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VIRTUAL LAB FOR TEACHING A COMPUTER PROGRAMMING COURSE

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ABSTRACT

This paper focuses on the design, development and implementation of blended learning strategy at Faculty of Science, Omer Al-Mukhtar University, Libya. Initially the student will analyse the current status of blended learning as an integral part of university education, the latest innovations, students' and lecturers' attitudes and experiences with these and the implications of including blended learning courses for the future. The findings of this study will be beneficial for the student's workplace because the developed methods for the design, development and implementation of blended learning strategy will ensure the improvement of learning experiences provided by Faculty of Science from Omer Al-Mukhtar University, Libya.

KEYWORDS: Libyan education, E-learning, Information Technology

INTRODUCTION

In the early 1990s, the Omar Al-Mukhtar University established their Department Of Computer Learning to provide BSc degrees in Software Engineering and Computer Science .The course material has traditionally been delivered through lectures (also known as school-based learning, or SBL) and reinforced in the lab sessions (laboratory-based learning, or LBL). The SBL is based on a teacher-centered approach in which experienced lecturers provide theoretical knowledge and information via traditional materials (e.g., a blackboard and chalk), and the students receive printed lecture notes and read textbooks. The students later attend lab sessions utilizing a student-centered approach in which they receive hands-on training in the techniques presented in the lectures. Recently, the academic staff within the department has observed that students display a lack of practical experience and understanding of theoretical subjects that are essential to the success of lab sessions. Internal review reports show a variety of issues concerning the learning processes and traditional teaching methods, limited access to IT, a lack of development processes, poor curriculum review, and a limited link between the practical tasks and theoretical content. (Omar Al-Mukhtar University, 2013)

Due to large class sizes, especially at the undergraduate level, the vast majority of the Libyan higher education institutions face significant challenges in adequately assessing student learning and providing feedback to students. Additionally, there are shortages of proper teaching facilities and of science educators who are skilled enough to properly utilize course materials, practical exercises, and demonstrations. Some universities have opted to increase the number of faculty members, or to alleviate some of the strain by increasing the number of students who use one computer, but the majority of students still display a lack of practical experience and understanding of theoretical subjects during the computer lab sessions (Othman et al., 2013)

Analysis of the existing SBL curriculum: The SBL require the teacher to provide interaction and discussion, demonstration and communication with students face-to-face. In addition learners communicate and interact with each other. Teachers have to give all the exercises and assignments to students by themselves. The SBL provides many chances for interaction between learners and teachers and among learners.

Presentation method	**School-based learning environment**
Who	Student to teacher (one way)
Where	Single classroom
When	Faculty's choice
How	Lecture and projector

Table 1: Existing School-based learning presentation method dimensions

However, this interaction is restricted to one place at one scheduled time which may not be convenient. See table 1 for more details .Furthermore, the lack of tools in the laboratory or class session may not support an effective learning and teaching process. Teaching computing courses is a major challenge for the majority of lecturers at Omer AL-mukhatr University. These courses contain numerous abstract concepts that cannot be easily explained using traditional educational methods.(Othman et al.,2013)

Guzdial & Soloway stated (2002) that"certain challenges arise when teaching computer science (CS) courses to students who are not physically co-located and have individual learning schedules. Learning to program is a difficult task for many students even in traditional class. The dropout and failure rate is as high as 30 percent in introductory programming courses at the university level “,the author suggest that Integration of ICT in learning and teaching will change the design of the curriculum, the way students learn, and the way they and the teachers communicate.

Qualification offered-The science faculty offers the B.S. degree in Computing and other degrees for different departments. The computer science course is a compulsory course offered throughout the eight semesters of studies of the Department of Computing which take four years study each year comprises two semesters, and each semester takes three months. Learners who register for the course come from all over Libya, as the Department of Computing is extremely popular with learners who need to study programming. The computer science course is organized into two parts, as at all universities, one delivered through lectures which is the theoretical part also known as School Based Learning (SBL), with three hours of lecturing for each module per week. SBL is based on a lecturer-centered approach in which experienced lecturers offer information and theoretical knowledge via traditional tools (e.g., a chalk and blackboard), and the students receive textbooks and printed lecture notes. The other is the laboratory part, with two hours per week of lab instruction which is called laboratory based learning (LBL). The LBL part aims to apply empirical theories for understanding, measuring, and improvement of the software improvement process in the computing department. The main objective of LBL is to train students in techniques, technologies and equipment used on the computing learning course. Currently, the LBL and SBL are not working well, so it is necessary that the faculty change the strategy of the teaching system. Students have only two hours each week for exercise and practical learning in LBL, the rest of time going to theoretical learning.

Faculty science lecturers: They teach computer programming language at postgraduate and undergraduate level to learners over the age of 19. The lecture is delivered by an academic teacher based on traditional facilities, e.g. blackboard and chalk and other basic electronic facilities (within LBL and SBL). The lecture material is hard copy sheets and students notes recorded in a textbook. The lecturers, who deliver practical and theoretical modules during SBL, are required to hold a PhD or Masters degree.

The structure of computer programming course:

- Module 1: Website design
- Module 2: C++ programming
- Module 3: Matlab
- Module 4: Java
- Module 5: Database

Faculty science Demonstrators: The demonstrator who works in the lab enables students to understand theoretical subjects during SBL and prepare learners for the lab exercises. Demonstrators write programmes and solve the most difficult problems. Demonstrators also observe learners during their LBL programmes.

Faculty science students: are enrolled into faculty science at age 19 based on their learning capabilities and preferences; also they must obtain the secondary school certificate. The degree which they can get from faculty is the Bachelors degree which needs four years of study on most courses.

Form and assessment - Students attend obligatory schoolroom laboratory exercises and tutorials. To get an acceptable final mark students must pass the written test at the end of the schoolroom lectures, achieve all the exercises in the LBL and pass the final examination..Undergraduates are not allowed to sit the final examination unless they finish the laboratory exercises which are based in LBL and classroom tutorials which are based on SBL. The learners have classes and lectures (SBL) every week. Lectures, which are obligatory, introduce new concepts. Students are expected to prepare and complete the programming exercises in the LBL in their own time. Of course, the main assessment of the session is currently considered a closed book assessment and contains a mixture of multiple choice questions and article answers. The computing course is a hard course, with average exam pass rate of 50%. In order to develop the computing course to support the establishment of more effective learning activities, it is necessary to review the institutional context currently available to support the implementation of the e-learning package.(Othman et al .,2013)

Analysis of the existing LBL programme: Lab-based learning is a great setting for the learning and teaching of science. It provides students with several options and opportunities for reflection, discussion and solving real problems.

Lab-based learning is conducive to involving students in performing experiments and it help them to promote active learning, and the students can solve problem through hands-on experience(Carnduff & Reid, 2003), it deepens learning by encouraging learners to make effective decisions through critical thinking, and when working as group can further improve learners' cooperative skills. There are several chances to enhance the lab by integrating practice and theory through combining strategies; for example computer based learning or the web.

Johnstone (1997) indicated that the lab is an environment for data getting that can let students have ‘brain space’ to process information and moreover students can follow and interpret the results made during the experiment. In recipe laboratories the action is predetermined, with staff, demonstrators and technicians each having a clear understanding of what the possible results are and all the expectations of what will happen. Consequently, the wrong results can be clearly identified by the demonstrators as well as rectified for the learners before they go to the lab work.The laboratory enables students to develop experience and skills in conducting experiments, and to gain familiarity with the use of devices as well as the ability to define some of the materials used. Secondly, since laboratory experiments often rely on accuracy, students develop awareness of the need to be accurate in the weights of materials used and the importance of precision in operating conditions. Finally, laboratory experiments encourage students to think, discover and research, which helps to familiarize them with the methodology and design of scientific research.

Henige (2011) identifies five categories of aims that may be achieved by usage of the lab in science classes:

1. Skills - investigative, organizational, manipulative, inquiry, communicative;
2. Concepts - for instance, taxonomic category, hypothesis, theoretical model;
3. Cognitive abilities - application, analysis, critical thinking, problem solving, synthesis;
4. Understanding of scientific learning - scientists, scientific enterprise and how it works interrelationships between technology and science; Attitudes - such as risk taking, objectivity, curiosity, interest, precision, responsibility, consensus, collaboration, confidence, perseverance, satisfaction and enjoyment of science

Skills gap in LAB computer science

This study provides an identification of the existing practical skills gap between school-based learning (SBL) and laboratory based learning (LBL) in the Computing Department within the Faculty of Science at Omar Al-Mukhtar University in Libya. A survey has been conducted and the author has elicited the responses of three groups of stakeholders, namely the academic teachers, lab demonstrators and students. Using lists of members of the computing department, the questionnaire was circulated to all participants by e-mail (by Arabic language). An introductory letter was included, explaining that the data would be used both to improve the course and design a blended learning strategy for the improvement of teaching and learning methods, and as material for study. The letter also assured participants that all responses would be treated confidentially, and gave a date by which responses should be received. The finding: Overall, the author received 113 respondents which differ in terms of demographics; for example, the age and gender. This allows for a biased sample population to be analysed and collected with a minimal chance of error between the over-all consequences (Othman and Impes,2013).

Gender – The analysis of data revealed a set of significant differences in the way males and females who were studying and working in the computing department - females were more represented than males, (62% compared with 38% male).

Age – the study indicated that 53% were aged 20-30, 27% were aged 30-38, and only 20% were aged 38+. As expected most respondents were aged between 20 and 38.

Figure 1 illustrates the cognitive domain questions, the respondents were teachers and they indicated that students must improve their skills in performing and understanding newly introduced ideas and problem solving activities for implementation in practical tasks through Lab and classroom sessions. In addition, they agreed that the IT skills level for students was very low during both Lab and classroom. However, teachers believed that learners were fully aware of university's rules and regulations as well as health and safety standards.

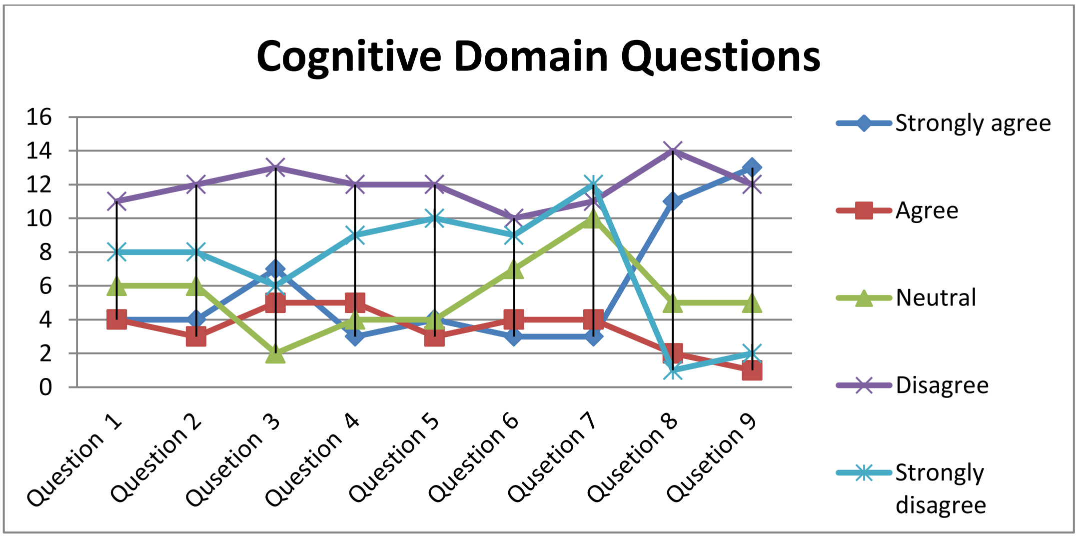

Figure 1: Cognitive domain questions

Figure 2: indicates that the responses from lab assistants focus on improving students' effectiveness in working as a group to share ideas and to participate actively in group discussion during practical tasks, and having a positive attitude to change. However, the respondents agreed that students were able to understand others' behaviours during SBL and LBL, including teachers and could interact in positive manner with others.

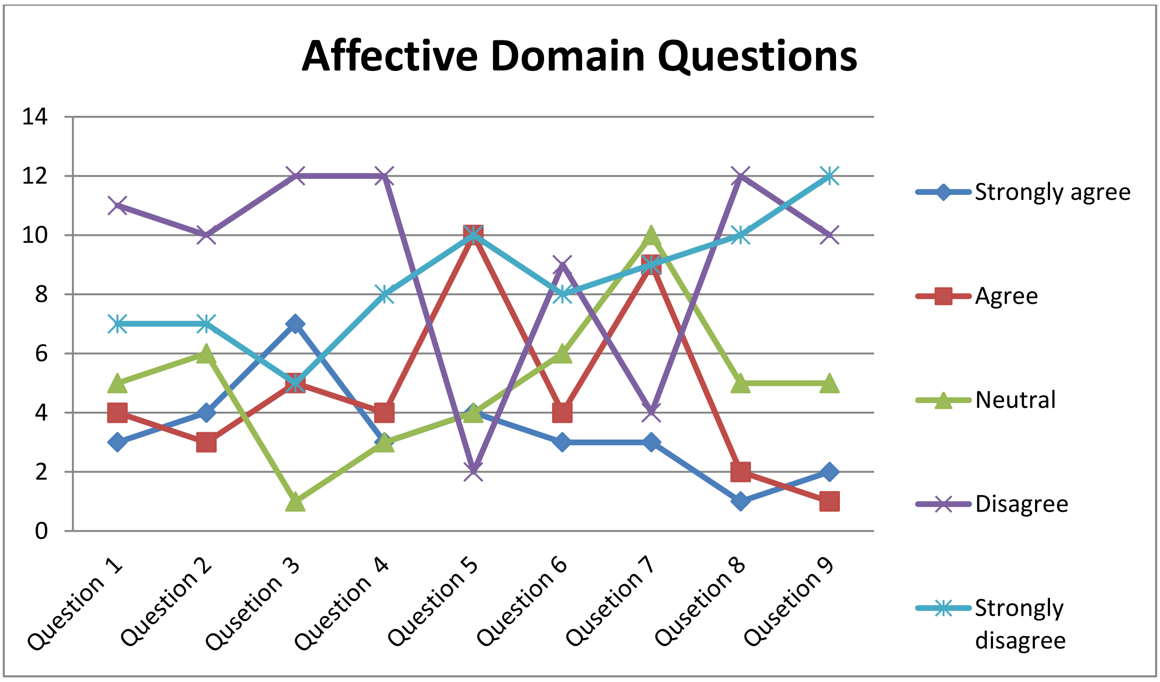

Figure 2: Affective Domain Questions

Figure 3 shows the responses from students that are related to the psychomotor domain. The results indicate that students need to improve in terms of thinking skills and communication skills during practical tasks in LBL as well as that students need improvements in terms of practical skills standards during SBL in order to perform well during Lab sessions and meet the university's expectations.

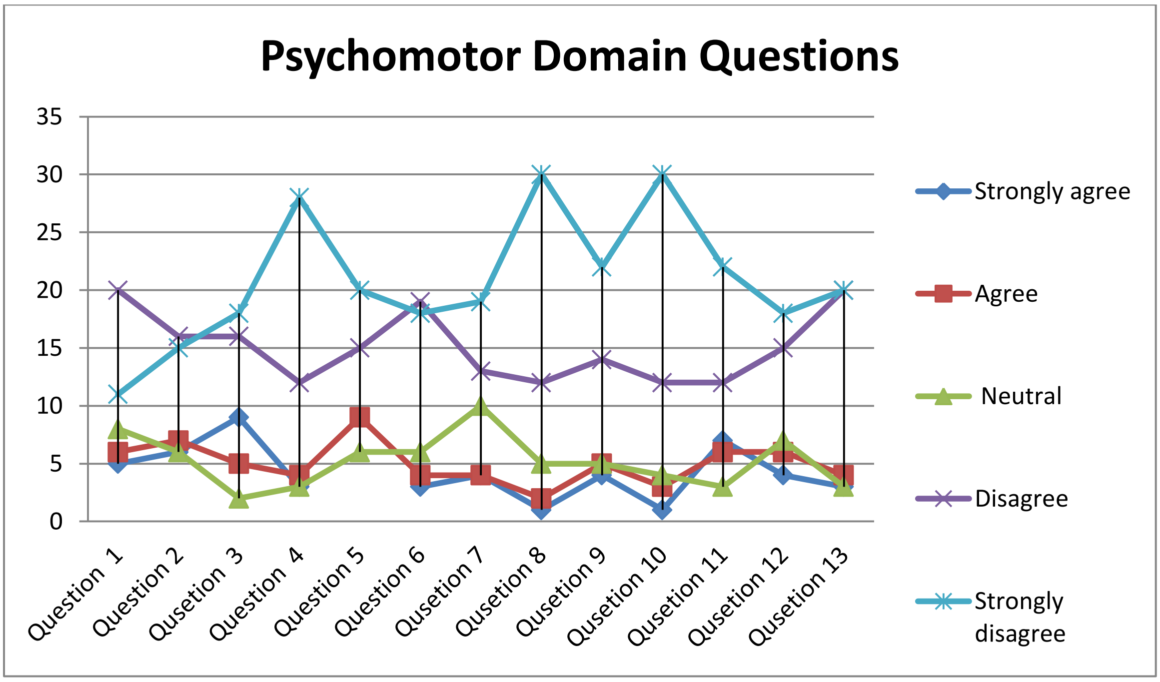

Figure3: Psychomotor Domain Questions

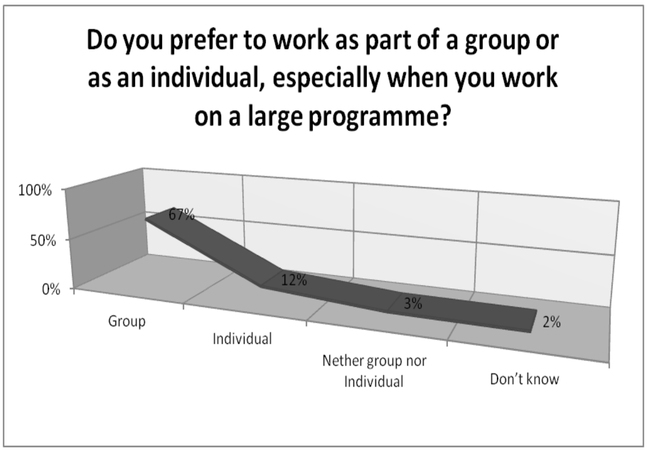

Figure5: Student responses

Figure4: Student responses: group work

In general, the failure to consider Bloom's pyramid structure is the leading cause of laboratory failure - the lack of lower level knowledge components inhibits application of medium level elements and therefore prevents successful execution of laboratory exercises.

Our observations and analysis, confirmed by the results of the student survey, allow us to indicate the following reasons for students' failure in the laboratory:

1. Lack of understanding of theoretical issues necessary to perform exercises and analyse results;
2. Lack of experience of practical work ;
3. Discouraged by rate of failure in the laboratory;
4. Lack of materials;
5. Lack of availability of teachers and demonstrators;
6. Poor standard of traditional laboratory facilities and conventional course.

The Main Pillars to Determining Future Needs:

The importance of virtual lab: it is open 24 hours a day, seven days a week and during holidays; thus there is no limit to time or place of use, as the student can access it at any time, day or night from anywhere in the world. It does not require access to classrooms, and it is not necessary that computers are available in the university or school, because the material can be used from home. Students can use it several times and look at the scientific material of the course and lectures constantly. This gives the student a positive and active role in the online module, and increases the process of interaction and communication between the teacher and students, since each student contributes to the preparation of the scientific material with the module and is able to express his opinion and comment on the submissions made by other students. It provides an opportunity for students to access a wealth of information, and can be used by students from all over the world, giving them also the opportunity to learn about different cultures. In addition to scientific learning, it allows students to gain computer skills. The process is characterized by flexibility and provides opportunities to enrich and audit learning, whereby the teacher can use multiple methods of teaching, such as simulation, exploration, experience-based learning and individual therapy. If teachers are appropriately trained in the use of well-designed tests, they will be able to diagnose the difficulties that hinder students' mastery of a certain point, and provide them with explanations and additional or alternative training to be proficient in that point. The teacher facilitates the correct tests and assignments, which offer him the facility to collect statistics on student progress both as individuals and as a group. It also allows the parents of the students to familiarize themselves with the scientific material presented in modulemail and to see their children's results first hand.

Types of Courses and Modules: There are several types of e-courses and emodules.The most significant of these are listen below, together with an indication of how they may be used.

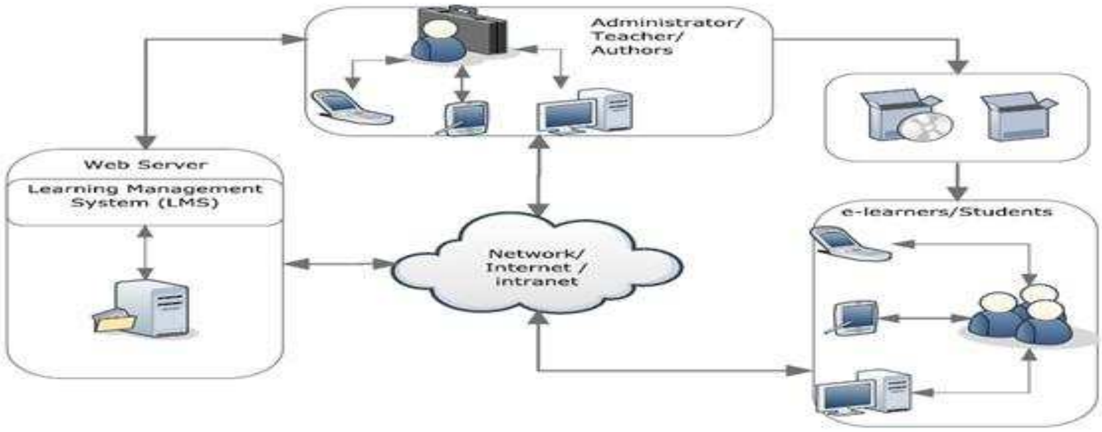

Figure6: the structure of the Virtual lab

(1) E-module not based on the Internet: This type of module involves a set of software that enables the teacher to design activities; for example, Author Plus facilitates the design of activities according to the inclinations and abilities of students who are studying the module. These programs can be used to design exercises for one lesson or training for an entire course, and are accessible for use by teachers with only basic computer skills. All that is required is a preliminary understanding of commands for Windows.

The module consists of programs, which are not designed to be based on the Internet, and comprises two versions - one which the teacher uses to prepare the training, and a copy, which the student uses to solve exercises and answer questions. The teacher’s version is on a computer of its own, and is not used or seen by the students, whilst the student version is on a special computer which allows the teacher to see it. The student version is loaded on the students’ computers, and they cannot change, erase or modify exercises prepared by the teacher, or add their own exercises. The program has its own database, and when the teacher sets any exercises or tests, the results are stored in the database. This can include longer exercises, or tests with different formats, such as fill the gap tests, multiple choice or reordering tests etc. The teacher can add question or phrases to the text, or features such as pictures, animations or extracts from films or music, and can preview the sound effects and images associated with these before storing them permanently. It is possible to set the time for reading and student response to questions, as well as the time to open the text. It can also correct student responses in several ways: immediate correction, which lets the student know whether the response is right or wrong after each question, or deferred correction, where the student is told whether the responses are right or wrong after completing answers to all the questions. It can allow the student to choose the response method he prefers, and give the student the percentage of correct responses, with comments on the level of performance. Students can be given the correct answer with an explanation of the errors, which occurred during the course of answering questions. There is also the option to offer hints to help the student in choosing the correct answer.

The program presents a set of lists at the top of the screen offering commands or instructions in MS Word, and a group of small windows inside the computer screen gives the teacher's instructions, texts and questions. There are a range of options that determine the mechanisms and functions that can be used in the preparation of the lesson, such as a list of types of questions and quality of feedback, quality of training correction and whether this should be temporary or not, and options to add effects such as sounds, images and colours.

(2) Online module based on the Internet: This type of module is based on a simple Internet format and contains a set of drawings and texts for the module, a set of exercises and tests, and records of test scores. The module may be developed to include animation, simulation, audio and visuals, and offers the possibility to add links to scientific material which can be found on the Internet or the World Wide Web. The Internet-based module consists of a set of tools that enable the student to communicate with the teacher and with his fellow students, and to look at and participate in the information relating to the module by using the following tools: home module, tools module, academic calendar, bulletin board, panel discussion, room dialogue and module-specific information.

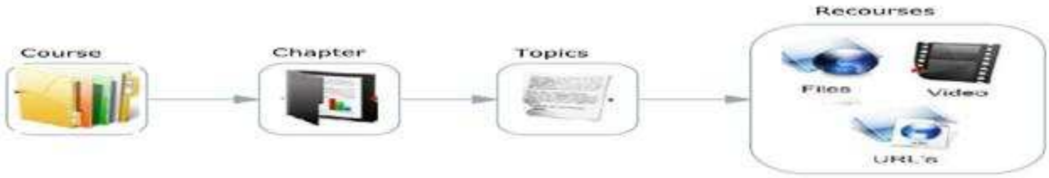

Figure 7: Course structure used with Virtual lab

It consists of scientific course content written with accompanying vocabulary and multimedia, and the scientific material can take the form of reading, tasks, lectures, special instructions, glossary, and notes and so on. It may include visual and audible material, photos, and simulations prepared by the computer, slide shows, attached documents, notes and images, and topics are organized in the form of files and folders with links, which lead students to different scheduled classes.

CONCLUSION

This study has shown that the use of computer animations can assist students to better understand complex and difficult concepts in various computer courses. The LBL course training will allow the incorporation of sound, moving pictures, and animation into lessons, which extends instructors' capabilities to deliver materials that increase learners' interaction with the subject matter. Through these media, students can watch practices in action, see micro-views of larger structures, and navigate interactive materials, simulations and images. E-tutorials will take place of the computer programming teachers in a virtual state. This will offer step-by-step directed tours of the entire e-learning package. Multimedia can transfer information effectively and quickly to all students, and can keep students interested in SBL. The researcher will blend video, audio, text, simulations, images and multimedia into a single online Moodle application available to students at school or home. The e-Learning package will help learners to improve research and technical skills, which cannot be accomplished by reading a textbook in the SBL or LBL workplace. The links will be on the Moodle application, which will help students use online resources by offering news archives, databases for online libraries, and a wealth of other information. Also, an LBL module can train educators to provide materials to students more clearly anytime and anywhere.

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