people learn best when they are engaged in a social process of constructing knowledge through the act of constructing an artifact for others. In Moodle learning is best if done in groups. The learning path is generic with free access to the learning resources and activities. There exists a possibility for implementation of lesson. Lesson is activity based on the sequencing of learning content and test item. According to the answer, the learner follows the learning path through lesson.

Concerning security issue, the system uses basic username and password authentication. The software provides tools for administrators to assign access privileges to different group roles: administrators, instructors, students and guests. Actually, Moodle is a Course Management System (CMS)-designed to help educators easily create quality online courses with different resources and activities that can be controlled by administrative tools explained here:

**The resource menu:** The (add a resource) menu shown in (Fig. 1) contains:

**Compose a text page:** This resource allows posting a page of text (text that one can type in or cut-and-paste from another document).

**Compose a web page:** This resource is very similar to the text page, except it supports full formatting.

**Link to a file or web site:** This resource adds a quick link to files being uploaded to the classroom, or it adds a link to other websites.

**Display a directory:** This resource allows the students to view an entire directory (folder) at once. The directory and the files in it must already exist (they can be added using the files link in the administration block).

**Insert a label:** This feature allows inserting text, images and other things directly into the topic (or week) box.

**The activity menu:** Activities in Moodle are educational things to do. The Add an activity shown in Fig. 1, menu allows adding flexible array of course activities. These differ from resources in that they are interactive, they encourage and in some cases require student participation. The course activities may comprise of:

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

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

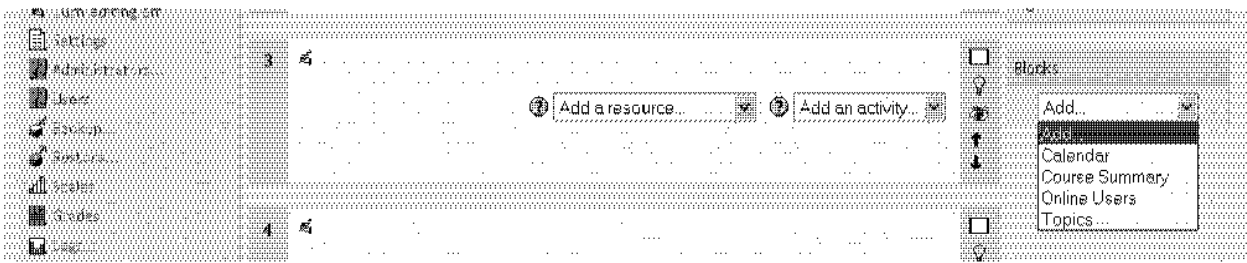


Fig. 1: Moodle resource menu



Fig. 2: Moodle administrative tools

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

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

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

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

**Quiz:** This feature adds a quiz to the class. It can contain any number of questions and they can be true/false, multiple choice and fill-in-the-blank. These questions are kept in the course question bank and can be re-used

within courses and between courses. Quizzes can allow multiple attempts. Each attempt is automatically marked and the teacher can choose whether to give feedback and/or show the correct answers. The quiz may also have feedback, where it can explain to the students why the answer is what it is.

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

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

**Administering class:** The administrative tools for class shown in Fig. 2 are:

**Turn editing on:** Allows the instructor to make changes to the class.

**Settings:** Allow the instructor to change the look of the class.

**Administrators:** Lists all the administrators (instructors) for the course.

**Users:** Lists all of the users in the class. The instructor can manually enroll or unenroll a student from the course

**Backup:** Allows data to be backed up.

**Restore:** Allow restoring old class data (that was previously backed up).

**Scales:** Allow the instructor to define special scales for evaluation. These are made up of word evaluations (i.e., excellent, good, average, etc.).

**Grades:** Lists the grades of the tests and quizzes of each enrolled student.

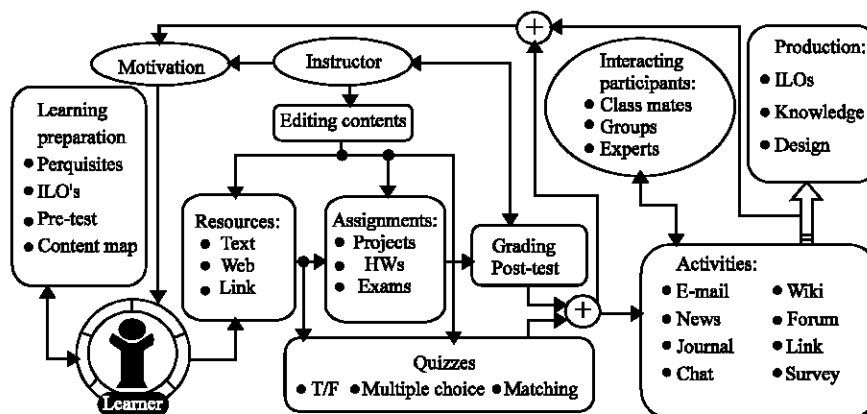


Fig. 3: Suggested model based on MOODLE-LMS

**Logs:** Shows all of the activity in the class for a set amount of time.

**Files:** Allow the instructor to upload files to the course, or to view any files that are already there.

**Help:** Brings up the Moodle manual.

**Teacher forum:** Is a teacher-only discussion board.

**The suggested model based on MOODLE-LMS:** The implementation of the information and communication technology in education with e-learning management system allows improving effectiveness of the education. The management system of education allows better cooperation among the learners, the tutors and the students. The accessibility, usability and student collaborative learning are improved. Higher motivation among the students and the teachers is achieved. The content expert (instructor) must be able to apply pedagogy to the content; that is he must know how to present the sub-content sequentially with suitable media. Based on the previous discussion, the above model shown in Fig. 3 has been suggested for implementing a Biomedical Instrumentation course on the Moodle platform. The authors have suggested the model keeping in mind that, e-learning is a means of education that incorporates self-motivation, communication, efficiency and technology. Because, there is limited social interaction, students must keep themselves motivated. The isolation intrinsic to e-learning requires students to communicate with each other and the instructor frequently to accomplish their assigned tasks. E-learning is efficient as it eliminates distances and subsequent commutes. Distance is eliminated because the e-learning content is designed with media that can be accessed from

properly equipped computer terminals and other means of internet accessible technology. Also, for learners, the e-learning should be accessible, well organized, clearly written, learner-centered, affordable, flexible, efficient and has a facilitated easy-to-use, reliable services to achieve the fruitful results of the design of e-learning system. The learner should enjoy all available support services provided in the course without any interruptions.

For learning preparation, the e-course syllabus and content map should be stated in a precise way. The prerequisite should be known; otherwise the student must not register in the course officially. The e-course Intended Learning Outcomes (ILOs) should be specified precisely so the e-learner will know the goals and objectives of the course from the first step in the learning process. A pre-test can be used to encourage the learners to discover the end of journey before starting. The instructor has full control over all settings for a course, including restricting other teachers, choice of course formats such as by week, by topic or a discussion-focused social format exists, editing and choosing flexible array of course resources and activities: forums, journals, quizzes, choices, surveys, assignments, chats, workshops...etc. The instructor should create means for feedback and motivation to encourage students and improve their attitudes toward the course. The instructor evaluation and grading policy should be clear for the students.

Quizzes are automatically graded and can be re-graded if questions are modified. Quizzes can have a limited time window outside of which they are not available. At the teacher's option, quizzes can be attempted multiple times and can show feedback and/or correct answers. Quiz questions and quiz answers can be shuffled (randomized) to reduce cheating. Questions can be imported from external text files. Quizzes can be attempted multiple times, if desired. Attempts can be

cumulative, if desired and finished over several sessions. The instructor can provide sample documents for students to print. Grading is very flexible with many options. The instructor and student can view a complete report about activity of the student for each of the items.

Another important factors involved in the suggested model are the motivation and feedback. Motivation is internal feeling that drives the e-learner to keep the learning process until achieving the specified ILOs, by designing excellent instructional messages by the content editor. Learner may be more motivated to succeed in a learning program if regular and effective feedback is provided in a way to increase the student's self esteem.

Knowledge construction is facilitated by good interactive online instruction, since the students have to take the initiative to learn and to interact with other students and their instructor and because the learning agenda is controlled by the student. Instructional interactivity is a necessary component in the suggested model. Allen (2003) tells us that instructional interactivity is defined as interactions that actively stimulates the learner's mind to do those things that improve ability and readiness to perform effectively. In other words, instructional interactivity invites the learner to practice new skills or discuss scientific problems with experts, classmates in a personal form or in groups, to end the journey with fruitful learning products, development of new knowledge, skills, attitudes and ILOs realization.

**RESULTS**

The suggested model was used for implementing a Biomedical Instrumentation course (for Biomedical Engineering students at Palestine Polytechnic University) on Moodle platform. A sample of 14 students has studied the course using the e-learning approach. A pretest/posttest for students achievement and attitudes were conducted and the results are shown in Table 1 and 2.

**Achievement descriptive statistics:** When examining descriptive data concerning the pretest and posttest achievement scores (Table 1), it was noticed that there is an increase in the mean of scores by (53.071) after the application of the e-learning model on the biomedical instrumentation course. This value represents the gain in students achievement. Also, it is well-known that the standard deviation is a measure of how well the mean represents the data. Small standard deviation (relative to the value of the mean) indicates that the data points are close to the mean. A large standard deviation (relative to the value of the mean) indicates that the data points are

Table 1: Descriptive statistics for achievements pretest-posttest

Test	N	Mean	SD
Pretest	14	29.36	9.153
Posttest	14	82.43	5.919

Table 2: Descriptive statistics for attitudes pretest-posttest

Attitudes	N	Mean	SD
Pretest	14	72.29	3.361
Posttest	14	93.79	2.234

distant from the mean, or that the mean is not an accurate representation of the data. As seen in the Table 1, the standard deviation in the posttest (5.919) is reduced compared to the standard deviation in the pretest (9.153), which means less data variations and pointed out that the student's scores are around the mean (82.43).

**Attitudes descriptive statistics:** When examining descriptive data concerning the pretest and posttest score of student's attitudes toward e-learning (Table 2), it was noticed that there is an increase in the mean of scores by (21.5) after the application of the e-learning model on the course. This value represents the gain in the attitudes of the student sample toward e-learning. Also the standard deviation in the posttest (2.234) is reduced compared to the standard deviation in the pretest (3.361), which means less data variations and pointed out that the student's scores are around the mean (93.79).

**CONCLUSION**

Universities can no longer ignore e-learning. Computers and the internet have become an integral part of higher education. How effectively these educational tools will be used to enhance the learning process depends on building an e-learning strategy that not only optimizes the use of technology to create convenience for learners but also addresses important pedagogical issues in the information age. After the teachers go through training for preparation of e-learning courses it helps them to focus on the experiences that would be best for learning from the learner's point of view, rather than just publishing and assessing the information they think they need to know. It can also help the teachers realize how each participant in a course can be a teacher as well as a learner. Their job as a 'teacher' can change from being 'the source of knowledge' to being an influencer and role model of class culture, connecting with students in a personal way that addresses their own learning needs and moderating discussions and activities in a way that collectively leads students towards the learning goals of the class. The suggested e-learning model highlights important issues that have to be evaluated and incorporated in a strategic e-learning plan: analyze the needs of the clients (learners and their employers), design

and implement learning materials and create communities of learners for knowledge construction. Continuously, evaluate e-learning phases until rational satisfactory concerning planned outcomes are achieved, with treating weak issues must be followed.

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