Developing Cognitive Competencies in a Blended Learning Environment in Higher Education

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Abstract— This paper aimed at examined the effect of a blended learning environment on developing cognitive competencies in Higher education. To test research hypotheses, the researchers used the developmental research method for one experimental group. The sample consisted of 25 female students registered in an educational technology course in the Public Authority for Applied Education and Training at the state of Kuwait. The researchers applied the experiment during the second semester of the academic year 2015/2016. A list of instructional design standards was developed in order to be used in designing blended learning environment, and developing according to ADDIE instructional design model. The achievement test is an instrument for measure the cognitive competencies. Results of the study revealed statistically significant differences at (0.05) between mean scores of pre and post applications of the cognitive competencies achievement test in favor of the post application.

Index Terms—blended learning, project based learning, competencies, instructional technology course, state of Kuwait.

I. INTRODUCTION

The development and modernization of learning through the application of the modern technological methods and approaches is one of the challenges of this century. The use of the latest technological innovations becomes an urgent need and a step forward in the education systems and development, and it depends on the application and employment of the latest IT and e-learning developments.

Eryilmaz, (2015) said that the rapid developments in IT have shown significant changes in the field of education, and therefore, new concepts about learning and teaching have been emerged, including blended learning which is one of the modern technological innovations. According to Mei-Jung (2014) the blended learning is a learning style that blends the computer technology and the Internet with traditional learning.

Based on the above, this research seeks to design a learning environment for a university course in the educational technology using a project-based blended learning (PBL) strategy and describing its impact on the development of the students' competencies for this course. The researchers refer that the concept of blended learning is based on a range of various teaching methods combining e-learning and traditional learning; however, a project-based learning design is a new strategy for blending and a project-based learning is a style of learning.

Thomas Markham (2011) describes project-based learning (PBL) thus: "PBL integrates knowing and doing. Students learn knowledge and elements of the core curriculum, but also apply what they know to solve authentic problems and produce results that matter. PBL students take advantage of digital tools to produce high quality, collaborative products. PBL refocuses education on the student, not the curriculum—a shift mandated by the global world, which rewards intangible assets such as drive, passion, creativity, empathy, and resiliency. These cannot be taught out of a textbook, but must be activated through experience."

The research aims to develop cognitive competencies in the female student video production course. Chuadhry & Shah, (2012) describes the educational skills as the ability to perform a certain activity according to specific criteria. The researchers see that the video production course of the educational technology courses covers cognitive aspects and mental skills, and PBL strategy was applied in a manner appropriate to the development of such skills.

Blended Learning

Rosen & Stewart (2016) defines PBL as a powerful instructional approach in which learning is performed face-to-face accompanied by e-learning element, and such element is introduced to the blended learning simultaneously (while teaching) or asynchronously (obtaining the educational material at any time). Therefore, the blended learning is not a learning style in the classrooms but also the best and most attractive style in providing the necessary educational materials (Slomanson, 2014).

The researchers first applied the strategy of the instructional e-learning through responding to e- activities followed by the traditional classroom learning in which the teacher is the expert and supporter of learners, then applied the four stages of PBL (plan, design, implement, assess) using collaborative learning groups in the production of projects that are assessed and evaluated by the teacher who provides his feedback to learners traditionally or electronically. Blended learning was designed based on projects. Larmer, (2015) believes that PBL is a design and production of a material and realistic product over various stages and steps of the project (the final product) to get learners acquire different skills and knowledge. Speckels, (2012) and English & Kitsantas, (2013) see that PBL is significant in achieving many of the learning objectives (cognitive, emotional, and skill aspects).

Educational video production course is a compulsory course in the specialty of educational technology in the State of Kuwait, and the preceding requirement of the Photography

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course. The educational video production course code is 324 and the Photography course code is 125. The educational video production course is scheduled to teach learners how to take shots and deal with a portable video camera, and how to capture and design animated pictures. The cognitive competencies of the course are (learning the concept of the educational video, learning the concept of video production using one camera and knowing the camera parts, learning the concept of the scene, learning the concept of the shot, knowledge of the concept of lighting, knowledge of the concept of shooting standards, knowledge of the concept of distant and remote shots, learning the concept of a long , medium and close-up shots, learning the concept of the foundational and detailed shots, learning the scenario specifications, knowledge of the concepts of (Pan), (Tilt), (Zoom), (Dolly) and (Truck) cameras, learning the concepts of high angle and low angle shooting, learning the concept of shooting at eye level, learning the concept of the bird shooting angle and learning how to move from one shot to another).

Some students of the educational video production course were Kuwaitis and non-Kuwaitis who study the specialty of educational technology at the College of the Basic Education of the Public Authority for Applied Education and Training in Kuwait. Students' GPA, age, and grades varied; i.e. some students were in the second academic year and the third academic year. Students had various cultural and social backgrounds. Students' prior knowledge, skills and trends towards subjects and their psychological characteristics relating to perception and responding to certain stimuli as a TV program or a picture or a video shooting varied as well.

II. Research Methodology

The researchers applied the developmental research method that is appropriate to this type of research. The development Research method integrates the following research methods:

1. Systematic development method; and
2. Experimental research method.

A. Research Population

The research population were made up of all students who study the specialty of educational technology at the College of the Basic Education of the Public Authority for Applied Education and Training in Kuwait. The available population were students who study the educational video production course at the College of the Basic Education of the Public Authority for Applied Education and Training in Kuwait.

B. Research Sample

The research sample was selected (intentionally) and consisted of 25 students registered in the educational video production course at the College of the Basic Education of the Public Authority for Applied Education and Training in Kuwait. This number of students represented the experimental group of this research.

List of competencies of the educational video production course

The researchers prepared a list of competencies of the educational video production course. After refereeing, this list

was composed of 87 aspects of cognitive competencies, 40 mental skills and 21 performance skills.

III. PBL Strategy

PBL strategy was made up of main four stages; namely, planning, design, implementation and assessment as illustrated in the below Figure:

Stage	Items
1. Planning Stage:	1. Analyze the course content and select the projects 2. Determine each project's outcomes 3. Divide students into groups to implement the project 4. Prepare the collaborative learning roles for the project.
2. Design Stage:	1. Formulate the project's titles 2. Formulate the project's objectives 3. Distribute the project's tasks to students in the collaborative groups 4. Design the work activities and environment (the Project).
3. Implementation Stage	1. Distribute the working groups to projects 2. Use e-learning to learn the project's aspects 3. Determine the project's parts to be learnt 4. Provide support and guidance to students.
4. Assessment Stage	1. Assess the work of each working group to verify the project's achievements 2. Provide feedback to students 3. Follow up the course teachers 4. Apply various tests.

Fig. 1. Design standards of the PBL strategy (**PBL Strategy**).

A. Design standards of the PBL strategy

Based on the literature reviewed by the researchers, the design standards of the PBL strategy was drawn up of 10 standards and 71 indicators.

IV. Preparation of the Research Instruments

The following instruments were developed by the researchers to get the data for the dependent variables of this research; namely: (the cognitive achievement test, a measurement of learning satisfaction, and the product assessment card).

A. The cognitive achievement test of the educational video production course

The cognitive achievement test was developed in light of the educational video production course competencies. The number of test questions were (78) questions; a mark for each question. The internal validity of the test was verified by Cronbach's Alpha coefficient (α), which stood at (0.765).

V. Design And Development Of The Experimental Materials Of PBL Strategy

ADDIE Model was used by the researchers to design and develop the PBL strategy, and it consists of five stages as indicated in the below Figure:
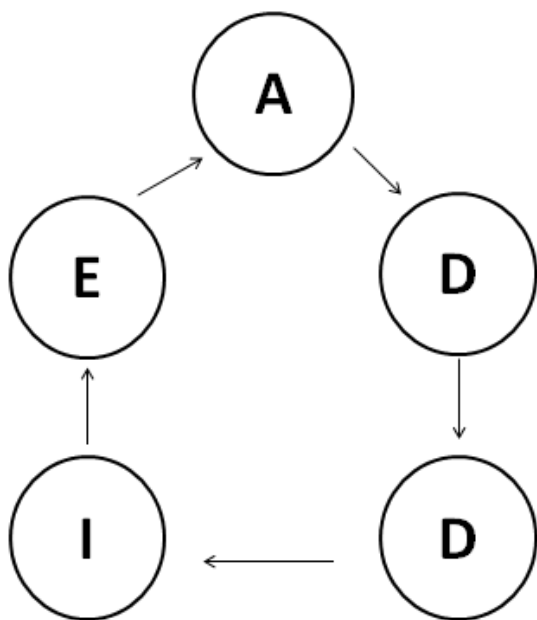
Fig. 2. ADDIE Instructional design model.

A. First: Analysis Stage:

• **Analysis of students' characteristics and learning needs:**

The researchers analyzed the students' characteristics, their previous attainment, knowledge and skills, as well as their cognitive, performing, emotional and academic trends as follow:

1. Students are registered in the educational video production course and they are 25 students.
2. The educational video production course is one of the compulsory courses in the Department of Educational Technology, College of Basic Education. It is a 3-credit course and requires the actual attendance once a week for four hours in the classroom.
3. Students have experience in photography and how to deal with the cameras. Learning style was limited to the traditional form of learning and study of the educational video production course.
4. The researchers found out that the students had no information about the blended learning in terms of e-learning, PBL and the use of virtual learning environment.

• **Analysis of the educational video production course content**

The educational video production course content was analyzed and it was agreed on the part on which the research experiment would be applied. The overall objective of the educational video production course is the development of students' knowledge of the (meaningful picture) that is designed by the director to influence the audience (positively or negatively), and how to set up, develop and understand the meanings of the footage and sounds to be delivered to the audience. The course focuses on the use of regular video camera, how to use them to deliver the information to the viewers and the desirability of admiration. Students are trained on how to use the camera and carry out several projects to achieve the desired goal. Finally,

a student selects a comprehensive final project theme freely freedom, and the themes on which the research experiment were applied were: (general concepts and terminology of the educational video and types of television shots and movements of different camera and software used in the montage).

• **Analysis of students' learning needs:**

Based on the analysis of the course content, the researchers identified the students' learning needs. They were cognitive competencies (cognition aspects, mental skills) as well as the performing skills.

B. Second: Design Stage:

Design refers to the development of plans and preliminary drafts for the development of the educational process. The following procedures and steps followed by the researchers:

1. Organizing learning objectives:
Organize learning objectives and determine the goals to be achieved by direct learning method and the objectives that can be achieved by e-learning method. Achievement of some learning objectives may require the integration between the direct learning method and e-learning method.

2. Organizing PBL content:
After analyzing PBL content, it was organized according to a specific sequence that is conducive to achieving the learning goals that have already been identified in less time and effort as possible. The researchers took the following steps:

− The course e-learning content consists of a general introduction, objectives, PBL method along with the support and guidance methods and the student guide.
− The content was composed of three educational modules, each module contains introduction and a general objective and procedural objectives as well as the project learning requirement (electronic activities) and stages of the project learning (planning, design, implementation, and assessment) and the final project.
− All modules included the requirements of the project learning (electronic activities) using the virtual learning environment, where some of them have been collaboratively implemented in the classroom; some have been individually implemented outside the classroom, with the provision of immediate feedback. The electronic activities included a paragraph to introduce each activity, short introduction to link the topic with the previous experiences of the students, and clarification of the importance of this activity, in addition to self-evaluation questions upon completing all activities.
− There were direct classroom activities that have been carried out throughout the phases of the project (design - planning - implementation − assessment). They were direct and traditional classroom activities that had been carried out collaboratively between students, such as:
− The analysis of educational videos like constructive ads in Module 1 as illustrated in Figure 8 along with the videos assessment card. Module 2 identifies the shooting scenario for the project, as well as class activities on the types of shots. Module 3 included direct class activities on the

camera movements and angles and introduction to the final project scenario.

3. Design of PBL strategy:

The researchers presented a new strategy which is a PBL strategy. PBL strategy depends on collaborative working groups and students were divided into seven groups; each group consisting of four students.

4. Design of learning activities:

The researchers selected the experiences and learning activities in the virtual learning environment for each objectives; such educational activities and experiences were selected in a manner that is appropriate to collaborative learning, and the activities and experiences were designed in the light of the PBL strategy so as to provide interaction among students and content through the Websites listed in learning activities, the diversity of experiences, learning activities and resources used in virtual learning environment. The researchers carried out the following:

• Diversity of learning materials and resources provided, the means transmitting information vary. The varied information sources facilitated the learning process, provision of experiences and activities, and provision of appropriate feedback for such activities.

• The identification of a set of communication tools that provide further interaction between students with each other or with the researchers that are used inside and outside the learning environment simultaneously or non-simultaneously. Therefore, various course and emails topics were discussed, and what's App was selected to communicate between students and researchers.

5. Design of a virtual learning environment

− The educational website of the course, which is the learning objectives, contained (31) activities, and each webpage contained activity that begins with an introduction and preface with a paragraph or a video clip and then a question is asked. The remaining activities followed the same pattern, and at the end of each activity feedback is provided, a question is asked to the project groups, and discussion was made between students and teachers on the idea of the final project during the design of the webpages and learning, the researchers developed a plan on how to construct e-activities through their distribution to a group of webpages, determination of the webpage attributes, and how to distribute texts, pictures and videos inside the webpage. The researchers used the (Photoshop) software to design webpages. They also used several software to design videos such as (Camtasia), (MovieMaker), (Adobe Premiere) and (EDIUS). (Dreamweaver) was used to set up the website in the Internet completely.

− Interaction in the virtual learning environment of the PBL strategy was divided into the interaction in the direct learning environment and face-to-face learning inside the classrooms and e-learning via the Internet. The details are as follows:

1. Interaction in the direct learning environment through the interaction between the course teachers and students through the students' positive participation in solving the oral questions, teachers' reply to students' inquiries and provision of support and assistance to students to meet the requirements of the project; in addition to the students' interaction with each other in solving the activities of the project requirements, and solving the activities of the project's learning stages through a worksheet that was distributed to the students by the course teachers.

2. Interaction in e-learning environment through the interaction between the course teachers and students through the asynchronous communication by email, panel discussion, What's App application, as well as the interaction between the students with each other through the panel discussion, solving activities and assignments in a cooperative manner; in addition to the interaction of the students with the educational content on the virtual learning environment represented in the educational activities which can be re-run at any time with immediate feedback.

C. Third: Development Stage:

At this stage, the educational and multimedia materials that have been identified in the design stage were obtained. The elements of the website content of the virtual learning environment have been developed as well. They are: an introduction, the goals of general and specific modules, educational activities, self-assessment questions, discussion, and assignments; some had been produced in the traditional learning environment, and some had been produced in the e-learning environment. This is in addition to preparing the learner's guide, which contains instructions and guidelines and the action plan of the course. Moreover, the photos and videos to be inserted in the pages of the electronic activities and requirements of the project learning and solving the activities of the project learning phases have been developed. To produce several different content elements, several programs and software have been used by the researchers.

D. Fourth: Implementation Stage:

At this stage, the researchers experimented the learning environment for PBL strategy that aims to developing the students' competencies. The research experiment group were the 25 students of the educational video production course. The course lecture was delivered once a week on Tuesday from 12 pm to 4 pm at the College of the Basic Education of the Public Authority for Applied Education and Training in Kuwait. The experiment began on Tuesday, 22.03.2016 and completed on Tuesday, 26.04.2016.

E. Fifth: Evaluation Stage:

At this stage (before the application and implementation process), the researchers adjusted the PBL strategy and ensured that it is valid and fit for use. In addition, they developed the educational design standards conformity card for reefing of instructional design for refereeing the learning environment in the light of the list of standards developed by

the researchers. A meeting was held on 17.03.2016 at 11 am in the Distance Learning Department, the Arabian Gulf University, to referee the learning environment by a group of specialist professors in the field of distance learning and training, and their suggested amendments were addressed to create a fit for the purpose learning environment which gained 90%.

VI. THE RESEARCH FINDINGS:

This part contains the results of the research hypotheses tests. The three hypotheses of the research were as follows:
There is a statistically significant difference at ($\alpha \geq 0.05$) between the means of scores in the pre and post application of the cognitive achievement test of the experimental group in favor of the post application.
To investigate that there is a statistically significant difference at ($\alpha \geq 0.05$) between the means of scores in the pre and post application of the cognitive achievement, the following tests were used:
1. (t) test of the (Paired Samples Test) as shown in Table 1

TABLE I: RESULTS OF THE (T) TEST OF THE PAIRED SAMPLES TO VERIFY THE THAT THERE IS A STATISTICALLY SIGNIFICANT DIFFERENCE AT ($\alpha \geq 0.05$) BETWEEN THE MEANS OF SCORES IN THE PRE AND POST APPLICATION OF THE COGNITIVE ACHIEVEMENT

t	Mean	SD	differences		t value	df	Sig. Level
			Mean	SD			
post	69.40	5.43	21.44	8.13	13.18	24	0.000
Pre	47.96	5.86					

The results reported in Table 1 revealed that the value of the virtual difference between the means of scores in the pre and post application of the cognitive achievement equals to (21.44), and the value of (t) of the difference between the means of scores is (13.18), which is statistically significant difference at (0.05), where the significance equals to (0.000) which is less than (0.05). This means rejecting the zero hypothesis and accept hypothesis 1.

2. The value of the effect size was calculated using 2η value. After calculation of the t test of the difference between the means of scores in the pre and post application of the cognitive achievement, value of "2η" was calculated according to the following equation:

$$(\text{Kiess: } 1989, 446)\ 2\eta = \frac{t2}{t2 + df}$$

Table 2 shows the results.

TABLE II: RESULTS OF THE EFFECT SIZE CALCULATED USING 2H VALUE

Variable	value t	df	η^2
Cognitive Achievement	13.18	24	0.8786

Results of data analysis reported in Table 2 revealed that the significance level of 2η value was (0.8786). It signifies that the effect size of the PBL strategy on the cognitive achievement test was (87.86%).

3. Blake's Modified Gain ratio of the cognitive achievement test was calculated using the following equation:

$$\frac{\text{Gain Mean}}{\text{Mean of pre application} - \text{Final Mark}} + \frac{\text{Gain Mean}}{\text{Final Mark}}$$

Table 3 shows the results:

TABLE III RESULTS OF BLAKE'S MODIFIED GAIN RATIO OF THE COGNITIVE ACHIEVEMENT TEST

Variable	Final Mark	Mean of pre application	Mean of post application	Gain Mean	Blake's Modified Gain Ratio
Cognitive Achievement	78	47.96	69.40	21.44	0.98

Based on the results of Table 3, we note that Blake's Modified Gain Ratio is (0.98).

4. To test McGugian Effectiveness Ratio, the following equation was used:

$$\frac{\text{Gain Mean}}{\text{Mean of pre application} - \text{Final Mark}}$$

Table 4 shows the results:

TABLE IV: RESULTS OF MCGUGIAN EFFECTIVENESS RATIO OF THE COGNITIVE ACHIEVEMENT TEST

Variable	Final Mark	Mean of pre application	Mean of post application	McGugian Effectiveness Ratio
Cognitive Achievement	78	47.96	69.40	0.71

Based on the results of Table 4, we note that McGugian Effectiveness Ratio is (0.71) which is greater than (0.60). This means that the use of PBL strategy is effective.

VII. DISCUSSION OF THE RESEARCH FINDINGS

This discussion will be divided into three components as follows:

First: Discussion of hypothesis 1 relating to the cognitive achievement of the competencies of the educational video production course that states: "**There is a statistically significant difference at ($\alpha \geq 0.05$) between the means of scores in the pre and post application of the cognitive achievement test of the experimental group in favor of the post application**".
Upon the analysis of hypothesis 1 relating to the pre and post application of the cognitive achievement test of the experimental group with respect to the impact of PBL strategy in developing students' competencies in the educational video production course, the results revealed that there is improvement in the students' competencies in pre and post application of the cognitive achievement test. This proves the effectiveness of learning using PBL strategy that has been designed to develop the students' competencies in the educational video production course in the Education Technology Department, Kuwait.

This has been achieved through the comparison between the pre and post application of the cognitive achievement test of the experimental group. Based on the interpretation of the results, the researchers noted that the post application of the cognitive achievement increased and it was higher than the pre application of the cognitive achievement test. The difference between the means of scores in the pre and post application of the cognitive achievement test of the experimental group was (21.44) in favor of the post application. This means that the use of PBL strategy can improve the students' cognitive achievement with the provision of the conditions of the current research.

The researchers believe that the reasons for the existence of such differences between the pre and post application of the cognitive achievement test in favor of the post application were attributed to the use of PBL strategy which is characterized of the following:

1. The foundations of PBL strategy relating to the cognitive achievement were as follows:
• PBL strategy is based on constructivist learning.
• PBL strategy is based on the determination of the aspects to be learnt directly and needs e-learning.
• PBL strategy is based on content analysis and selection of constructive topics of the projects.
• PBL strategy is based on the application of the learnt cognitive competencies and skills.

2. The stages of PBL strategy which contributed largely to the promotion of the development of the students' cognitive achievement.
3. Organizing of the educational modules that provided an opportunity for the research sample to develop the cognitive achievement, which contributed to the increase of their motivation towards learning and acquisition of educational experiences.
4. PBL strategy provided an opportunity for students to identify the learning stages of the project, which provided more opportunity to learn and gain experience and cognitive competencies and skills.
5. The design of e-content of the course was clear and structured. It helped students to move smoothly from one tool to another without any complications.
6. The use of multiple electronic resources to access information and knowledge. This helped students to easily understand and save them.

7. Methods of the presentation and design of the educational activities according to the PBL strategy that use induction and introduction to each activity were encouraging to learn and get to know the new and distinctive items.
8. Provision of feedback for each educational activity along with the support and guidance by the course teachers helped to confirm and develop the learning process.

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