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A PROPOSED MODEL FOR DESIGNING E-LEARNING COURSES

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ABSTRACT

E-learning has become an effective component in most educational institutions; for this reason, there is a clear need to develop general principles and standards through a systematic model to design e-learning systems. There are many models of e-learning courses design, but they are differentiated in quality, in most of these models there is a gap between the needs of system developers, content designers, lecturers, and students. In this research, a new model was proposed to design e-learning courses in an attempt to bridge this gap. The proposed model carries out the analysis, design, and development of courses for e-learning systems and its application, then how to evaluate the performance of this system and its usability. A case study was developed by the stages of this proposed model and using Moodle platform, it illustrates the creating courses process, study plans, lessons for each semester, and the analysis, design, and creation of scientific content. where the scientific content was designed based on the educational approach used by Iraqi universities.

Keywords: *Software Engineering, E-Learning, Software Modelling And Design, Requirements Engineering.*

1. INTRODUCTION

E-learning is an advanced form of learning across computer networks where electronic devices are used by the student to enable him to interact with the colleagues and the teacher on the other [1]. Horton defined it as the use of web technology and the Internet to bring about learning [2]. Ghirardini defined it as "the use of computer and Internet technologies to deliver a broad array of solutions to enable learning and improve performance" [3]. It can also be defined as an educational system that provide educational and/or training programs for learners at anytime and anywhere using interactive information and communication such as the Internet.

A number of studies confirmed the importance of e-learning, as studies have revealed a significant impact of e-learning in developing students' research skills [4]. Another study showed there were statistical differences between an experimental group of students who studied through the e-learning environment [5].

This development of education has given the learner the benefit of obtaining the required information, but at the same time put some other requirements such as knowledge of many skills, that is, the student and the lecturer must have skills of how to use the system, otherwise this will lead to reverse results [6]. Therefore, the lecturer and the students must be aware of a large percentage of the concept of e-learning and how to use the system in order to benefit greatly, in addition to the system developer or the scientific content designer who must be at close distance from the lecturer and student and know the requirements of each of them so that there is no gap between them, also to communicate between the designers themselves, this requires a standardized development methodology or instructional model to the design of e-courses and the scientific content of e-learning systems.

The objective of this study is an attempt to simplify the analysis and design of e-learning courses by proposing a new model. This model contains the analysis, design, development and testing stages of e-courses system as well as the scientific content. This can be done by studying other models and then identify their strengths and weaknesses. Strengths are used and integrated and weaknesses are discarded to achieve an integrated model. A typical ADDIE model and Prototype model will be specifically combined with the addition of some proposed stages. To judge the effectiveness of the proposed model, we take advantage of the Quality Matters QM [7], which is

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one of the evaluation tools that used in the assessment of e-course design.

2. RELATED WORKS

There are several models to design e-learning systems, some are complex, the others are simple. Most of the researchers in this field proposed new models to develop e-learning systems, and they are based on the ADDIE model, which consists of linear phases of development from one stage to the next, and they did not address the details of the course design, further more they did not focus in the requirement stage that can be changed at any time through the developing process, such as: [8] [9]. Others are suggested models that uses the iterative or evolutionary flow of their task that can be repeated in one stage or more, also they did not focus in requirement change at early development, such as: [10] [11] [12]. Others suggested new instructional models but their models were specialized in a particular subject and not in general, also, the design stages were traditional and did not ignore its weaknesses, such as [13] [14] [15], researches such as [2], [16] were provided an instructional guide only, and not an attempt to change models or upgrade them and detect their weaknesses. Others such as [17], [18] trying to develop tools that can guide the developers but also, they did not discuss the details of the model and how to update and upgrade it.

From the above, it is clear to the researcher the multiplicity of design models and their similarity in the following stages: analysis, design, development, evaluation, but differed in the tasks and steps of each stage, in accordance with the objective pursued by the model, there is flexibility in dealing with these stages, depending on the nature of feedback received, and then finally the required modification. Some models have also identified certain characteristics that are directly related to the educational Internet environment. To sum up, they did not identify the gap between developers, content designers, lecturers and students, which must be identified and attempted to be eliminated in order to communicate between each of those mentioned. Based on this, the researcher proposed a model in line with some of these models and take advantage of its strength and ignore the weakness.

3. BACKGROUND

The architectural design of any particular system, whether electronic or in the real world must follow a specific methodology. Development models of the software system classified according to the nature of the problem and overlapping elements. There are four typical types of process flow: linear flow, iterative flow, evolutionary flow, and parallel flow [19]. In the linear flow, tasks and events are carried out sequentially. In the iterative flow, one or more tasks can be repeated before reaching the next activity. In the evolutionary flow, all tasks are executed once and then repeated several times, and finally in the parallel flow, one or more activities are carried out in parallel with another activity.

The development process of educational systems can be defined as "a description of the teaching process that takes place in a special learning unit (e.g., courses, lessons or any other event in which a learning design occurs)" [20]. E-learning development methods can be divided into traditional and agile methods. Instructional Systems Design (ISD) is the traditional approaches to developing educational and training systems. It is used to increase practice and skill in developing instructional courses that make knowledge and experience more efficient, effective and attractive [21]. The development process in this approach is to identify the current environment and learners' needs, then determine the goal of education, and then make some adjustments to assist in the transition process. The Dick and Carey system is another instructional approach model that addresses instruction as an entire system and focusing on the interrelationship between context, content, learning and instruction [22].

The Rapid Application Development (RAD) is one of agile methods that describes a software development which emphasizes on prototyping and iterative processes, is an approach to software product development based on small planning [23]. Rapid Content Development (RCD) is a model that has iterative design, reusable components and e-learning tools for rapid and cost-effective execution [24].

3.1 ADDIE Model

It is one of the most used traditional models in the development of e-learning systems. ADDIE consists of five phases: analysis, design, development and implementation, and the evaluation of the previous phases is reviewed and revised. The phase is reviewed and evaluated before it is delivered to the next stage. Figure 1 illustrates the development process using the ADDIE model.

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3.2 Prototyping

It is an agile model used to develop systems quickly and with customer participation at all stages

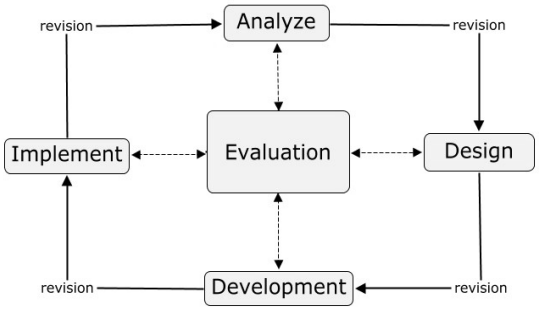

Figure 1: The Development Process of ADDIE [11]

to benefit from his/her feedback. The development process starts with the requirements phase, a quick initial plan, a quick design, then a prototype based on the plan and currently available requirements. This model is then delivered to the customer for evaluation and review. Customer and user feedback are then recorded and a new model is constructed based on feedback [25]. Figure 2 illustrates the development process using prototype.

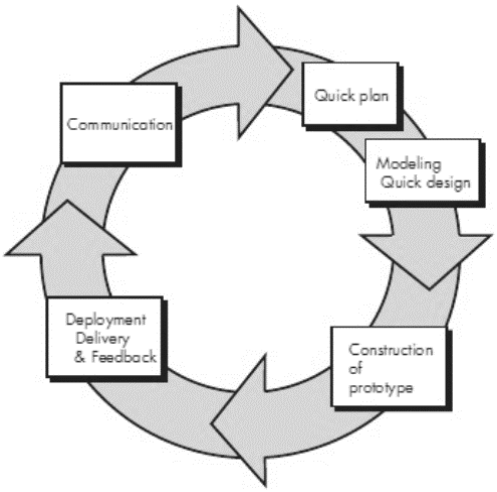

Figure 2: The Development Process of Prototype [25]

What distinguishes this model is the rapid design of the system, the first model (the same system to be designed but with fewer functions) can be presented to both the customer and the user to take advantage of their feedback, and then another model will be redesigned with some improvements.

4. PROPOSED MODEL

The process of analysis and design of e-learning systems faces many challenges such as lack of design of e-learning environments, different requirements and inability to choose appropriate educational strategies that provide best use of available learning resources, as well as lack of proper design models or design templates to develop e-learning systems [26]. Although there are many ISD models, most of them are based on the ADDIE model, which consists of linear phases of development from one stage to the next, and the end is the evaluation process used to review and revise the previous phases. It is noticeable that this model is based on linear flow, a disadvantage of this approach is that not all requirements are present at the time of commencement. The customer often does not satisfy all requirements in one session, but it is increasing and needs to be modified at times [27]. In addition, the single efficiency is not usually fully processed at one phase, and the customer does not notice the finished product until after the end of the entire development process, as well as, these models are designed for developers only, while the rest of the stakeholders of the system have limited role to feedback and reviews, and are not engaged in the design process, even in a simple manner. It is best to place customer needs in the middle of the design process to cover its requirements, and to conduct conversations between the students, the developer and the instructional content designer to avoid the gap that will arise when the system is implemented [19].

In order to optain better results, we have modified the ADDIE model by combining it with other models. The result is a new model that is suitable for the development of e-learning systems and the process of designing e-courses, as well as to take advantage of some of the features found in other models and avoiding its disadvantages. We inserted the prototype phases after the design stage or as an extension. In this case, we will use the iterative flow through which one or more of the phases can be repeated during the development process. We have added some proposed stages to improve analysis and design. Figure 3 illustrates the integration of the ADDIE model with the prototype model.

One of the benefits of this model is the ability to communicate with all stakeholders of the system and record their observations as well as scientific content designers by creating a prototype of the system and delivered to the customer and then the feedback is recorded. Figure 4 illustrates the development process using the proposed model.

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4.1 Analysis Phase

In the analysis phase, the system requirements are defined and information from the real world is collected. The gap between the actual behavior and the desired goals are also determined. Information

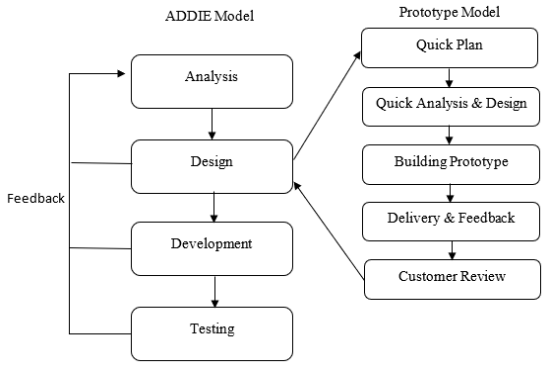

Figure 3: The Integration of ADDIE with Prototype

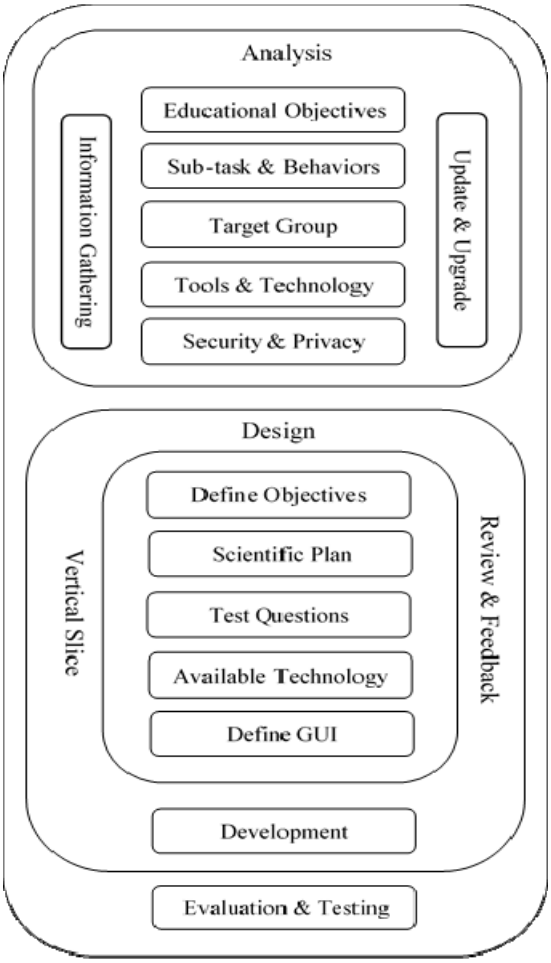

Figure 4: The Development Process using the Proposed Model

about the student, the environment, the technology used, and the scientific content is obtained in an effort to bridge this gap. Here are some tools that can be used to collect and analyze information:

- Research or questionnaire.
- Direct and indirect observation.
- Interviews.

Analysis stages are:

4.1.1 Information gathering

This stage includes information gathering about the e-learning system and requirements analysis. It consists a number of steps, such as: preparation of the information document, identification of learning topics and identification of guidelines.

4.1.2 Analysis of educational objectives

The objectives or outcomes are defined or clarified, after understanding the nature of the work or learning objective, the results are obtained for all the skills needed to achieve the desired goal.

4.1.3 Define sub-tasks and behaviors

This is a crucial stage towards developing behavioral learning objectives that become the basis of educational content. At this stage, sub-tasks and special behaviors are defined to achieve educational goals.

4.1.4 Identify the target group

The target group (learners or trainees) are analyzed, their behavior, their environment and their academic basis; because student information greatly influences the integrity of the choice of scientific content.

4.1.5 Identify tools and technology used

In this stage, the learning tools and technology used for students are identified. The technical tools can be divided into two main parts: [2]

• Hardware tools: Devices or equipment used inside or outside the classroom to assist in e-learning, i.e. computer types and network connection type.

• Software tools: such as applications and the type of software installed in these computers and e-learning management systems.

After selecting the learning tools, the techniques that can be used are analyzed, the scientific content designers are consulted with technical supervisors to understand the technology limitations, and the restriction developed by the IT department that are responsible.

4.1.6 Information security and privacy

In this stage, a security and privacy mechanisms are identified to prevent the penetration of the e-learning system. It is necessary to have alternative plans in the case of loss of information or damage, and chosen security algorithm; encryption method or the process of making backup copies of information [28].

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4.1.7 System & scientific content update and upgrade

In the last stage of the analysis phase, the mechanism for updating the system and upgrading it in the future is identified, such as scalability and the possibility of expansion and increase the number of lecturers, students and subjects, as well as the mechanism of scientific content update and upgrade in an easy and flexible, and how to change the graphical user interface GUI according to suggestions of feedback and change management.

4.2 Design Phase

At this phase, the results of the analysis phase are used to form the required schema for e-learning and its scientific content. The results of this phase are the design document. This document covers the objectives and strategies of education as well as the design of scientific content. The document is used to communicate among team members and is important to keep the project track and focus on the real goal of education. Several studies and research have indicated the use of design documents and patterns that are important for development, as well as the importance of developing standards in the design of learning elements such as: [15], [18] and [29].

After all modifications are made, the final design schema for the e-learning system is validated by all parties and compared with the lecturers' and students' notes. The following are the stages of designing the e-learning system:

4.2.1 Define educational objectives

The first stage in the design phase is to study the tasks or sub-goals that are listed in the analysis phase, and then to create a set of behavioral educational objectives. These objectives are specific and testable. For example, you can write final words for website design course such as:

After completing this course, the student will be able to:

- List types of programming languages available to deal with website design.
- List available databases types for dealing with website design.
- List and compare available content management systems.
- Handle with content management system control panel.
- Do own project work.

4.2.2 Development of the scientific plan

The scientific plan contains the study plan of the courses and its outline, sub-topics, summaries, the scheduling of the practical activities, homework, examinations, projects, research papers and the method of evaluation. The process of composing scientific content is the most important in the designing process of educational systems, in addition the importance of the interactive feature of updating, modification and development of content, which must be easy and clear within the interactive environment [17]. Figure 5 illustrates the available activities in Moodle platform.

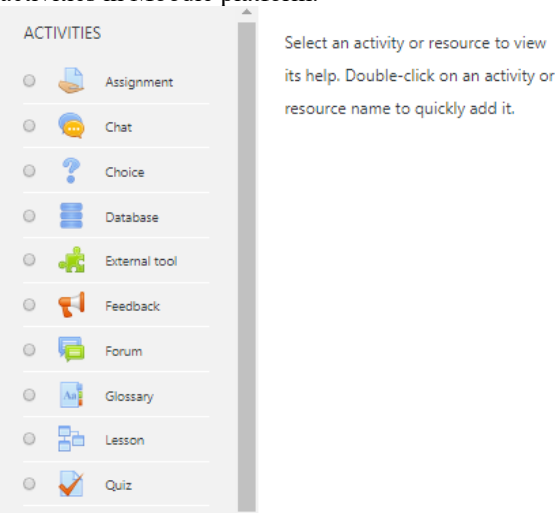

Figure 5: Available Activities in Moodle Platform

4.2.3 Define test questions

The design document contains a brief description of students' tests, for example: multiple choice, true or false, fill blanks, simulations, educational games, and exercises. Figure 6 illustrates some of the test questions available on the Moodle platform.

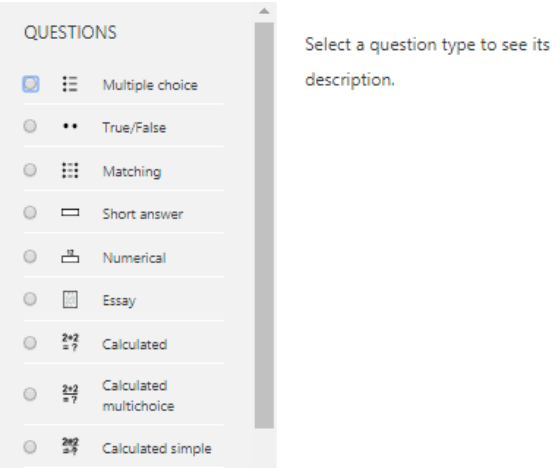

Figure 6: Tests Available on Moodle Platform

4.2.4 Define available technology

The design document formally identifies the technology available to both students and lecturers,

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as well as the determinants identified by the IT department.

4.2.5 Define GUI Specifications

GUI is important to be pre-designed and quality assured, because the user usually evaluates the entire system's work through which it is encountered. The poor user interface is the reason why some systems are not used [30]. Therefore, it is necessary to pay attention to the GUI, especially in e-learning systems, because it is the mediator between both the lecturer and student, and also to encourage both of them to use electronic systems and motivate them, especially when using a, clear, sequential and user-friendly GUI. The design document contains a detailed description of the GUI such as buttons, menus, check boxes, and navigation features that will be available on the page.

4.3 Create Prototype Model

At this phase of the project life cycle, a prototype of the e-learning system is created to be quickly tested with a sample of students and lecturers. This initial prototype helps to provide valuable information through feedback on technical issues, error management, and the addition of other learning events. The design document is changed based on this assessment, and a new prototype is subsequently developed based on the evaluations and some new enhancements are added.

The use of the prototype will greatly enhance flow processes for system development. This model will overcome constraints on the traditional approach to communicating with all members of the development team early in the project life cycle, as well as access to feedback through the lecturer and students and the content designer at an early date as well. Early review and evaluation are critical to software development, as errors can be detected and corrected early, as well as the preferences of lecturers and students [19].

4.3.1 Create a vertical slice of the system

Some developers assume that the prototype must consist of a few designs for the user interfaces that show the look and feel of the system, without entering into the programming details or at least part of them. However, for reviewers and evaluators who provide feedback, this form should include a small portion of the entire system, sometimes referred to as the vertical slice [31]. This vertical slice includes the main interface, the main menu with one integrated lesson, and sometimes a part of the test questions. When designing a vertical slide, consider all the features that will be available later in the final system to be tested in this mini-form.

4.3.2 Evaluate prototype model

At this stage, an evaluation of the prototype is carried out. For good results, consideration should be given to the culture and experience of reviewers and evaluators in this subject, for example, the student's culture, level of expertise, their environment, school and technology background. The main purpose of prototype evaluation is not to evaluate the scientific content or subject, but to assess the ease of browsing the system, evaluate the appearance of the interfaces, the technical performance and the appropriateness of its use by the lecturer and students. Below are some sample questions that will be provided to reviewers and residents:

- Do you notice the ease of use of the e-learning system?
- Was the style and consistency of the facades appropriate?
- Are the system features such as glossary, notepad, and preferences helpful and error-free?
- Do you have a suggestion to add other features?

Depending on the results of the prototype evaluation, some modifications may be made to the design document and incorporated into the development phase. If there are a lot of negative results, it's common to re-create the form based on new changes.

4.4 Development Phase

At this phase, the appropriate platform is selected for the design of e-learning system. There are many of these platforms, which vary in design, specifications, form and mode of preparation, including commercial and open source, such as Moodle [32], Google Classroom [33] WebCT, Claroline and ATutor [34]. To determine which system is right for you, answer the following questions:

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- What is your goal of entering the student on your system?
- What is the scientific content to teach and be taught?
- How will you put this scientific content?
- How many users are there?
- Will you host the system or will you use an external host?
- What is the specific budget for purchasing this system?
- What are the possibilities of the system?
- The possibility of tracking students?

4.5 Evaluation and testing phase

Evaluation is done by displaying the system to the arbitrators and stakeholders such as students, lecturers and content designers. The notes are recorded and worked on, in addition to recording the technical tools that the system is testing, and each of these tests is documented.

5. PROPOSED MODEL TESTING AND EVALUATION

We tested the model through a case study of e-learning system that was developed using the Moodle platform. On the basis of the proposed model, we have established study plans for lectures, each semester of the academic year, the establishment of courses and the registration of students and lecturers. Students can be assessed and tested through e-exams, in addition to the possibility of designing daily assignments and training on the practical part of the course. The possibility of adding video and audio lessons, adding other text files, the possibility of instant conversation between the lecturer and the students, and the presence of a special forum for students to discuss. The system alerts the lecturer to the important assignments and timing of examinations and lectures, and the student can get a report on its own grades, in addition to many other characteristics. Figure 7 illustrates the main page of the e-learning system being designed.

To evaluate this model, an experimental study was conducted for the e-learning system, which was designed for a group of Northern Technical University NTU students in the 2017-2018 academic year, as well as a group of NTU lecturers, furthermore a number of scientific designers from multiple places, so that they can judge the quality of the system. The number of students was (95), the lecturers was (22), and the scientific designers was (6). The evaluation is done through direct and indirect interviews as well as through the questionnaire that was collected through the electronic forms on the NTU official website, and was distributed to the group of lecturers, students and content designers to express their requirements before system development, their evaluation and feedback after the development of the system. The technical environment of the system was the laboratories of the computer systems department. The evaluation is conducted into two stages: the initial evaluation and the experimental evaluation.

5.1 Initial Evaluation

It aims to identify the needs before starting the design of e-learning system and discover the requirements that students, lecturers and content designers want, which helps in determining the system requirements in general, and to give an idea of the aspects that need more attention than others. Notes were recorded for lecturers, students, and content designers as well as the recording of available technical tools in this department to suit the requirements of this system. Table 1, table 2 and table 3 shows lecturer, student and content designer notes that we will consider in the analysis phase of e-learning system.

Table 1: Lecturer Notes About E-learning System

1.	The possibility to get started and find various course components.
2.	The possibility of saving backups of the importance of data in the system.
3.	GUI elements must be consistent in shape, color and easy to understand.
4.	Confidentiality of dealing with the system and data, and the authoritative roles of users.
5.	Educational objectives, sub-tasks and detailed lessons must be clear to the student, and provide texts, files and information is clearly graphic, and the possibility of modifications.
6.	The possibilities of interactive learning, such as voice or video conversation between the lecturer and students and students with others.
7.	The possibility of creating a user defined reports for both students and lecturers.
8.	Provide multiple possibilities for the purpose of testing and practice, in addition to the ability to evaluate projects and homework.
9.	Possible to produce and manage lesson plans.
10.	Search and navigate to resources within the system.

5.2 Experimental Evaluation

It is made during the design phase especially in the first model (prototype), and also at

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the end of developing the e-learning system, in order to know the level of achieving objectives of the system and its requirements, as well as to meet the requirements of the lecturer, the student and the content designer satisfactorily. A questionnaire form was distributed to the lecturer, student and

Table 2: Students Notes About E-learning System

1.	There should be an easy way to use the system in terms of initial registration, enroll and frequent login.
2.	The possibilities of interactive learning, such as voice or visual conversation between the lecturer and students.
3.	GUI elements must be consistent in shape, color and easy to understand.
4.	An easy way to browse the lessons and interact with it.
5.	An easy way to deal with test questions that should be miscellaneous.
6.	An easy way to browse the grade report.
7.	A variety of technology is used in the course.

Table 3: Scientific Designer Notes About E-learning

1.	Students are introduced to the structure of the course.
2.	Communication for discussions and other forms of interaction are clearly stated.
3.	The tools used in the course support the learning objectives
4.	A variety of technology is used in the course.
5.	The system provides lecturers and students with information on protecting their data and privacy.
6.	Course navigation facilitates ease of use.
7.	Users with privileges should be able to access appropriate information.
8.	Access to resources should be controllable.
9.	Course navigation facilitates ease of use.
10.	Design document should be modifiable.
11.	Students are introduced to the purpose and structure of the course.
12.	Assessments used are varied, sequenced, and suited to the course level.

content designer that we well considered when we evaluate the e-learning system during the evaluation and testing phase.

1) Lecturer evaluation: The first evaluation process was conducted with the lecturers. We recorded the subjects for each lecturer, and made the appropriate modifications and the selection of the procedures needed in the course.

2) Students evaluation: In the second part, the system was tested and evaluated by the students. We recorded their notes about the system to be designed. After that we presented it to them for use, experimentation and modification.

3) Content designer evaluation: In the third part, the content designers recorded the system functional and non-functional requirements, and recorded the needs to create the scientific content.

To judge the effectiveness of the system, we take advantage of the QM, which is one of the evaluation tools that used in the assessment of e-course design, consisting of eight general standards, each of which is composed of a number of specific criteria. We compare the results of these three stages to take advantage of decision-making related to modification and change to suit the requirements of users. Figure 8 illustrates the process of evaluating the system by lecturers, students and content designers and how to obtain results.

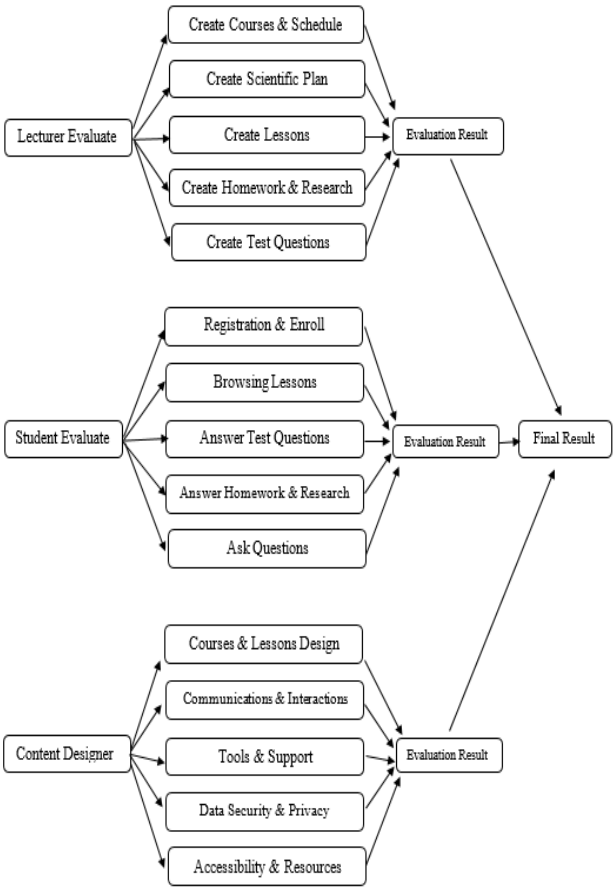

Figure 8: The Process of Evaluating the System

The quality of instructional design for e-learning courses has been implemented using a gradual scale as follows:

1. Determine the relative weight of each criterion that determines its importance when evaluating, through three weights: a basic standard and takes 3 degrees; a very important takes two degrees; an important takes a one degree.
2. Use a specific rating value for each criterion to help the evaluator estimate the criterion. This value is determined by a five-point scale: Excellent=5

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degrees (given to the standard that satisfies all performance); very good=4 degrees for a standard that achieves all performance but varies in quality or implementation); good=3 degrees (given the standard of which 50% -75% of the performance); weak=2 degrees (given the standard that achieves 50%-25% ; Acceptable=1 degree (given to a standard that achieves less than 25% of performance); Unverified=0 (given when the standard or any of its performance is not met).

3. Computation of the final result of criteria list: which is equal to the sum (relative weight * degree of performance rate) / relative weight. The evaluation list included 30 sub-criteria, 71 weights, 124 performance indicators. So, the final result equals (4.28 out of 5) which is a (very good) result. Table 4 shows the criteria and the performance indicators of the E-learning system.

6. CONCLUSIONS

This study provided a snapshot of some of the key issues in the analysis, design and development of e-learning courses and the systematic improvement of scientific content. A model was proposed tries to cover some of the shortcomings in the other models to bridge the gap between the users of the system. A typical ADDIE model and Prototype model will be specifically combined with the addition of some proposed stages.

The results are expected to be useful to the lecturers, students and content designers of e-learning systems. The lecturers will be able to deal correctly with the educational tools as their requirements, the students will benefit from this work when their needs are met, and the content designers will be able to design the courses in an easy, standard, and to suit the requirements of both lecturers and students without gap of their need.

An e-learning system using the Moodle platform was developed as a case study of the development of using the proposed model. This system was a tool through which both the development process and the process of dealing with lecturers and students were experimented with questionnaires and interviews conducted. The system was presented to a sample of students and lecturers at the Northern Technical University NTU and a group of content designers. The results were calculated through the questionnaire forms and through the detailed assessment and final evaluation of the lecturers' form, student form, and content designer' form at a (very good) rate.

The end result of the evaluation indicates the success of the proposed model, and gain approval of lecturers, students, and content designers especially in the Arab and Iraqi environment, in particular. This result represents the acceptance of users to use e-learning systems for clarity and ease of use, on one hand, and the system received the approval of content designers because the process of development was conducted systematically, standard, general and meet the purpose of both lecturers and students on the other hand. Hence, we conclude that the systematic use of systems development is the most successful for users of the system. Good design ensures students' continued interest and motivation to continue learning, as well as for the lecturers where easy design encourages its use for e-learning systems rather than traditional systems, as is the case for a content designer who will find it easy to use a consistent design approach.

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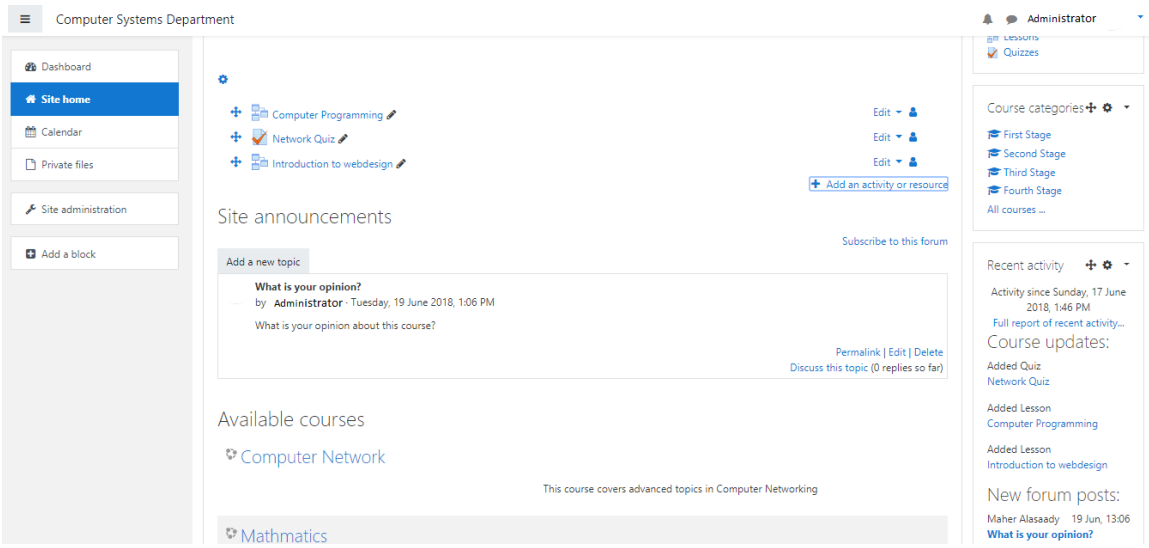

Figure 7: The Main Page of E-learning System

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Table 4: Evaluation for E-Learning System

Domain	Main Criteria	Sub Criteria	weight	Rate
Courses and lessons	1- The course design contains a comprehensive general description and shows the means of achieving the objectives, evaluation, methods of teaching followed, content, and requirements for the study of the course.	1-1 Includes general description of course and the appropriate scientific reference.	3	5
		1-2 Includes a general, comprehensive and clear description of the course and its tribal requirements before beginning its study	3	5
		1-3 The advantages of the system in terms of adding and modifying lessons and adding the exam questions and choose the type.	3	4
		1-4 The process of evaluating students and setting their own grades.	2	5
		1-5 A brief description of the course and its aims.		2
Learning objectives and outputs.	2- The course includes explicit and clearly articulated learning outcomes that help students focus their efforts on the course.	2-1 Contains a clear and comprehensive description of learning objectives and outcomes.	3	4
		2-2 Course competencies, describe outcomes that are measurable.	2	3
		2-3 The learning objectives or are suited to the level of the course.	2	3
		2-4 Describe the behavioral objective of the course.	1	3
Scientific content	3- Provides appropriate tools for the instructional design of the course and is comprehensive enough to achieve the stated objectives and learning outcomes.	3-1 Provides appropriate content to help the student achieve learning objectives.	3	3
		3-2 The scientific content takes into consideration the accuracy, objectivity and modernity.	2	4
		3-3 Scientific content is comprehensive, relevant and consistent.	2	5
Accessibility and usability	4- Provides means for accessibility and usability to ensure access to system without mistakes.	4-1 The course design facilitates readability.	1	3
		4-2 Protecting the student's data and privacy.	4	5
		4-3 The possibility of saving backups of data in the system.	2	5
		4-4 The easy way of registration, enroll and frequent login, and the authoritative roles of users.	5	4
Interaction, control, support and assistance.	5- Provides frequent interactions, various methods of navigation and control to ensure access to educational material.	5-1 Allows for frequent and varied interactions.	2	5
		5-2 Provides precise navigation tools for interaction and access to educational material and resources.	1	4
		5-3 The searching, retrieving and creating appropriate reports.	3	4
	6- Provides a variety of methods to promote, support, guide and assist learning.	6-1 Provides adequate two-way feedback to enhance learning.	3	5
		6-2 The system uses clear methods, mechanisms and instructions.	1	4
		6-3 Provides support and assistance to students with special needs.	2	4
Technical design	7- Provides technical standards to design an appropriate GUI.	7-1 GUIs ease of use.	3	5
		7-2 Considers of link design and navigation tools in the course.	1	4
	8- Provides technical principles for designing multimedia elements to attract student attention.	8-1 Considers the main principles of writing educational texts.	3	4
		8-2 The use of educational audios and videos of quality.	3	5
		8-3 The use of educational images and graphics of quality.	3	5
		8-4 The ability of update and upgrade the system.	2	5
Evaluation and testing of student performance	9- Provides appropriate assessment to measure learning effectiveness, assess students' progress, and measure the effectiveness of the course and ensure its quality.	9-1 Provides appropriate assessment and measurement strategies for the course objectives, requirements and students' characteristics.	3	4
		9-2 Measure the course effectiveness and ensure quality and harmony with the university's e-learning program.	3	3