Developing Skills of Cloud Computing to Promote Knowledge in Saudi Arabian Students

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***Abstract*—The present study aims to develop the skills of the cloud computing applications and the knowledge economy among the university students by designing a participatory electronic learning environment. A sample was chosen from the students of the "General Diploma" in the Faculty of Education, King Khalid University. This sample was divided into two groups; experimental group that comprised of 15 students trained through the participatory e-learning environment; whereas, the control group comprised of 17 students, who were trained through the Blackboard Learning Management System. Skills for cloud computing applications and a knowledge economy skills scale were developed. Kolmogorov-Smirnov Mann was used for identifying the normality test of variables. Whitney test and Spearman correlation test were used to analyze the results, which indicated that the design of a participatory e-learning environment based on the theory of communication contributed to improve the skills level of cloud computing applications and knowledge economy skills. The results showed that participatory e-learning environment based on the theory of communication significantly contributes towards improving the skills level of cloud computing applications and knowledge economy skills among the students from Saudi Arabian universities. Moreover, future studies need to focus on blueprint in the context of the educational system of Saudi Arabia.**

Keywords*—*Cloud computing applications; e-learning environment; higher education; knowledge economy

I. INTRODUCTION

Cloud computing has become an important technical trend that can reshape the IT operations (information Technology) and IT market operations. The students use a variety of devices, including desktops, laptops, smartphones, digital access devices, storage space, and online application development platforms through the services provided by cloud computing providers. The advantages of cloud computing include cost savings, high availability, and ease of access [1]. Author in [2] recommended the need for educational institutions to quickly turn to the use of cloud computing in the educational process as it does not constitute a cost or additional physical burden on the educational institution. According to [3], Google Drive is one of the cloud computing services that help to overcome the problems of collective learning. The problems of collective learning include the adoption of a learner in a group over others, the lack of participation of some members of the group, and the lack of commitment of some members for setting goals.

The knowledge economy revolves around knowledge acquisition and is used to improve life in all areas using the human mind and the use of scientific research. Skills of the knowledge economy are defined as a set of behaviors and activities that enable the learner to deal accurately and skillfully with knowledge to employ them effectively in the fields of science and life. The most important of these skills include; critical thinking skills, effective handling, problem solving, decision making, and creativity and innovation [4]. The benefit of the knowledge economy depends on how it becomes a learning economy using modern technology and techniques to communicate with others to spread ideas and innovation, rather than gaining global knowledge. Learners in the learning economy can create wealth that is equal with their ability to learn and engage in innovation and innovation with others [5].

The leader of the communication school confirmed that the process of learning takes place in different ways including; modern information and communication technologies. These technologies include; computers, multimedia-based software, websites, e-mail, email lists Blogs, and Wiki Virtual social networks. The communicative theory is like constructional theory that emphasizes social learning, allows learners to communicate, and interacts with each other or while learning. This theory emphasizes the role of participatory technology to acquire knowledge, skills, and digital values [6]. The design of the participatory e-learning environment considering the "communicative" theory of the above learning strategies combines the formal learning provided by the teacher so that all students benefit from their experience. The formal curriculum serves as the foundation for all students and provides participatory learning spaces through Web tools (2.0) (Blogging, wiki, Facebook, etc.). This helps the students to interact and share the information they have searched for, under the guidance of the teacher, along with directing and preparing the output of these participations.

Cloud computing provides useful support in the field of education, along with its significant use in infrastructure, communication, software applications, data storage, and platform system [7]. According to Arpaci [8], adopting cloud computing in education is capable of enhancing knowledge management. Further Li [9] summarized that cloud computing is beneficial in higher education as it enhances the level of education modernization, reduces costs, and helps in achieving sharing of educational resources. Huang [10] stated that benefits of cloud computing are observed through ease of access to educational content, training facilities for scientific innovation, collaboration and knowledge building, and providing support to students and teachers for easy facilitation

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and exchange of knowledge. The students are offered to share the teaching and learning materials, scientific and research articles through Google Docs or DropBox [11].

It is important to integrate technology in general, and cloud computing in universities, particularly. It is known that constructivist strategies for cognitive learning determines the efficiency of a classroom setting [12]. Certain educational environments are introduced by cloud computing based on teaching and learning practices that take place in the framework of social interaction and cooperation to build knowledge. There is need to focus on the role of cloud computing to enhance teaching and learning practices in Saudi Arabia; although, studies have shown the significance of cloud computing in higher education system in other regions.

In the similar context, this study aims to develop the skills of students toward cloud computing skills and their knowledge economy enrolled in the General Diploma in the Faculty of Education, King Khalid University. The aim has been fulfilled through the development of a participatory electronic learning environment based on the theory of "communication Connectivism". The study is significant as it would help in proposing training programs based on the design of an electronic environment that can benefit teachers in various scientific disciplines to develop their skills in the field of cloud computing. It would also help in designing platform-based electronic environment (Pbworks) that can benefit specialists in different subjects to develop their skills for the services of cloud computing and other various applications. Moreover, it would also instruct the curriculum developers towards the use of technological innovations in teaching and learning.

II. Material and Methods

A. Study Design

The study has conducted an experiment for determining the effectiveness of the proposed cloud-based learning environment in order to improve practices and learning performance in a higher education on product design. A quasi-experimental study was conducted on a product design course in a computer-aided classroom at a Saudi Arabian University for examining the effectiveness of the proposed cloud-based learning environment.

B. Study Sample

The study investigates the effectiveness of developing an electronic environment based on the theory of communication to develop the skills of cloud computing and the knowledge economy of students. The recruited participants were divided in two groups; one was experimental and the other was a control. The experimental group was trained on the proposed program based on the theory of communication through the platform Pbworks; while, the control group used the learning management system environment Blackboard available at the University. The tools of the study were applied in a tribal manner to ensure the equivalence of the two groups as shown in Table I. Table II shows that the value of the test Kolmogorov-Smirnov (0.16), (0.23), (0.18), was less than (0.05). This confirms the non-normal distribution of the data.

TABLE I. Degree of Equivalence between Students of the Two Study Groups

Group	Tool	Number	Variance*	Calculated value of (P)
Experimental	Observation card	15	6.96	1.29
Control		17	5.37	
Experimental	Knowledge Economy Scale	15	8.98	1.34
Control		17	6.69	

TABLE II. Kolmogorov-Smirnov Test to Show Distribution of Data

Group	Number	Tool	Value	Function level	Statistical significance	Distribution
Experimental	15	Observation card.	0.16	0.04*	function	"Abnormal."
Control	17					
Experimental	15	Knowledge-based	0.23	0.00*	function	"Abnormal."
Control	17					

C. Study Materials

1) Designing an e-learning environment: Previous studies were examined to develop an e-learning environment based on the theory of communication [13,14]. The Siemens model considered in the present study comprises of five stages as illustrated in Table III (Siemens, 2005).

TABLE III. The Five Stages

<table>
<tr><td colspan="5">The First Stage: The Field Scope</td></tr>
<tr><td>Planning</td><td></td><td colspan="3">The Second Stage: Construction Creation</td></tr>
<tr><td rowspan="3">• Target Category
• Budget
• methods of delivery
• Strategy used.
• Formal and informal learning.</td><td>Analysis</td><td></td><td></td><td rowspan="2"></td></tr>
<tr><td rowspan="2">• Learners' learning range.
• Available technology.
• Students
• Nature of content.
• Support required</td><td>Design</td><td></td></tr>
<tr><td>• Learning Goals.
• Selection of technological media.
• Strengthening interaction
• A variety of shapes, layouts, external appearances)</td><td>Development</td><td></td></tr>
<tr><td colspan="2">Experimentation (during Phase I and II)
The Third Stage: User experience and experience User experience and piloting</td><td>• Identify required skills.
• Identify content experts.
• Determine the evolution of the incident through the schedule.</td><td>Delivery
• Play content.
• Run and handle links that do not work.</td></tr>
<tr><td colspan="3">The Fourth Stage: Top Calendar
Meta -Evaluation</td></tr>
<tr><td colspan="5">The Fifth Stage: Formative and final evaluation (for the first, second and third stages)
Formative and summary evaluation (stages 1,2,3)</td></tr>
</table>

The First Stage - The field phase consists of two processes; the planning process includes the following:

- Identify the target group: They are students of the King Khalid University.
- Content Identification: The content is in the "Computer in Education" course for students of the general diploma for the second semester (1438).
- Determining the budget for instructional design: The researcher used the e-learning (system blackboard) available at King Khalid University. It is available free of charge to students and teachers for networking.
- Identify formal and informal learning methods for educational content: The study of the course "Computer in Education" through the Learning Management System "Blackboard". The platform Pbworks was also used for informal learning.
- Determining the general strategy followed: The researcher defined the strategy of learning through sharing and production in the educational task among students, as shown in Table IV.
- The researcher also identified the general strategy after integrating the activities into the formal learning as shown in Table V.
- Determining the delivery and delivery of instructional content: Learned content was delivered by students formally or informally through the World Wide Web.

D. Development Stage

At this stage, some computer programs were used to produce an e-learning environment based on the theory of communication. The most prominent of these programs and sites include; website Pbworks, website Appmakr, and IrfanView that is a special program for designing image and keeping its quality unchanged. The programs also include graphics program photoshop, location Google drive, production of a guide for the first group and second group.

1) Delivery: The main objective of this stage was to ensure that the educational content was running in e-learning management system and on the external sites that will be used by students in the formal and non-formal educational system. At the third stage, the content of the e-learning environment based on the theory of communication ensures that all the contents of the electronic environment were used by the student effectively, and referred to the e-environment environment for diploma students.

2) Evaluation: The measurement tools, namely: observation card and knowledge economy scale were applied electronically after studying all the educational contents of the students of the two study groups. The analysis process included the identification of target group. They had skills of using computers and the Internet.

3) Construction creation: The construction phase includes the design process and its objectives of learning were determined according to the formal and non-formal use of computers in education. Behavioral objectives for each lesson were determined according to the "Bloom Digital" classification.

The researcher developed a model for writing the content scenario of "Computer in Education" as shown in Table VI.

TABLE IV. DETERMINING THE GENERAL STRATEGY

Mission	**Activity**	**Activity Execution Environment**	**Activity**	**Evaluation of activity**	**Decision**
Writing a document in "Google"	Students will participate in writing the attached document by the researcher and upload it in an environment Pbworks	www.drive.google.com	Two days	The researcher evaluates the document prepared by the students	Students and teachers are discussed to make sure that the "document" attached by the researcher is correct and grades are given to the students who participated in the writing

TABLE V. GENERAL STRATEGY FOR INTEGRATION

Educational event	**Learning**		**Teacher Role**	**The role of the learner**
	Official	Informal		
Introducing students to the e-learning environment in the light of communication theory.	Official		The teacher introduces the students to the course (using the computer in education) and how to participate in informal learning environments (Pbworks). Teacher trains students to enter the site by username & password	Students enter the site elearning.kku.edu.sa For training on how to access the site. Students learn the contents of the course (use of computers in education). Login on the site www.pbworks.com In order to learn how to enter them.
Creating a website online.		Informal	The teacher guides students to how to build a personal site through a site Pbworks. The teacher provides a guide to how to build a website.	Create an e-site online. Each student displays the name of the site he designed in the blog Pbworks. Allow students to comment. Giving a degree to each student who designed a website online.

TABLE VI. CONTENT SCENARIO OF "COMPUTER IN EDUCATION"

Learning objective	**Educational content of the goal**	**Multimedia**					**shape**	**Relay and sailing**
		Text:	Audio	Photocopy	graphic	Video		

E. Preparation of Measuring Instruments

The note card was prepared to measure the behavioral performance of the Diploma students in the Faculty of Education, King Khalid University concerning skills of cloud computing in different educational fields. The main dimensions of the card were identified after studying the researches and studies that dealt with this aspect. These dimensions have been illustrated in Table VII.

After completing the preparation of the card, the researcher presented the card to a group of specialists in the field of educational technology, curriculum, and teaching methods and psychology. Their opinions indicated the suitable items of the card for study sample, with an amendment in the wording of some paragraphs in the second and fourth dimension. The observation card was applied to a sample of seven students after observing the opinions of arbitrators to determine the correctness of the language of the skills on the card, in terms of design.

F. Knowledge Economy Skills Scale

The knowledge economy skills scale has been prepared to provide the skills of knowledge economy to the students. The dimensions of the scale include; collaborative and collective work, innovation and creativity, problem solving and decision making, critical thinking, and application of technology. The scale included five dimensions as shown in Table VIII.

TABLE VII. DIMENSIONS OF THE CARD

Sr	Dimension	Statements
1	The first: Special skills in dealing with documents.	6
2	The second: Presentation skills.	6
3	The third: Special skills for spreadsheets.	8
4	The fourth: Special skills for creating electronic tests Online.	6
5	Fifth: Skills for creating interactive websites Online.	5
6	VI: Special skills for creating interactive video Online.	6
7	Seventh: Skills for creating interactive e-courses Online.	8
Total	4	45

TABLE VIII. THE NUMBER OF DIMENSIONS AND ITEMS OF THE SCALE IN ITS PRIMARY FORM

Sr	Dimension	Statements
1	Cooperative and collective action	6
2	Innovation and creativity	8
3	Problem solving and decision making	5
4	Critical Thinking	7
5	Application of technology	10
Total	5	36

III. RESULTS AND DISCUSSION

The study has reviewed the design models of the e-learning environments and the studies concerned with the theory of communication. There was a statistically significant difference at the level (0.05) between middle-grade experimental group (trained by electronic learning environment based on the theory of "connectivity") and control group (trained by e-learning management system Blackboard).

The statistical analysis was performed to test validity using the Mann-Whitney test to compare two independent samples. Table IX shows the results of applying the test to indicate the differences between the two grades of the two groups concerned with skills of cloud computing. Table IX shows that the value of test was calculated for observing card for cloud computing skills. This shows that there was a statistically significant difference between the intermediate grades of the students' grades in the post-application favoring the higher-grade average.

The ability of the experimental group to use cloud computing skills in a computer course was higher and statistically significant, as compared to the control group students in this course. This means that experimental group students have benefited from a participatory learning environment based on the theory of communication better than students who have been trained in the usual way of using the Blackboard environment.

There is a statistically significant difference at the level (0.05) between middle-grade experimental group and control group. Statistical analysis was performed using the Mann-Whitney test to compare two independent samples. Table X shows the results of applying the test to indicate the differences between the intermediate grades of the two groups concerned with the knowledge economy skills. Table X shows that that there was a statistically significant difference between the intermediate grades of the students in the post-application favoring the higher-grade average. This was in the favor of the experimental group.

The Mann-Whitney test was used to compare two independent samples, to find out difference in the sub-skills of the knowledge economy. Table XI shows the results of applying the test to indicate the differences between the intermediate grades of the two groups concerned with the knowledge economy skills.

Table XII shows the impact of the participatory e-learning environment among the students, which was equal to 75%. The percentage of the impact of the e-learning environment in the development of knowledge economy skills was 74%.

The correlation coefficient matrix (Spearman) was found between dimensions of the scale and the total score as shown in Table XIII. The correlation coefficient of the first dimension in the scale equal 0.75 and the correlation coefficient of the second dimension in the scale equal 0.76. The coefficient of the third dimension in the scale equals 0.46 and the fourth-dimension correlation coefficient by the scale as 0.58. Whereas, the scale equal 0.68, where all values are functionally and statistically acceptable.

The way students view and deal with the content of a participatory learning environment increase their motivation to learn and have positive attitudes toward learning through collaborative environment. These results are consistent with the studies conducted by [15-20]. The learning environment, designed according to the "communicative" theory is concerned with the needs of learners, which help them to work in organized partnership and carry out the tasks in an organized manner, along with providing continuous feedbacks. The interest of the study in checking the information obtained from the various websites has helped the students to develop their critical thinking skills.

TABLE IX. VALUES "U" AND ITS STATISTICAL SIGNIFICANCE AMONG THE MIDDLE RANKING STUDENTS IN THE APPLICATION DIMENSION NOTE CARD

Group	Implementation	N	FS-3 Average grade	Total grade	Values (U) Calculated	Values (Z) Calculated	Semantics
Demos	next	15	25	475	0.0 *	-4.82 *	Function
Control		17	9	153			

*Values U Table 75 (0.05, 15, 17)

TABLE X. VALUES OF "U" AND ITS STATISTICAL SIGNIFICANCE AMONG MIDDLE RANKING STUDENTS TO KNOW THE KNOWLEDGE ECONOMY SKILLS SCALE

Group	Implementation	N	FS-3 Average grade	Total grade	Values (U) Calculated	Values (Z) Calculated	Semantics
Demos	next	15	24.93	374	1.0*	-4.78 *	Function
Control		17	9.06	154			

*Values U Table 75 (0.05, 15, 17)

TABLE XI. VALUES OF "U" AND ITS STATISTICAL SIGNIFICANCE AMONG MIDDLE RANKING STUDENTS CONCERNED WITH THE KNOWLEDGE ECONOMY SKILLS SCALE

Group	Skill	N	FS-3 Average grade	Total grade	Values (U) Calculated	Values (Z) Calculated	Semantics
Demos	Cooperative and collective action	15	23.67	355	20,00	4.09	Function
Control		17	10.18	173			
Demos	Innovation and creativity	15	18.87	283	92.00	1.36	Not function
Control		17	14.41	245			
Demos	Problem solving and decision making	15	23.00	345	30.00	*3.72	Function
Control		17	10.76	183			
Demos	Critical Thinking	15	19.67	295	80.00	1.82	Not function
Control		17	13.71	233			
Demos	Application of technology	15	24.43	366.50	8.50*	4.51	Function
Control		17	9.50	161.50			

*Values U Table 75 (0.05, 15, 17)

TABLE XII. SCIENTIFIC AND PRACTICAL IMPORTANCE OF THE RESULTS OF THE STUDY

Independent variable:	Dependent variable:	$\eta^2 = z^2 / n-1$	Impact
E – learning environment	Cloud computing and AI	0.75	large
	Knowledge-based	0.74	large

TABLE XIII. CORRELATIONAL ANALYSIS

Dimension	Cooperative and collective action	Innovation and creativity	Problem solving and decision making	Critical Thinking	Application of technology
Cooperative and collective action	1				
Innovation and creativity	0.43	1			
Problem solving and decision making	0.27	0.06	1		
Critical Thinking	0.24	0.48	0.04	1	
Application of technology	0.45	0.75	0.21	0.41	1
Scale as a whole	0.75	0.76	0.46	0.58	0.68

IV. Conclusion

The present study has developed the skills of the cloud computing applications and the knowledge economy among the university students by designing a participatory electronic learning environment. The results have shown that the design of a participatory e-learning environment based on the theory of communication contributed to improve the skills level of cloud computing applications and knowledge economy skills among the students from Saudi Arabian universities. Based on the study findings, it is recommended that teachers need to pay attention towards training of students during and before service regarding the use of modern technologies in the field of education. There is a need to train teachers for employing modern theories related to technology to support the teaching and learning initiatives in the universities such as social theory communicative.

The study has highlighted the relationship between cloud computing and social constructivism theory in the context of the educational system of Saudi Arabia. The study findings would be of great help for all the stakeholders in understanding this perspective. Moreover, the study findings highlight the need of focusing on blueprint for further research.

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