NEW E-LEARNING STRATEGY PARADIGM: A MULTI-DISCPLINARY APPROACH TO ENHANCE LEARNING DELIVERY

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ABSTRACT

Despite the ever-increasing practice of using e-learning in educational institutions, most of the applications perform poorly in motivating students to learn. There are many issues which are not addressed due to very complex and varying ideas in the development. Most e-learning applications fail to meet the needs of students and fail to serve the ultimate goal of having on-line learning. To solve this problem, we investigated and identified the fundamental elements necessary in developing a new e-learning paradigm; technology, instructional design, social context, continuous assessment and their relationship. This new multi-disciplinary approach centered on activities that enhance learning delivery, develop and improve critical thinking and knowledge acquisition. At the end, a prototype system has been developed and a set of experiments have been conducted to demonstrate the effectiveness of the new approach.

1 INTRODUCTION

E-learning is the use of computer and internet technologies to deliver a broad array of solutions to enable learning and improve performance. It is now the fad in educational technology where to this date from Google, it has 625,000,000 related sites including articles, books and research papers. Inevitably, e-learning benefits have spread in different spectrum and increasing rapidly, a trend that is predicted to continue "learning for life" as initiatives being promoted by governments, educational institutions and research organizations [1].

In Libya, e-learning is seen as one of the possible solutions of many problems in the academe including factors from political, cultural and social aspects. Politically speaking, during the war or in the presence of security threat, or declared holidays, students were not be able to come to the university due to restricted mobility and treat to security and safety. Culturally speaking, majority of the university are women who are basically busy with family commitments and no time to attend classes physically. Socially speaking, the presence of communication barrier among foreign instructor who tasked to deliver information technology education and learners as effect of almost two decades of English embargo. Thus, the e-learning can fill this gap by allowing student to study anywhere, anytime at their own time and disposal.

Allowing students to have their own pace in learning entails greater responsibility to e-learning developers and instructional strategist. It must answer what strategy should be taken or adapted in the design of the curriculum in such a way that learning process will occur. Many e-learning strategist develop e-learning module and apply into specific domain by just rebuilding their existing materials into cyber-landscape, while others just converted their PowerPoint slides into e-lesson, these does not guarantee learning. There is need to develop alternative strategy to cater socialization, collaboration, personalization, assessments and content analysis must be incorporated in e-learning strategy. These aspects covered a wide range of applications and importance in e-learning development.

2 E-LEARNING FRAMEWORK

Numerous models for curriculum changes technology education have been implemented and lead easily to a situation of constructive phase, immediately follows the planning phase, without enough time for conceptualization, ideation and the evaluation of ideas [2],[3]. Good design and planning is very crucial to classroom-based learning program, and are even more in e-learning design. In traditional learning the most important is the delivery of learning, whereas in e-learning, it is the instructional design and development of structured material that can be used multiple times and shared by multiple learners using varied technology.

The e-learning framework of the study is shown in Figure 1, depicted that technology is the central driving force of the framework , without it, e-learning will not exist. The framework is divided into three module; instructional module, social context module and the assessment module. The instructional content module includes integration of multiple components such as content analysis and sequencing, personalization support mechanism and the use of digital media. The social module supports the use of social network media and collaboration while assessment module enclosed test and practice module, performance parameters, profiling, and continuous improvement analysis of learner.

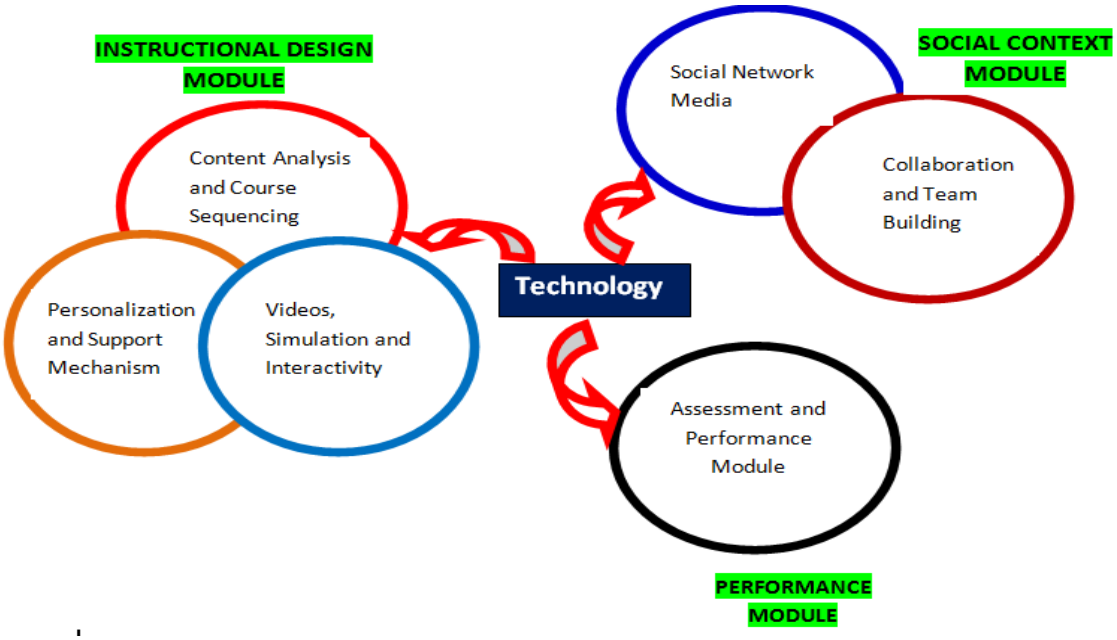

Figure 1. The Proposed E-learning Framework of Tertiary Curriculum

In the content module, different tools can be used to produce e-learning content, depending on which file formats will be used and how the end product will look like. Static documents such as PowerPoint and Microsoft documents can be used as a simple learning resources and can be interactive if added with more sophisticated tools such as animation, videos, graphics and simulations. Applying available courseware authoring tools and the use of graphics, text, and other media entice learning, but also provide a framework to organize pages and lessons for reliable navigation.

Different people have different perceptions on e-learning based on their backgrounds. Notably, the design of e-learning must consider cultural differences and context sensitivity issues especially in its learning environment [4]. In personalization, learners can jump to another topic of the curriculum without passing to other topics if he/she already knows to avoid unnecessary time. There are many

ways in personalizing the e-learning system, like phasing of content, changing colors, icons, access level and other mechanism [5].

In social content module of the framework, e-learning activities can be realized by using range of communication tools – both synchronous and asynchronous. In asynchronous tools such as e-mail, discussion forum, blog and wikis are more appropriate tool for task that requires more time to accomplish, students with communication barrier and too shy to collaborate while synchronous tools like chats, or audio conference provide higher social presence where learner can argue, comment and share resources. More and more educators are exploiting the use of social network media to perform socialization and collaboration [6]. Collaboration allows participants to work as group, creating a highly social learning environment, characterized by participation and interactivity for both students and facilitators [7],[8]. The facilitator is responsible for ensuring that the learning process is organized, stimulating and efficient. There are many papers that reported the used of collaboration using social networked media and benefited from it [9],[10].

The assessment module consists of how exams will be created, show results and discussion, and employ statistical tool that interpret the result automatically for students and facilitators. The assessment module can help to profile the students and use later for further personalizing the e-learning system.

3 E-LEARNING STRATEGY

To support the e-learning framework discussed in the previous section, an e-learning strategy must be developed [11]. One important element of deciding and defining e-learning strategy is the use of instructional model. It is the practice of creating "instructional experiences which make the acquisition of knowledge and skill more efficient, effective, and appealing. Figure 2 shows the ADDIE model composed of Analysis, Design, Development, Implementation and Evaluation. The model has been adapted based on its widely acceptance and used. The model has eight strategies, identified in each phase.

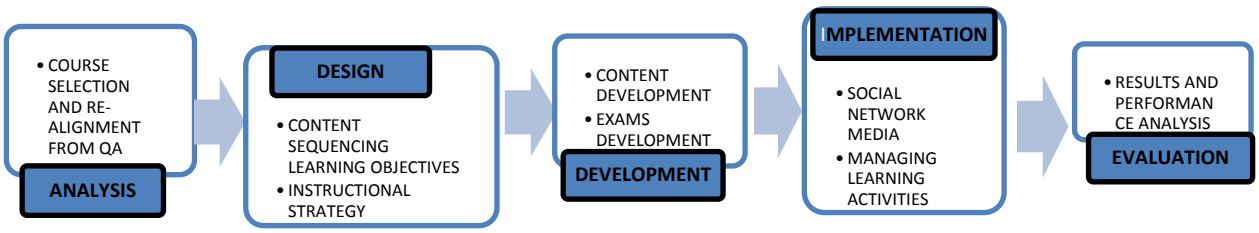

Figure 2. The ADDIE Model for University Curriculum

3.1 Course Selection and Re-alignment for Quality Assurance

In the curriculum, four cluster have been identified; hardware cluster, computing cluster, information system cluster and programming cluster. Each cluster is headed by a coordinator and responsible for coordinating to Quality Assurance (QA) department. The QA head is also part of the team. The following courses have been identified and listed in Figure 3.

Hardware cluster is a list of courses that deals primarily in the architecture of computer including logic circuits, network operating systems concepts and architecture, fundamentals of data communication and networking courses. Computing cluster courses were classified because of their algorithmic nature and focus on computing while information cluster courses were grouped accordingly because it is essential for information system development. Programming clusters were grouped according to the cluster name itself.

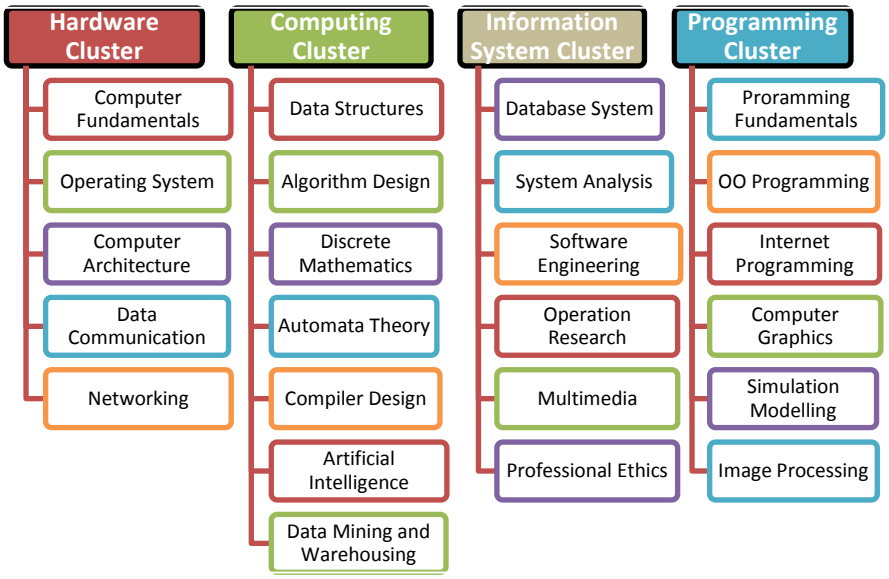

Figure 3. Identified Courses Arranged According to Cluster

3.2 Content Sequencing and Learning Objectives

Table 1 shows the identified content of the course e.g Design and Analysis of Algorithms with their corresponding objective. The identified contents together with corresponding objectives have been debated and discussed by the cluster member. The contents have been identified according to necessity, time constraints, pre-requisites, avoids overlapping and provides incremental learning and then approved by the QA in the university. A chunk of the summary of the course is given below.

Table 1. Identified Course Sequence and Objective Example

Course: Design and Analysis of Algorithms	
Chapter and Lessons	**Description of Objectives**
Chapter1. Introduction to Design and Analysis of Algorithms	To illustrate the relevance of algorithms in computer science and its various application in real word
Lesson 1.1. Criteria of Analyzing Algorithms	To explain and understand the criteria of analyzing the algorithms and its importance in coding algorithm performance.
Lesson 1.2. Problem Types	To simulate each e problem types related for course and its individual contribution in real world
Lesson 1.3. Time Complexity	To explain how efficient a code is, and understand Big-O, theta and omega notations in program coding

In identifying the course content, content sequencing must be properly studied and required analysis. If the designers do not include accurate and relevant content, the learning delivery will suffer as it will reflect poor instructional method and poor learning outcome. Content analysis shows specific learning objectives and curriculum outline base on the set requirements from quality assurance group. This can be done by applying two methods; topic analysis and objective analysis. Topic analysis is used to identify and classify the course content while the objective analysis, shows what/how learner should learn/improve or skills to be developed from each topic. According to the revised Bloom's

taxonomy of the cognitive domain, objective analysis can imply six different types of cognitive performance ranging from lowest (remember) to highest (create) as shown in Figure 4.

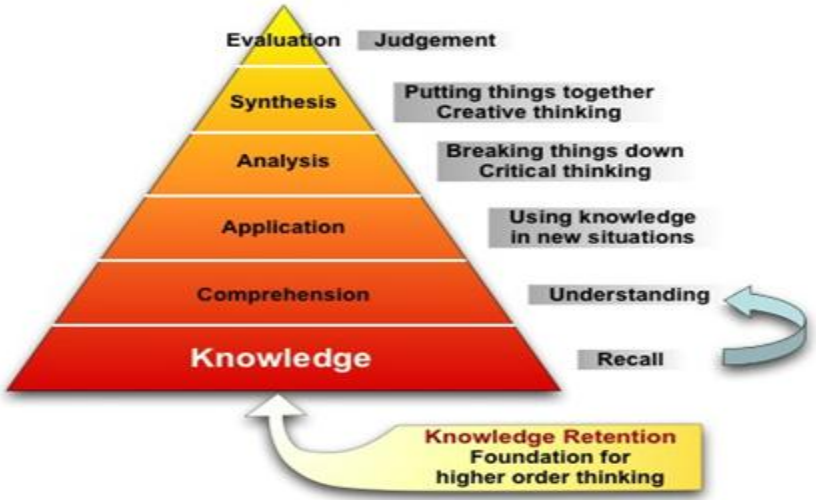

Figure 4. Bloom's Taxonomy of Cognitive Development

3.3 Instructional Strategy

The design of the e-learning course in the curriculum will a combination of following instructional methods as shown in Table 2. Expositive methods maybe in the form of static content such as documents and PowerPoint, interactive e-lessons, uses real case scenario, proven examples with theory and illustrations of how a task can be performed using videos with a step-by-step demonstrated procedure.

Table 2. Different Instructional Models

Expositive Methods	Application Methods	Collaborative methods
Presentations	Demonstration-Practice Methods	Peer Tutoring
Case Studies	Situational Based Exercises	On-line Guide Forums
Worked Examples	Symbolic Simulations	Collaborative Work
Demonstrations	Project Work	

Application Methods allow learners to practice the demonstrated procedure by either modifying the inputs, doing the same procedure, allowing the learners to take control with the application and control it. Situational case-based exercises improve critical thinking skills by asking learners to apply knowledge and principles to the problem at hand e.g. how to design a simple network. Symbolic simulations used to visualize complex problems such as how inputs dramatically change the graphs, commonly use to simulate mathematical model to gain scientific understanding. The collaborative method, on other hand, allows learners to have different kinds of activities e.g. evaluation and analysis of projects and assignments, one-on-one tutoring and online-discussion through social media. Using the three instructional models, this could be further analyzed by using Table 3.

Table 3. Instructional Models, Topics, Methods and Delivery Format Analysis

Instructional Model	Topics	Method	Used to	Delivery Formats
Expositive Methods	Criteria of Analyzing Algorithms	Presentations	Facilitate knowledge acquisition	Simple learning using documents and powerpoint
		Worked	Demonstrate	Code Simulation

		examples	generality (various data types)	
Application Method	Shortest Path Problems	Situational Based	Show how shortest path for Travelling Salesman Problem	Simple learning with interactive videos using Flash
		Symbolic Simulations	Map and Traffic Light Problem	Simulation

3.4 Content Development

Upon reviewing the course syllabus, topics and objectives next is content development. The primary focus of this strategy is the development of interactive learning materials. A major challenge facing providers of e-learning is the provision of meaningful interactive courseware that is responsive to learners, allowing them to actively participate in the learning process [12]. It is believed by many educational strategists that interactive system allows "learning by doing" and arouses interest and generates motivation and provides more engaging experience for the learner [13]. Interactivity results in deeper learning because learners can hypothesize to test their understanding, learn by mistakes and make sense of the unexpected. There are many techniques in presenting the content such as storytelling, scenario-based approach, toolkit and demonstrative-practice method.

Another important study that support importance of simulation, videos, graphics and pictures both in the design and e-learning implementation is the work of eLearning Guilds [14]. In their study it was proven theoretically and psychologically that the presence of interactive graphs, pictures, videos and other media elements increased and deepen learning. The six principles are as follows:

1. The multimedia principle: adding graphics to words can increase learning.
2. The contiguity principle: placing text near the graphics improve learning.
3. The modality principle: explaining graphics/video with audio improves learning.
4. The redundancy principle: explaining graphics with audio and redundant text can hurt learning.
5. The coherence principle: using gratuitous visuals, text, and sounds can hurt learning.
6. The personalization principle: use conversational tone and pedagogical agents to increase learning.

3.5 Exam and Assessment Strategies

Practice and assessment questions should be designed to reinforce the achievements of learning objectives. Different types of practice and test are required for different types of content such as facts, concepts, procedures and principles. Questions formats are usually in the form of multiple choice, multiple responses, matching, ordering, fill-in-the-blanks or/and short essay. In taking the practice test, feedback for the correct and incorrect answers is provided with explanation facilities. Students are usually allowed to have a self-paced e-learning provided he/she passes practice exams from prior topics to move to another. This will guarantee that learner understand the underlying concepts before proceeding to the next level.

3.6 Social Network Media

Another important element of learning is the priceless value of social interaction and collaboration. The rapid diffusion of social media enable users to connect with people than ever before. Students are using social media at school for various purposes such as communicating, exchanging information, sharing personal experiences and collaborating with one another. While many educational strategists are concerned how they should treat such media in order to prevent class disruptions, social media

provide affordable resources that can build social learning environment in a way that was not possible before. The use of social media provides a strong social component that allows learner to work together and collaborate. It provides social learning that helps learners in gaining experience, develop important skills in critical thinking, self reflection, and co-construction of knowledge [15].

Table 4. Synchronous and Asynchronous Communication Media

Synchronous	Asynchronous
• Chat (FB, YM) • Video and Audio Conferencing • Application Sharing • Polling • Whiteboard • Live Webcasting	• Email • Blogs • Discussion Forums • Wiki • Webcasting

Table 4 shows the list of synchronous and asynchronous media. In asynchronous media for e-learning, e-mail can be used as one-to-one communication, allows confidentiality and use for broadcasting a message in a group. Discussion forums, allow participants to hold conversations in the form of posted messages, read and reply mechanism. Wikis allow learners to share the same documents while blogs present diary-like format for collaboration such as assignments and commenting one's work. On the other hand, synchronous e-learning allows chat and instant messaging (IM) for feedback and keeping track textual dialogue in discussion. Polling use to collect's online opinion of the learners. Moreover, application sharing use for online tutorials which requires movements while audio and video conferencing allows voice over the Internet protocol (VoIP) allowing emulation of face-to-face and live communication but requires fast network connectivity.

3.7 Managing Learning Activities

To facilitate learning activities and make sure that process is efficient, organized and stimulating to the learner, e-learning in general must have the following; provide information on task, deadlines and place where to upload the files, provides summary at the end of each chapter, motivate and encourage participants to collaborate by integrating social media inside the e-learning module, assures links to other learning materials and resources including contact to facilitator, and organize final assessment module.

Content module and exam module activities can be monitored by incorporating Track Learning Module (TLM) in the e-learning system. The TLM of the novice learner is compared to expert TLM thereby allowing reinforcement if needed. Another new feature is the profiling module (PM), where students are automatically profiled based on his exams and activities. The exam is statistically analyzed using Blooms Taxonomy of cognitive level. These facilities allow learner and instructor if knowledge transfer occur in the process.

3.8 Performance Analysis

Various data analysis have been incorporated in the e-learning module allowing continuous profiling of students [16]. This performance analysis particularly focus on the results of exam and can be viewed by learner and facilitator in different level. Students can view his personal profile while facilitator can view all learner performance. Performance analysis can be done in multiple ways. For example, facilitator can view all students score in a particular test and determine difficulty and

discrimination and finding item response pattern. Another is to measure the individual and group gain cognitive level using the built-in Bloom Taxonomy statistics. Prior exams and post exams can validated by using Pearson, Cronbach and t-test correlation coefficient

4 SYSTEM EVALUATION

Method

The methods used for evaluation consisted of a combination of quantitative and qualitative data gathering approaches. The data collected included learning outcome-related data obtained through pretest and posttest, participants perception through questionnaires and interviews. To evaluate the effectiveness of the prototype, two sets of group were invited, a mixed group of students and staff (Group 1) and students only (Group 2) then, shown the two system in parallel. The two system; System A is prototype with the new features and System B, set of electronic lessons with graphics. Group 1 is composed of 10 staff and 25 students while group 2 is 25 students same from Group 1. For the 10 staff, 6 are males and 4 females while the 25 students are composed of 19 females and 6 males.

The data collection is roughly divided into three stages. First, group 2 participants completed a pre-test and a posttest after 2 weeks and used Bloom cognitive to evaluate the outcome of the exams [17]. Second, Group 1 evaluated the system using the Kirkpatrick's Model [18]. Kirkpatrick's Model includes four models; Reaction - how participants react to the learning system, Learning – knowledge and skill development, Behavior – how the transfer of learning is done using the system, and Result – how it affects individual outcome. The participants' evaluation of the system via the questionnaires used Likert Scale (from1, strongly disagree, to 7, strongly agree).

Results

The results obtained from the questionnaire are presented in Table 5. The initial findings show that the prototype with performance analysis is perceived to be more effective in terms of content management and functional support for learning, more helpful to obtain knowledge, more helpful in enabling learners to integrate knowledge, provide sufficient needs for social learning and collaboration, and improving individual performance. System gains significantly at all items identified in each level. One notable change is the social learning and exams where both have a perfect score in the prototype according to the learner survey average.

Table 5. Kirkpatrick Model Results

Level	Aspect	Prototype (System A)	E-lesson (System B)
Reaction	Provide Efficient Navigation	6.2	5.1
	Meeting Individual Learning Requirements	6.0	5.7
	Providing Interactivity and Learning Function	5.3	4.9
Learning	Exams (Practice and Marked)	7.0	5.0
	Increasing Cognitive level	6.5	5.5
Behavior	Integrating learning with classroom setting	6.5	5.6
	Facilitates social learning	7.0	5.0
	Provides Collaboration	6.7	5.1
Result	Improving individual performance	5.8	4.5
	Providing benefits to the department	6.0	5.0

On the other hand there is a significant increase of cognitive skills among learners at all six levels. The result of the pretest and posttest scores shows there is a significant increase of individual learners at their cognitive level; Understanding (.87), Comprehension (.77), Application (.81), Analysis (.73), Synthesis (.71), Evaluation (.68) average difficulty respectively. As shown in Table 6, the score of pretest and posttest is statistically significant with a t-test value of .0028 with .05 cut-off criterion.

Table 6.T-test Results Analysis

Group	Mean	Standard Deviation	Maximum	Minimum	Range	T-test
Pretest	12.3	2.11	15	10	5	.0028<.05
Posttest	15.6	2.17	19	14	5	

The findings from the pilot study are limited due to small sample size and short period of time yet it shows that experiment increase cognitive learning at both Kirkpatrick and Bloom point of view and also reflected in the exams using t-test value.

To get the qualitative data, it was collected through interview and soliciting feedback both from students and staff. Most of the staff commented that learning content is excellent yet it should be implemented in all courses identified in the first phase of the strategy. Another suggestion from the staff say that, the system should contain or links to other related materials to have a rich, comprehensive and abundant materials. However, this not necessarily important since it may hurt the learning process; causing concept overloading and navigational problem. Linking from one related link to another in the Internet can lessen momentum and cause exhaustion. According to some staff, performance analysis should be for facilitator only, but the researchers beg to disagree that such profile is very important since part of our system is to monitor the students performance and apply reinforcement if necessary during the learning process. Students should monitor their own progress by clicking their individual TLM. Profiling is very important for our next research.

For the students point of view, students have commented that e-learning must be adapted based on Arab perspective or allow customization or further personalization. Although our system allow personalization such as changing font size, color for viewing and other form of personalization; such perspective cannot be applied for the time being since our objective is to aligned into international standard. According to students, e.g., in Libya, the design should consider appropriate reading directions, right-to-left to suit the Arabic language; likewise, text justification and navigation systems should be fixed on the left hand side. Another comment is that it should be more in simulative type of learning, although we acknowledge the importance of such essence "learning by doing" and "learning by watching". Such contents of the course cannot just be applied to other courses especially for information system cluster. Another concern is the assessment module where items can be randomly selected. In this case, all questionnaires will undergo item analysis and will adapt the cognitive model to design specific cognitive skill.

In lieu with the social context, both staff and students agree that there should be a limit when to use or activate the social media such as FB or YM or any other social network media so that learners will only use it if necessary. The social network media in this context will only be used during online learning and collaboration and will be discouraged during face-to-face interaction to support blended learning. In general, adapting the new strategy is necessary to support social learning, cognitive learning and performance analysis.

5 CONCLUSION

In summary, a prototype has been developed using the eight identified strategy suitable for tertiary education. Although it is still in the process of fully implementing the program in the university level and subject for more negotiations, it open the idea that this strategy could support student to study at home at their convenience, thereby allowing them to collaborate and view the e-lesson. Also, other viewed this as one solution of the prevalent absences of students, e.g., man are usually doing business or managing business while woman are busy with family commitments, a common situation in Libya.

In the prototype, it was shown that if implemented properly and religiously, it will lead to an increase of cognitive learning and social learning. The incorporation of statistical treatment can be used to determine and perform performance analysis of learner and profile it for future reference. The purpose of profiling is to study further the students corpora; an area of studying pattern and performance of learners. Although it still needs more cooperation from different stakeholders, e-learning is a must and needs to be implemented.

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