International Journal of Multidisciplinary Education and Research– IJMER
Volume 1 : Issue 2 [ISSN 2475-2649]
Publication Date : 30 September, 2014

Computer-Supported Learning: A Teaching Aid for ECE Students

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***Abstract*— The use of computer hardware and software in education and training is a long established practice. In this work, an educational software is developed as a computer-supported tool to assist students' learning. Software engineering aspects are emphasized during the development, for the product to be simple and user friendly such that it can be used by all targeted students. In addition, the package is open for future expansions. Emphasis is paid to implementing solutions for issues that students face difficulties in understanding. The developed software system is provided with a database for many courses of the Electrical and Computer Engineering department. For the purpose of evaluation, number of students have used the software. Those students express a noticeable interest and benefit.**

Keywords— educational software, virtual learning, teaching aid, technology integration.

I. Introduction

Computer-supported learning, as a branch of the learning sciences is concerned with studying how people can learn with the help of computers. Major types of educational software include; coursework, classroom aids, assessment software, and reference software. The courseware describes additional educational material intended as kits for teachers or trainers or as tutorials for students, usually a package for use with a computer. Some educational software is designed for use in classrooms. Classroom aids typically refers to software that may be projected onto a screen at the front of the class and/or run simultaneously on a network of desktop computers in a classroom. Assessment software, on the other hand, allows students to complete tests and examinations using a computer, usually networked [1].

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The given concept imposes technology integration in teaching and learning [2], which could involve having a class room that is equipped with a computer, an Internet connection, a computer projector and other tools of technology [3,4,5]. Students can then experience utilizing this e-learning system through accessing and using a prepared databases representing supplement to their curriculum.. while using this teaching aid, students will be free to direct the way they learn following a concept of natural learning [6], where they can set their objectives and feel responsible about acquiring the necessary education away from the traditional approach of teaching in which the instructor is fully responsible about the flow of the education process.

A critical metric for the success of an organization may be reflected through its programs of education and training. For this main reason, such organizations are struggling to find the right blend of people, protocols, and systems to manage their learning programs. Learning management systems (LMS) were considered by organizations, having a concern with eLearning, as platforms to handle course registration, storing course content and delivery, assessments, administration, and reporting [7].

To choose the appropriate LMS, an organization such as a University, is having dozens of different providers with each of their products having its own characteristics, including strengths, weaknesses as well as costs [8]. The variety of such products' characteristics forces different levels of satisfaction, effectiveness, and return on investment.

In this context, solutions using open-source LMS have proven more favorable with respect to their commercial counterparts. Many of these open-source platforms such as; Moodle, ATutor, and Ilias are adopted in academic organizations [9]. As software systems, the open-source LMS have their strengths, and weaknesses and different evaluations have investigated such characteristics. The findings and recommendations of those evaluations are briefly referred to in the next section.

This paper presents a software system development. The system is intended to be a supplementary learning tool serving students of the Electrical and Computer Engineering department at Dhofar University. In fact, the university is already adopting the Moodle LMS. As a generic product, however, Moodle has some shortcomings as will be listed in the next section. Our computer-supported system therefore, is considering how to overcome some of the Moodle's shortcomings, as well as offering additional advantages including gaining the necessary development skills.

In the next section of this paper, an introduction to the LMS and the evaluations of the ones that are more in use especially Moodle, are presented., Section 3 will show a description, architecture, and details of the developed software. Conclusions and

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recommendations are shown in section 4 followed by a list of cited references.

II. Learning Management Systems

Categories of LMS include applications such as; virtual learning environments, course management systems, and collaborative learning environments. The different commercial and open-source platforms also vary in terms of capabilities and features. Nevertheless, a robust LMS should be able to, at a minimum, do the following [7]:

- Centralize and automate administration;
- Offer self-service and self-guided services (such as learner self-registration for courses);
- Rapid assembly and delivery of learning content;
- Consolidate training initiatives on a scalable Web-based platform;
- Support portability and standards, and
- Personalize content and enable knowledge reuse.

On the other hand LMS may have the following drawbacks:

- Most LMS applications, including Moodle, are not well in creating the content for courses or trainings. Users have to develop these files using separate, dedicated content authoring software such as MS office.
- Also, an LMS is not a substitute for instructional design when it comes to planning curriculum and courses. In fact, some LMS platforms have tools, such as lesson builder or planner features to assist with this process. However, creating a truly effective eLearning program still requires considerable planning and expertise.
- When adopted by a University, an LMS can be quite expensive, where costs have to cover acquiring the software package, annual license, maintenance, or subscription fee based on the number of users in the organization.

Due to the high cost incurred while adopting an LMS, some organizations go for the open-source solutions, and in this case, code is provided under a license that permits users to access, change, and improve it. Most open-source software is free to use in an unlimited manner, although the details of the software license can vary depending on the application. In addition to Moodole, Sakai is another example of such systems that is mostly adopted by academic organizations.

The source code of Moodle is written in PHP, a common, free scripting language that was originally developed for building dynamic Web pages. The Moodle software is designed to be highly modular; therefore, many developers and organizations have improved on its original release to increase functionality over the years. Moodle is being popular mostly because of its ease of use and many other features that are included [9, 10].

On the other hand, some users criticize Moodle based on the following [11]:

1) The interface design doesn't offer enough options for resorting and customizing its look and feel without too much coding work.

2) This workload for maintaining and updating the software can increase, as new versions are released because Moodle relies a lot on third-party add-ons to create functionality rather than including it as part of the core product.

3) Moodle lacks development and management toolset that can be considered of full-featured capability. This, in fact, is required by many large corporate clients.

4) A common user or a non-IT person will find it impossible to handle and maintain Moodle. This issue requires that the organization should employ an IT specialist, with all the necessary financial resources.

Considering the drawbacks mentioned above, the system presented in this paper is oriented towards resolving the criticized points of Moodle. Furthermore, developing this system was a useful project enhancing the necessary skill of developing a customized computer-supported learning aid for students.

III. The Computer-Supported Teaching Aid System

A. *The Development Life Cycle*

The computer-supported learning system is developed to be a web based system. The system, however, can also work as standalone. Both Visual Basic (VB) and cascading style sheets (CSS) are used for system implementation. With the use of visual basic, programmers can create efficient graphical user interface (GUI) as well as developing complex applications. Cascading Style Sheets (CSS) on the other hand, is a style sheet language used for describing the look and formatting of a document written in a markup language.

The development process activities, which are based on the principles and concepts of software engineering [12] can be summarized as follows:

1) *The requirements engineering phase* has started with emphasis on the technical feasibility of the project. It's revealed from this study that the system is feasible, where it will add to the teaching and learning of the ECE students. Another aspect of technical feasibility is also found encouraging, where the students involved in the project development are having the necessary knowledge to start, as well as the capability to choose the best learning content. Further on feasibility is that, it will be possible for the system to be integrated with the University website.

2) *The development phase* has included the design and implementation of the system. Numbers of attributes are given higher priority. For example, to ensure the ease of use, the development of the software has followed the conventions for usability[13]; a simple interface, the use of a minimal number of words, providing extra information for the user to turnover, and often, including simple icons with the words to aid users. Details of the architecture and system design are presented in the next section.

3) In *the evaluation phase*, the strategies for testing the code are followed. Each developed unit is tested and assurance is made that the unit is working as it should be. System items/units are then gradually integrated. With each step of integration, the assembled items are tested. After full integration, the whole system was tested. The last evaluation was done by a group of

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targeted ECE students, who were asked to use the system and report their feedback in a questionnaire form.

4) *The evolution phase* is not as clear as other phases, where the system is still need some improvements with further professional evaluations before it can be formally deployed.

B. *The System Architecture*

The system architecture is shown in Fig. 1. In this figure, it's clear that this web-based system is composed of a home page and five main pages (namely; Our Vision, CCE, Tutor Aid, Important Links, and DU news). In each page, there are sub pages that are related to the main page.

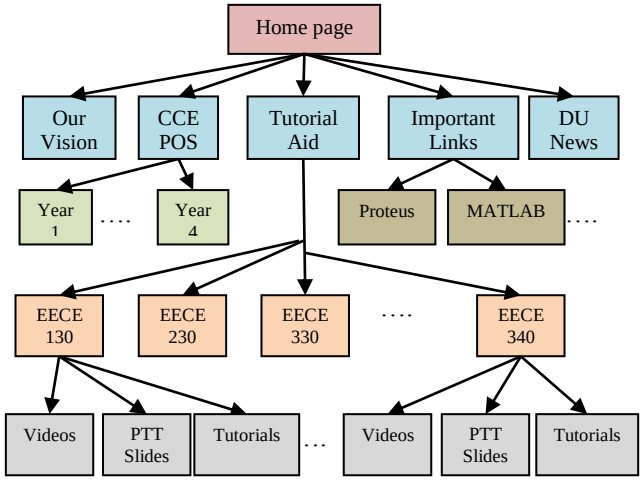

Figure 1. The computer-supported learning system architecture.

C. *Other Pages of the System*

1) The home page

The home page layout is shown in Fig.2. Form this page, a student can navigate to the rest of the system pages .

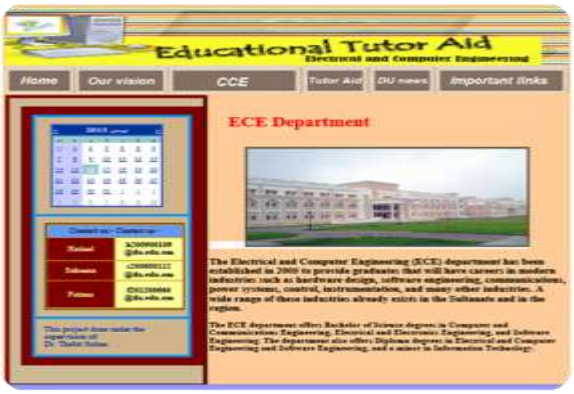

Figure 2. The system's homepage.

2) The Educational Tutor Aid page

Fig. 3 illustrates the Educational Tutor Aid page.

Figure 3. The Educational Tutor Aid page.

The above webpage represents the most important part of the system and it is given the most emphasis. The Computer and Communication Engineering (CCE) program is selected to be in this first version of the system. Navigation to CCE can simply done by clicking the proper button in the navigation bar. The following figure, Fig. 4, shows the look of the CCE program page. In Fig.5, the layout after selecting a course is shown. Course content now can be displayed per course chapters.

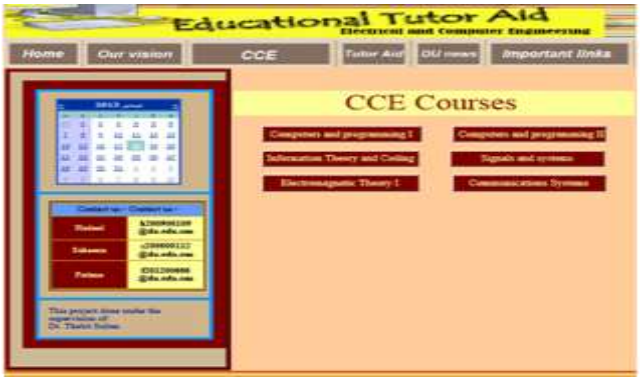

Figure 4. Page showing the list of the CCE courses.

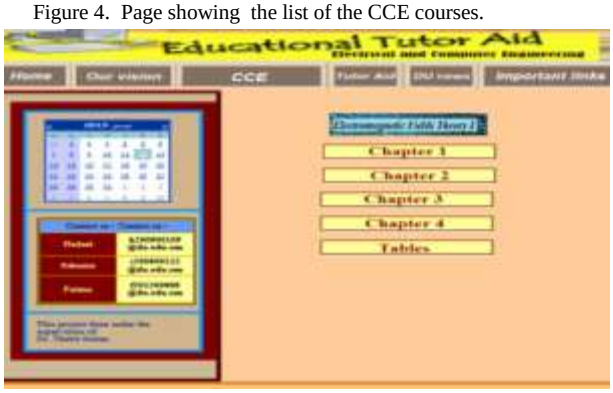

Figure 5. Page showing the content of a selected course.

Selecting a chapter can be done by pressing a button, as per Fig. 6. Chapter content can then be browsed, where a choice of (PPT slides, Tutorial questions, as well as selected helpful videos can all be accessed by properly pressing the matching button.

Both PPT slides and the tutorial questions can both be viewed and downloaded, while a link will lead students to the location of their chosen related video. Fig. 7 is showing corresponding pages.

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Figure 6. Page showing a course chapter content.

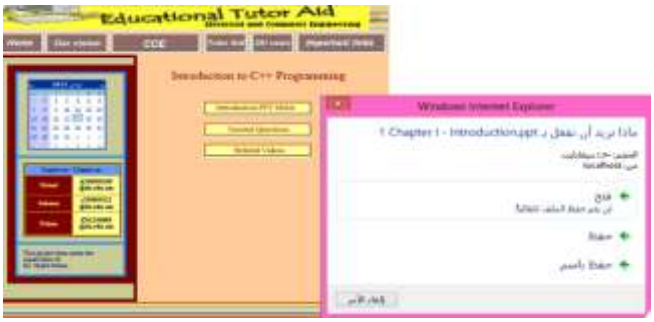

Figure 7. Page showing title contents of a selected course.

Course content and the helpful martial for the offered courses in the CCE program can also be accessed via the CCE page from the navigation bar. Once the page is selected, a statement describing the program, will be displayed in a new page together with four buttons leading to the four years plan of study (POS). Fig. 8, and Fig.9 are illustrating CCE program page and one of its consequent pages respectively.

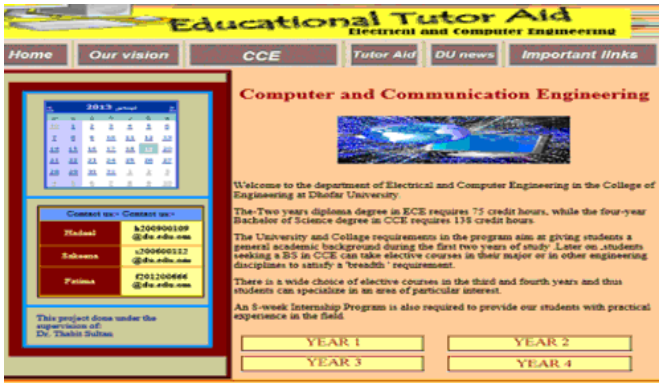

Figure 8. A page showing the CCE program page.

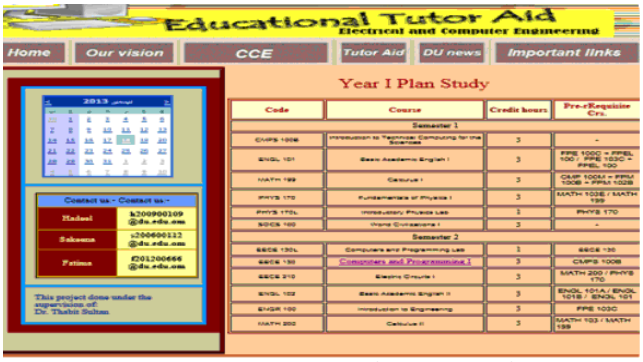

Figure 9. A page showing the first year plan of study (POS).

3) Other pages in the system

More helpful information can be found in other pages, which can be accessed by pressing their corresponding buttons. As the system is designed to be a website, pages with links to access some supportive teaching material such as; the MATLAB and PROTEUS software are used and listed in the Important Links page. Other pages are (Our vision and the DU news). Fig. 10, Fig. 11, and Fig. 12 are showing images for these pages.

Figure 10. The Our vision page.

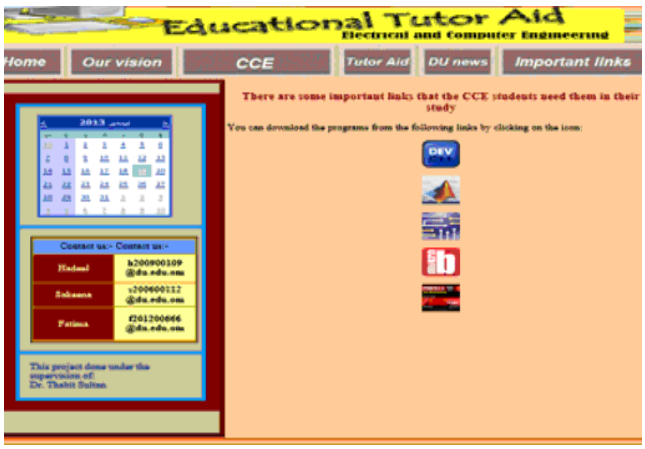

Figure 11. The Important links page.

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Figure 12. The DU NEWS page.

IV. Conclusion

A computer-supported learning and educational software system is developed, whose main objective is to provide a tutoring aid for students to have an additional source helpful in following up and hence understanding the curriculum. The computer and communication (CCE) major in the ECE department at Dhofar University is considered and a web-based tutorial software is implemented. The software package provides a rich data base of courses' material of this major. Teaching material in the system's database includes, but not limited to, power point slides, some helpful self test and tutorial question, and multimedia content (such as video). The package is featured by a user friendly graphical user interface that can easily lead the user to browse through the content. Furthermore, simplicity is promoted during the development to give a room for future expansions. Students who have tried the software expressed their positive feedback and interest. Despite that, the system, as a customized learning management system (LMS), still need many improvements such as assigning authorities, developing a security mechanism, and a documented management process of upgrading functionality through adding more courses and martial without degrading the system's architecture.

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