

Survey Study about the Importance of e-Learning in Kurdistan, Iraq

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Abstract--- *The education system has faced a lot of obstacles in the developing countries such as; the classical curriculum system which is not up to date, the large numbers of students and teachers, some who have started leaving their schools, neglecting the needs of disabled students whom the system is not encouraging to actualize some of their potentials in learning. In addition students are suffering from inequity related to rural-urban differences and in sufficient resource allocation for the education system especially outside the cities. Three methods of principal component analysis Jolliffe method, Screen diagram method and Bartlett method have been used in this study. The method has been chosen as the best method. According to the methods the most important of e-learning are improves student's performance, decreases the need of having special tutors, provides sufficient facilitation for disabled students, importance for external students and reduces the rural-urban division gap. Based on what have been mentioned and for the purpose of reforming and enhancing the education system, Information Technology (IT) has been suggested. Hence, this paper is exploring the significance role of e-learning to enhance the quality of education as well as Web 2.0 supplements and the various methods and techniques to improve the electronic learning.*

Keywords—*curriculum, education system, e-learning, Information Technology, Web 2.0, principal component, Jolliffe method, Screen diagram method and Bartlett method.*

1. INTRODUCTION

The international sanctions imposed on Iraq by United Nations security council in 1991, as a consequence of the Iraqi invasion of Kuwait on Aug 2.1990, severely affected the ability to provide basic services in all sectors especially the economic, education and health sectors which have direct tragic impacts on the living standards and the quality of services provided by the Iraqi government. Moreover Iraq has faced several internal violent and military conflicts due to prolonged ethnic and sectarian disputes. In addition the war against ISIS also had a negative impact on the service provision and the education system became one of the most affected areas of public services suffering from the crisis and its aftermaths.

According to the Research and Development's (RAND) report, on 2014 Kurdistan Region's population was estimated to be 5 million by the Kurdistan Regional Government (KRG).the illiteracy among youth (age 20 to 29 years old) is relatively high.

The same report indicates that 27 percent of females are uneducated while the rate for uneducated males is 11 percent [9].

The Education system can be considered out dated operating predominantly by classic teaching methods based mainly on memorization and examination without improving writing skills and critical thinking.

The quality of study is poor and pedagogies date several decades back. In many schools classrooms are filled with large numbers of students far above the international standards. Moreover students' hobbies and interests are neglected. Beside that there is no facilitation for students and teachers with special needs such as restrooms, elevators and ramps for wheelchairs.

Adding to this, inequity and rural-urban division have resulted in drop out by large numbers of students who are leaving schools because of the low income. Likewise public universities and institutions do not have the capacity to absorb the huge number of high school students who have low marks below the minimum degrees needed for enrollment in the higher education institutions.

Evidence shows that even two decades of the Kurdish federal self-governing authority new technology has not been incorporated properly into the education system, except for a dim appearance in the universities.

It is known that Information Technology has been used in some developing countries as supplement to the educational classical system. The classical education system, which is known to be face to face learning, is inadequate to meet students' requirements for learning at a time when students are now aware of what to ask regarding the way of learning. Therefore the system is required more than ever to include various techniques and tools for learning.

It is argued that blended learning provide better solution for the current education-direction. Blended learning is the mix between face to face and distance learning. The new paradigm of learning has been supported by technology. In the last two decades information technology reshaped the world and has become catalyst for the modern education, which is known by e-learning.

Education method has shifted from traditional face-to-face to different types for example distance learning, e-learning and mobile learning [5].

There are some differences between traditional learning environment and new learning environment has been shown in the table 1 [5].

Table 1: compare between traditional learning and modern leaning environment.

Traditional Learning Environments	New Learning Environments
- Teacher centered instruction - Single sense stimulation - Single path progression - Single media	- Student centered instruction - Multisensory stimulation - Multipath progression - Multimedia
- Isolated work - Information delivery - Passive learning - Factual, knowledge-based - Reactive response - Isolated, artificial context	- Collaborative work - Information Exchange - Active/exploratory/inquiry based learning - Critical thinking and informed decisions - Proactive / planned action - Authentic, real-world context

Electronic learning encompasses a lot of definitions and terms. There are numerous names for online learning activities, including E-Learning, Web-Based Learning (WBL), Web-Based Instruction (WBI), Web-Based Training (WBT), Internet-Based Training (IBT), Distributed Learning (DL), Advanced Distributed Learning (ADL), Distance Learning, Online Learning (OL), Mobile Learning (or m-Learning) or Nomadic Learning, Remote Learning, Off-site Learning, eLearning (anytime, anyplace, anywhere learning), etc.

The term Electronic Learning (E-Learning) represents open, flexible and distributed learning [6]. "E-Learning can be viewed as an innovative approach for delivering well designed, learner-centered, interactive, and facilitated learning environment to anyone, anyplace, anytime, by utilizing the attributes and resources of various digital technologies along with other forms of learning materials suited for open and distributed learning environment" [6]. Another definition for e-learning is "e-learning is a learning process created by interaction with digitally delivered content, network-based services and tutoring supports [14]. In this respect European

Union (EU) E-Learning Action from 2001 defines ELearning as "the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services as well as remote exchanges and collaboration" [5]. E-learning is not just using information technology to shift from face to face learning to distance learning. The process is much more complicated than it is shown in some articles. E-learning is a framework which contains a group of elements that is robustly related to each other such as; philosophical education, technology, institution and culture.

Distance learning employs enormous series of technology to improve students' abilities. It can be used as text graphics, audio- and videotape, CD-ROM, audio- and videoconferencing, interactive TV, and fax. Distance education or training courses can be delivered to remote locations in both synchronous and asynchronous mode, and do not exclude classroom-based learning and blended mode [11].

A. A Brief History of E-Learning

The very first beginning of distance education goes back to the first quarter of the 19th century, which the teacher and student loosely coupled the time and place [18]. Developing the computer software and hardware delivers modern methods of teaching and learning [11].

From 1950 to 1960 e-learning was consolidated by video conferencing, and teleconferencing has been used from 1950 to 1980 [18]. By 1990s, e-learning for education has become significant field of education technology. The internet distributes infinite data and knowledge to students and it provides a lot of chances for individualized learning such as, tele-learning, distance-learning and collaboration [18]. The computer based CD-ROM was delivered by 1990 and by 1998 the web based learning for education became a very significant part of education technology. E- Learning has become the predominant acceptable approaches for creating fast, scalable, low cost learning and corporate training.

The e-learning has witnessed fundamental changes by using web 2.0. The term 'Web 2.0' was officially coined in 2004 by Dale Dougherty, a vice-president of O'Reilly Media Inc.[3].The web 2.0 has fundamentally changed the e-learning, it provides a lot of vital, attractive and up-to-date techniques for learning methodologies.

B. Main advantages of electronic-learning [4] [29]:

There are several advantages for using e-learning for education as shown before:

1. Enhanced quality and value of learning achieved through greater student access and combination of appropriate supporting content, learner collaboration and interaction, and on-line support.
- 2-Decreases the cost of learning delivery, reduced travel, subsistence costs and time away from the job.
- 3-Studying at both real time and not at real time allows any student to organize their study with their free time and it provides learner's satisfaction.

- 4- Provides flexibility for students as time and place are taken into consideration.
- 5- Providing access to large amounts of data to qualification.
- 6- The students have opportunity to learn from the tools and material that he or she wants to learn form.
- 7- Overcoming shortages in teaching staff.

C. *The problem of the study*

Face to face learning is not sufficient enough to adapt with modern society. In the Kurdistan Region-Iraq, in the last two decades education sector has faced a lot of problems such as the continuation of the traditional methods and mindsets behind the education system and the inability to modernize essential pedagogies. Furthermore low quality of study, lack of suitable facilitation for disabled students, rural-urban division, inequity, lack of equal opportunity for competition, and drop out by large numbers of students who are leaving education because of low income.

D. *Objectives of the study*

The aim of this study is to find out a better solution to improve and enhance the education system in Kurdistan Region-Iraq. Electronic learning has been studied as a solution to improve the education system.

E. *Hypothesis*

- H₀: E-learning does not enhance education
- H₁: E-learning enhances education
- H₂: E-learning is significant to improve student's performance
- H₃: E-learning is important for external students
- H₄: E-learning has importance to reduce the gap caused by rural-urban division.
- H₅: E-learning has importance to decrease the need of having special tutors.
- H₆: E-learning has importance to provide enough facility for disabled students.
- H₇: E-learning has importance to decrease the inequity between students.
- H₈: Pre-test using online test helps the student to do the exam without pressure.

II. LITERATURE REVIEW

Researches show that electronic learning as a model or platform has been dramatically changed from traditional face to face learning to the blended learning. It is argued that interest in education has been revolutionary impacted by Information technology. As a result electronic learning has been affected by information technology and the second generation of the web. In general the e-learning models are not replacing the traditional model; it is accumulating of the process to fill up the education system's gaps. The e-learning has been developed properly more than a decade ago in the developed countries. Although it has been initiated recently in developing countries but in China and India it has been developed for a long term learning system provided with numerous methods for learning such as; written word, radio, television, and the Internet [10].

According to Deepshikha Aggarwal who explored the role of e-Learning in India as a developing country, gender separation, disabilities can be accommodated, and cultures can be shared across the learners. All trainees are treated as having equal abilities, flexibility of doing the course timetable, placeless and the learner repeat the content of course according to the user's understanding (1). Kak Bra and Sidqi(2013) studied measuring the impact of ICT and e-learning on higher education system with redesigning and adapting MOODLE system in Kurdistan Region. They found that the majority of participants prefer multimedia platform for teaching and learning. Yet the limitation of using IT and paper based education are predominantly backed in the framework. There is no professional staff for developing the electronic system for education. In addition there is a shortcoming in required legislations for enforcing property rights (protection for copyrights) and there is an absence of information technology in the region's educational curricula. They mentioned time, costs and benefits of e-learning, however they are expecting the traditional education to remain, as it cannot be easily transformed or abandoned [19]. Haseeb and Al -Abaade(2014) point out the electronic learning system depends on modern technology use by the teachers and students with no time and region restrict. The researches mentioned a lot of obstacles facing the implementation of electronic learning such as technical, financial and human skills. Their study found that the technical and financial impediments are the most effective hurdles compared to the lack of professional staff [15]. MdShahidUddin Akbar addresses e-learning for sorting out the challenges facing the education system in Bangladesh. He suggested designing a new platform to cover the changes in the current system. Setting up the new system should be under national strategy supported by the government. In order to guarantee the quality of the e-learning system the new system requires creating partnership and collaboration between stakeholders such as academicians, promoters and among the regional & international network to contribute the expertise [6].

Khan has designed a model for e-learning considered to be one of the most extensive and comprehensive models. The model consists of eight dimensions, each dimension includes number of sub-dimensions (see figure 1) [6].

- 1-Institutional is related to administrative issues such as academic affairs and student services.
- 2-Management denotes the maintenance of e-learning framework and division of information.
- 3-Technological corresponds to technology affair, hardware and software.
- 4-Pedagogical is concerned with teaching and learning, it is related with content, audience, goal, and medium analysis as well as design approach, organization, and learning strategies.
- 5-Ethical dimension is related to social and political influences, cultural diversity, bias, geographical diversity, learner diversity, digital divide, etiquette, and the legal issues.
- 6-Interface design is concerned with the user interface and website usability.

7-Resource support relates with the help desk and source available for better learning support.
 8-Evaluation refers to the estimation of student and assessing the instruction and learning atmosphere.

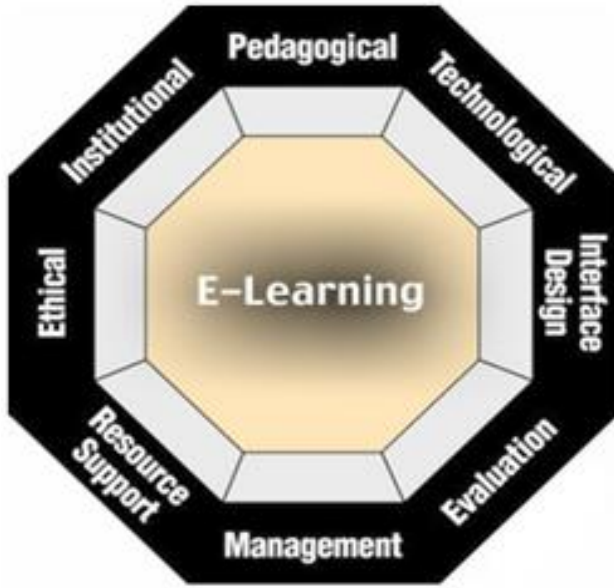


Figure 1 Khan Model

El-Ameer and Idris in their article "Modified Khan eLearning Framework for the Iraqi Higher Education" modified and rearranged the Khan's model for the Iraqi Higher Education as follows;[5]

- 1-They have changed the orders of the eight dimensions of Khan's model, the technology lays in the base, so it indicates the vital role of technology.
- 2- They added a wireless technology for the sub-component of the Khan's model.
- 3- Human resource capability has been added to the framework.
- 4- The pivot dimension shifts from the students towards learner-centered teaching and learning environment.
- 5- Khan did not point out the time as a dimension or even in the sub-dimension, however if the framework is employed on the blended learning, the time should be taken into consideration.

The existing structures and facilities that tertiary institutions provide are limited and in some cases, there is no access for people with disabilities and special needs. In the developing countries, such as Ghana, the education infrastructure and resources are inadequate because of growing number of people, so in order to admit the large number of students to the preparatory (high school) and higher education, complementing the education has been adapted by e-learning institute. Currently distance learning has been adapted by a lot of universities and polytechnics [5].

Electronic learning supports education for learning due to exploiting information technology. E-learning is a process to solve out the problem in the education system. E-learning trends to be global platform and it is not related with a certain methodology or technique, it is a set of approaches provided to learners. At present in the developing countries e-learning is used to empower students and overcome reliability in the education system as it is supporting enhancing education, decreasing the need of having special tutors. Furthermore it facilitates for students with disabilities. It also decreases the inequity and the rural-urban division.

III.METHODOLOGY

Principal Components Analysis (PCA) is one of several statistical tools available for reducing the dimensionality of a data set. It is concerned with explaining the variance – covariance structure of a set of variables through a few linear combinations of these variables. Although p components are required to produce the total system variability, often much of this variability can be accounted for by a small number k of the principal components. If so, there is almost as much information in the k components as there is in the original p variables. The k principal components can then replace the initial p variables, and the original data set, consisting of n measurements on k principal components. Analyses of principal components are more of a means to an end rather than an end in them, because they frequently serve as intermediate steps in much larger investigations [16],[25].

A. Population principal components

Algebraically, principal components are particular linear combination of the p random variables $X_1, X_2, \dots, X_p$. Geometrically, these linear combinations represent the selection of a new coordinate system obtained by rotating the original system with $X_1, X_2, \dots, X_p$ as the coordinate axes. The new axes represent the directions with maximum variability and provide a simpler and more parsimonious description of the covariance structure. As it will see, principal components depend solely on the covariance matrix Σ (or the correlation matrix P) of $X_1, X_2, \dots, X_p$. Let the random vector $X' = [X_1, X_2, \dots, X_p]$ have the covariance matrix Σ with $\lambda_1, \lambda_2, \dots, \lambda_p \geq 0$. consider the linear combination

$$\begin{aligned} Y_1 &= \hat{a}_1 X = a_{11}X_1 + a_{12}X_2 + \dots + a_{1p}X_p \\ Y_2 &= \hat{a}_2 X = a_{21}X_1 + a_{22}X_2 + \dots + a_{2p}X_p \\ &\vdots \\ Y_p &= \hat{a}_p X = a_{p1}X_1 + a_{p2}X_2 + \dots + a_{pp}X_p \end{aligned} \quad \dots (1)$$

And

$$\text{Var}(Y_i) = \hat{a}_i \sum a_i \quad i = 1, 2, \dots, p \quad \dots (2)$$

$$\text{Cov}(Y_i, Y_k) = \hat{a}_i \sum a_k \quad i, k = 1, 2, \dots, p \quad \dots (3)$$

The principal components are those uncorrelated linear combinations $Y_1, Y_2, \dots, Y_p$ whose variances in equation (2) as large as possible.

The first principal component is the linear combination with maximum variance. That is, it is

maximizes $\text{Var}(Y_1) = \hat{a}_1 \sum a_1$. It is clear that $\text{Var}(Y_1) = \hat{a}_1 \sum a_1$ can be increased by multiplying any a_1 by some constant. To eliminate this indeterminacy, it is convenient to restrict attention to coefficient vectors of unit length; it defines as [16]

First principal component = linear combination $\hat{a}_1 X$ that maximizes

$$\text{Var}(\hat{a}_1 X) \text{ subject to } \hat{a}_1 a_1 = 1$$

Second principal component = linear combination $\hat{a}_2 X$ that maximizes

$$\text{Var}(\hat{a}_1 X) \text{ subject to } \hat{a}_1 a_1 = 1 \text{ and } \text{Cov}(\hat{a}_1 X, \hat{a}_2 X) = 0$$

1th principal component = linear combination $\hat{a}_i X$ that maximizes

$$\text{Var}(\hat{a}_i X) \text{ subject to } \hat{a}_i a_i = 1 \text{ and } \text{Cov}(\hat{a}_1 X, \hat{a}_i X) = 0 \text{ for } k < i$$

B. Methods of principal components

Choosing the number of principal component:

There are several methods used to determine the number of component entering to the principal component analysis, we will discuss in this paper three of these methods and compare them and these methods are:

1) Jolliffe method

This method was suggested by Jolliffe in (1972). This method is based on finding characteristic roots of correlations matrix between the explanatory variables, and then note the characteristic roots that more than 0.7, principal components corresponding to those roots remain in the analysis, while the principal components corresponding other characteristic roots are neglected from the analysis and thus the number of principal components is equal to the number of characteristic roots entered to the analysis[13], [17].

2) Scree diagram method

This method was suggested by Cattell in (1965). It depends on the chart by appointing characteristic roots of correlation matrix on the vertical axe versus characteristic roots number on the horizontal axe, the shape produced is like a rock form the characteristic roots that are located on the upper surface. Their principals are taken into consideration but the characteristic roots which are located down the rock are neglecting their components. It was developed by Jolliffe in 1986. He used the characteristic roots logarithm versus characteristic roots number and the number of principal components is equal to characteristic roots number corresponding to an elbow in curve, the point which ends the bending on it also ends big characteristic roots on it and start small roots which exclude from the analysis[22], [12], [21].

3) Bartlett method

In (1951) Bartlett put formula tested whereby equal to P -K the characteristic roots extracted from variance covariance matrix. This method has been modified by K.V.MARDIA in 1979 and suggested the following formula:

$$\chi^2 = n(p-k) \log\left(\frac{a}{g}\right) \dots (4)$$

$$n = n - \left(\frac{2p+11}{6}\right)$$

Where

n: sample size

p: Number of explanatory variables

k: last characteristic roots number which enter the analysis

a: arithmetic mean of all characteristic roots extraction from variance covariance matrix

g: geometric mean of all characteristic roots extraction from variance covariance matrix

For testing this hypothesis:

$$H_0: \lambda_p = \lambda_{p-1} = \dots = \lambda_{k+1}$$

$$H_1: \lambda_p \neq \lambda_{p-1} \neq \dots \neq \lambda_{k+1}$$

If the calculated chi square is less than the tabled chi square with degree of freedom $\frac{1}{2}(p-k+2)(p-k-1)$ then H_0 is accepted. This means that the principal components corresponding to the roots equal in total so variance interpretation of all principal component therefore is neglected[3], [5].

IV. WEB TECHNOLOGY AND EDUCATION FOR LEARNING

A. Web 2.0

The web technology provides functionality and services according to the hardware and software availability, as much as the hardware and software become more sophisticated the web technology deliver more complicated services. In the first generation of the web the uses seeking to find out the data in the web was static and read only framework. The users cannot update or generate the content. The first generation is one-way experience it looks like the students are going to the library to search for the certain resources. In contrast, the Web 2.0 is read and writes framework, it depends on the user participation and it allows the users collaborate and share information online [24]. Web 2.0 is a term that describes the changing trends in the use of World Wide Web technology and Web design that aim to enhance creativity, secure information sharing, increase collaboration, and improve the functionality of the Web as we know it Web 1.0. [23].

Web 2.0 describes applications that distinguish themselves from previous generations of software by a number of principles. Existing work shows that Web 2.0 applications can be successfully exploited for technologies enhancing learning [26]. Web 2.0 is "the social use of the Web which allows people to collaborate, to get actively involved in creating content, to generate knowledge and to share information online" [8]. User generation content is the most significant characteristic of the web 2.0. The second generation applications and services permit publishing and storing of

textual information, by individuals (blogs) and collectively (wikis), of audio recordings (podcasts), of video material (vidcasts), of pictures, etc. [26].

In general the Web 2.0 Websites contain some of the following techniques;

1-Search: no obstacle to find out the data.

2-Links: direct to significant part of data of the website which is the most common visited to.

3-Authoring: it support generating current changing the user generate data. For example in wikis, the data is iterative in the sense that the users undo and redo each other's work.

4-Tags: categorization of content by creating tags that are simple, one-word descriptions to facilitate searching and avoid having to fit into rigid, pre-made categories.

5-Extensions: using algorithms to computerize of the model matching for automation of pattern matching for customization such as Amazon.com recommendations.

6-Signals: use the Real Simple Syndication (RSS) fees technology to produce a subscription model which alerts users of any date changes [23].

B. *Methods of learning by using Information and Communications Technologies (ICT) based tools*

ICT provide asynchronous and synchronous approaches to data interact between the students and the teachers, classmates and training materials content [7]. Asynchronous means learning the materials not in current time, it is pre-recorded. It exists for user without considering the time, date and location. Currently the common method for e-learning is Asynchronous for example online courses, screen share and web conferences [28].

Synchronous the content is live between the student and the tutor. It is significant for instant messaging and shared application [7].

Synchronous method is less common approach. It needs both sides, student and tutor, to be in line at the same time [28].

C. *The modern Key Trends in E-Learning*

Delivering the various e-learning techniques relay on utilizing the hardware & software, so chronological e-learning shows the various distribution of e-learning, it becomes more sophisticated as much as the hardware & software complicated. By 2013 current technology have become sophisticated trend toward e-learning delivery, which include [7]:

- Gamification using Two Dimensional (2D) and Three Dimensional(3D) games and simulations for facilitate learning.

- Mobile devices such as notebooks, e-book readers, tablets, smartphones and Wi-Fi communication technology which are permitting electronic learning.

- Massive Open Online Courses (MOOCs) is a free publishing web based online course.

- HTML5 it is a new web publishing platform which provides better performance, multimedia, and connectivity.

- TinCan API is the current generation of application programming interfaces software developed for reporting for e-learning in learning management systems used.

- Responsive Web Design (RWD) it is emphasizing on the displaying of the web content due to all devices properly.

D. *Technology enhanced learning (TEL)*

Currently internet users are spending much more times using social networks, wikis, blogs and social bookmarking. These applications are implementation of web 2.0 technology, so it would be better to make use of the application for learning. "Technology enhanced learning refers to the support of any learning activity through information and communication technology" [7].

In the modern technology based learning multimedia interacting has been used for enhancing education. For instance simultaneous transmission via computer screens of text, graphics, computer software, animation, video, voice-over and music in stereo sound, as well as virtual reality worlds. Web 2.0 revolution coordinates well with modern trends for implementing the education [23]. Today chap appears to be fascinated to use web 2.0 application usually for the community features of flexible communication, harmonize and self-expression on the web. [23]. The modern technology enhanced learning (TEL) is heading towards exploiting web 2.0 characteristics namely tags for user modeling, personalization of mashups, and ontologies and authoring [26].

Around 2005, a new range of web tools began to find their way into general use, and increasingly into educational use [20]. In the new era learners have many chances for managing their learning and generating personalized data, source, tools and services. Moreover web 2.0 promote vast framework for expressing ability, simplify more cooperation method of working, enables community creation, dialogue and knowledge sharing, and creates a setting for learners to attract authentic audiences. [23]. Using technology for electronic learning facilitates interaction and controlling computer software program which is extensively used in the field education and training. Advanced computer software and hardware are obtained for generating better quality of flexible and cheap exercising material[7].

Web 2.0 technology can bridge the gap between internet users and education. Due to exploiting the web 2.0 technology many applications have been used by the users, and various methods have been used. Users' intention and hobbies are playing a great role in remaining the user online, so exploiting these methods and techniques for education could assist the learning.

V. RESULT AND DISCUSSION

In this research, the chosen population is a teaching staff (students, teachers and educational supervisors) at the preparatory stage. The sample size for using data consists of 210 observations which were collected by questionnaire form which contains a set of questions about students and learning

affairs in Erbil and Sulaimani governorates. This form contains a dependent variable with eight independent variables described as the following respectively:

Y: Electronic learning.

X1: Enhances the education.

X2: Improve student's performance.

X3: Importance for external students.

X4: Reduces rural-urban division gap.

X5: Decreases the need of having special tutors.

X6: Provides sufficient facilitation for disabled students.

X7: Decreases the inequity between students.

X8: Pre-test using online test helps the student to do the exam without pressure.

The statistical program Statistical Package for the Social Science (SPSS) version 21, used in analyzing the results to determine the advantages of electronic learning and to determine the number of components entering to the principal component analysis.

A. Jolliffe method application

Characteristic roots (Eigen values) of the correlations matrix, shown in Table 1, are those roots that their value is more than 0.7 and equal to 6. Characteristic roots and principal components corresponding to those roots explain % 83.83 of the total variation for all principal components, this means that Total Characteristic roots that have been excluded from the analysis are two Characteristic roots and their value are less than 0.7.

Table 2: Total Variance Explained of Jolliffe method

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.252	28.156	28.156	2.252	28.156	28.156
2	1.035	12.941	41.096	1.035	12.941	41.096
3	1.013	12.660	53.756	1.013	12.660	53.756
4	.885	11.065	64.821	.885	11.065	64.821
5	.815	10.192	75.013	.815	10.192	75.013
6	.705	8.818	83.831	.705	8.818	83.831
7	.682	8.522	92.353			
8	.612	7.647	100.000			

But the rotated matrix for remaining principal component in the analysis has been represented in the table (3), Columns represent principal components and rows represent variables.

Table 3: Rotated Component matrix^a of Jolliffe method

	Component					
	1	2	3	4	5	6
X ₁	.051	.152	.944	.086	.025	.072
X ₂	.251	.660	.095	.393	-.029	-.172
X ₃	.054	.038	.058	.896	.138	.167
X ₄	.112	.061	.077	.145	.007	.945
X ₅	.865	.126	-.065	.157	-.113	.101
X ₆	.007	.091	.038	.137	.947	.006
X ₇	.647	.106	.409	-.132	.324	.054
X ₈	.047	.862	.133	-.110	.138	.183

Note that the strongest variables correlated to the first principal component are X5 (Decreases the need of having special tutors) and X7 (Decreases the inequity between students.).

The second principal component shows strong connections with the explanatory variables X2(Improves student's performance) and X8(Pre-test using online test helps the student to do the exam without pressure), whereas the explanatory variable X1(Enhances the education) is strongly correlated to the third principal component, the explanatory variable X3(Importance for External students) is strongly correlated to the fourth principal component and the explanatory variable X6 (Provides sufficient facilitation for disabled students).

B. Screen diagram method application

By applying the previous method Eigen values of the correlation matrix was obtained as described in Table (1). Figure (2) shows Eigen values logarithm (vertical axis) versus Eigen values number (horizontal axis).

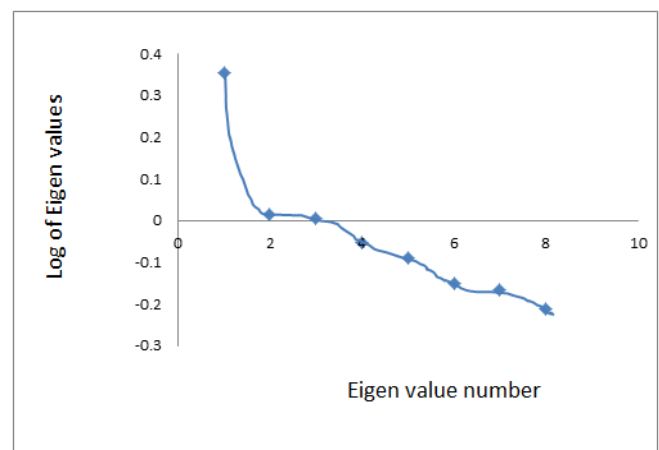


Figure 2: Scree diagram

The fourth principal component represents the end point of the crankshaft bending curve, we note that the component No. 4

represents the end point of the crankshaft bending curve, which represents the large roots breakpoint and start small roots so the number of Eigen values extraction for this method is four Eigen values is entered in the analysis of the principal component analysis while the last two roots are neglected from the analysis. The four principal components explain % 64.82 of the total variation for all principal components.

C. Bartlett method application

The Bartlett method depends on finding characteristic roots of variance covariance matrix for explanatory variables and then we test the hypothesis:

$$H_0: \lambda_p = \lambda_{p-1} = \dots = \lambda_{k+1}$$

$$H_1: \lambda_p \neq \lambda_{p-1} \neq \dots \neq \lambda_{k+1}$$

Table 4: Total Variance Explained of Bartlett method

Initial Eigenvalues ^a			Extraction Sums of Squared Loadings		
Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1.252	32.189	32.189	1.252	32.189	32.189
.544	13.987	46.176	.544	13.987	46.176
.459	11.798	57.974	.459	11.798	57.974
.433	11.122	69.096	.433	11.122	69.096
.377	9.705	78.801	.377	9.705	78.801
.307	7.887	86.688	.307	7.887	86.688
.267	6.865	93.553			
.251	6.447	100.000			

For all the values of k found that less valuable for k achieved the above hypothesis is k = 6 All values of k larger than 6 while the values of k less than 6 give calculated chi square (x2) greater than tabled chi square that mean reject H0, and table 3 shows the Bartlett method which included the use of six Eigen values in the analysis. Also from this table it can be seen that the variance ratio explained by six components entered in the analysis is 86.69 of the total variation for all principal components.

And the rotated matrix has been represented in the table (5), note that the explanatory variables X2 (Improves student's performance) and X5 (Decreases the need of having special tutors) correlated with first principal component, the second principal component appeared correlated with explanatory variable X6 (Provides sufficient facilitation for disabled students), whereas the explanatory variables X3(Importance for External students) and X4(Reduces the rural-urban division gap) are correlated to the third principal component. While the remainder components (fourth, fifth and sixth) showed strong correlation with explanatory variables X8 (Pre-

test using online test helps the student to de the exam without pressure), X1 (Enhances the education) and X7 (Decreases the inequity between students).

Table 5: Component matrix ^a of Bartlett method

	Component					
	1	2	3	4	5	6
X ₁	.078	.085	.092	.117	.970	.129
X ₂	.501	.394	-.053	.252	.157	.028
X ₃	.196	.548	.579	.023	-.040	-.069
X ₄	.029	-.079	.879	.059	.106	.094
X ₅	.924	-.100	.142	.031	.018	.158
X ₆	-.060	.819	-.032	.053for	.076	.132
X ₇	.158	.119	.069	.113	.133	.959
X ₈	.112	.080	.073	.971	.112	.110

D. Multiple linear regression analysis of the principal component

After the principal components entering in the analysis have been identified for each method of the methods described previously, these components are entering as independent variables in the regression model and extract analysis of variance table for each method of the three methods and table 6 represents analysis of variance (ANOVA) for these methods, when looking at this table, we find that the mean square error value of Jolliffe method is 0.655 and mean square error of Screen diagram method is 0.669 but mean square error of Bartlett method is 0.654. These values confirm the fact that the increase in the number of principal component leads to reducing the mean square error (MSE). Since the MSE of Bartlett method is less than MSE of other methods, so it is the best method.

Table 6: Regression analysis table for three methods

Method	S.O.V	d.f	S.S	M.S	F	Sig.
Jolliffe	Regression	6	7.598	1.266	1.933	.001
	Residual	203	132.965	.655		
	Total	209	140			
Screen diagram	Regression	4	2.853	.713	1.066	.374
	Residual	205	137.147	.669		
	Total	209	140.000			
Bartlett	Regression	6	7.322	1.220	1.867	.088
	Residual	203	132.678	.654		
	Total	209	140			

VI.CONCLUSION

After comparing the Mean Square Error (Mse) for the three methods, we find that Bartlett method is the best method which gave the lowest value of Mse (0.654). Moreover comparing variation ratios that are explained by the principal components selected according to each method, we find that the largest proportion of the variance (variance which explained by the selected principal components from sum total variance to all the principal components) have been given when applying Bartlett method and equal to % 86.69.

Through the study of the most significant advantages of e-learning, we adopted Bartlett method to determine the number of principal components entering to the analysis thereby determining that E-learning has the following advantages:

- Enhancing the education.
- Decreasing the need of having special tutors.
- Providing enough facilitation for disabled students.
- Decreasing the inequity between students.
- Reducing the rural-urban division gap.

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