Measuring the Performance of E-Learning System in Saudi Arabian Educational Environment

Syed Farrukh Amin

Industrial Management Technology Department
Yanbu Industrial College
Kingdom of Saudi Arabia
samin@yic.edu.sa

Norizan Mohd Yasin

Faculty of Comp. Science and Information Technology
University of Malaya
50603 Kuala Lumpur, Malaysia
norizan@um.edu.my

Abstract— **This paper investigates the effect of the performance of E-Learning System (ELS) among the college teachers. The study incorporates DeLone & McLean (1992, 2002) model of measuring the performance of information system. In addition, it also tests the correlation among various dimensions of Information Systems. The investigation of this exploratory research states that there is higher level of user satisfaction once the system is user-friendly and easy-to-use. This leads to higher correlation between user-friendliness and fast processing and retrieval of information. This paper does not represent the views of all the users of ELS since it has been tested only in Yanbu Industrial College environment.**

Keywords- E-Learning System, Information System Dimension, Individual Impact, performance measurement.

I. INTRODUCTION

E-learning comprises all forms of electronically supported learning and teaching. The information and communication systems, whether networked or not, serve as specific media to implement the learning process. Its applications and processes include Web-based learning, computer-based learning, virtual classroom opportunities and digital collaboration. The term is still utilized to reference in and out of classroom educational experiences via technology, even as advancements continue in regard to devices and curriculum. Content is delivered via the Internet, intranet/extranet, audio or video tape, satellite TV, and CD-ROM (Shi, Liu, et al 2008). It can be self-paced or instructor-led and includes media in the form of text, image, animation, streaming video and audio.

The popular way of E-learning is Computer Based Teaching (CBT). Most of the primary, secondary level educational institutions are incorporating E-learning tools and techniques for various subjects taught. Higher Education is not lagging behind with it. Number of university/College professors use Multimedia, Smart Board, Learning Software and Computers for teaching and learning activities.

This paper explores to understand the impact of using E-Learning System among the college teaching faculty members by using DeLone and McLean (1992, 2002) model of measuring performance of Information Systems (IS). DeLone & McLean (2002) developed and tested the model in various environments and assessed the performance of on different occasions. This model adopted for this empirical study to test the attributes of IS in Yanbu Industrial College (YIC) to identify the effects of information quality on user satisfaction and relationship between the performance of information systems and user satisfaction.

II. LITERATURE REVIEW

It is necessary to understand the definition of information quality or its dimension. IS researchers highlighted the multifaceted nature of information quality. During the earlier phases of information quality research, IS researchers focused on the quality of information system output primarily in the form of reports (DeLone and McLean, 1992, 2002). Gallaher (1974) used quality attributes, relevance, informativeness, usefulness, and importance to measure the value IS reports. Other IS researchers considered report format as an information quality measure (Zmud, 1978; Oslon and Lucas, 1982). Ahituv (1980) used five information characteristics to measure information value: accuracy, timeliness, relevance, aggregation, and formatting. To develop a composite measure of information value, King and Epstein (1983) used various information attributes such as sufficiency, understandability, freedom from bias, reliability, decision relevance, comparability, and quantitativeness in their article "Assessing the Information Systems Values".

IS studies revealed strong relationship between information quality and individual performance (Etezadi Amoli and Farhoomand, 1996; Seddon and Kiew, 1994; Teo and Wong, 1998; Wixom and Watson, 2001). Their studies provided strong support for the effects of information quality on individual performance. Wang and Strong's (1996) research develops a hierarchical framework that

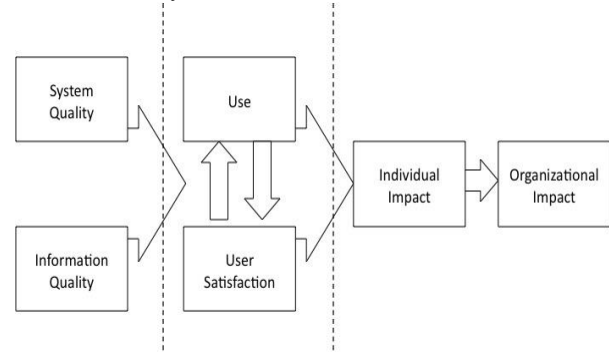captures the aspects of data quality that are important to information users.

In order to make good quality decision, a successful information system should provide complete, relevant and timely available information for decision making process (Wongjin Jung, 2007). Consequently, organizations where decision making process depends on information quality and user satisfaction may end up by taking unnecessary risks, adopting impractical ideas and making mistakes (Grise and Gallupe, 1999). Wang and Strong (1996) pointed out that poor data quality brings substantial pessimist social and economic impacts. Due to poor quality of data and information adds billion of dollars cost (Redman, 1998). In the information systems literature, information quality is one of the dimensions for evaluating the success of IS (DeLone and McLean, 2002). They reviewed a total of 180 articles and concluded six major categories – systems quality, information quality, information use, user satisfaction, individual impact, and organizational impact for successful IS. According to their model information quality affects user satisfaction which is the ultimate impact over an individual. This particular concepts derived by the organizational effectiveness literature (Lewin and Minton, 1986; Miles, 1980; Streers, 1976). DeLone and McLean (2002) addressed that individual impact is closely related to decision performance and a Validation Test of an adaptation of the DeLone and McLean (2002) Model in the ELS Field by Rolden & Leal (2003). There are other models such as Technology Acceptance Model (TAM) suggested by Davis (1985) but this focuses on Actual System Use not the Net benefits of using System.

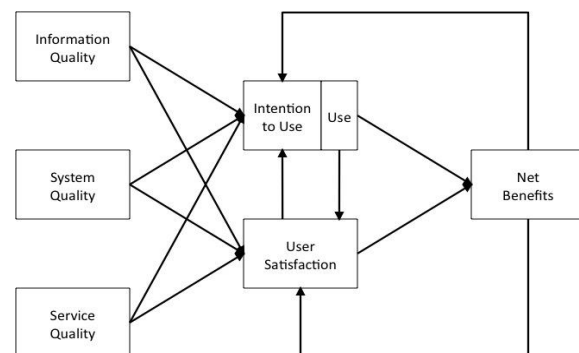### A. DeLone & McLean Model of Information Success

DeLone and McLean reviewed the current definitions of IS success to provide a general and broad definition by designing a new model for IS success. This model measures and classifies into six major factors; Systems Quality, Information Quality, Intention to Use, User Satisfaction, Individual Impact and Organizational Impact. Thus, they produced a multidimensional measuring model with interdependencies between the different success categories (DeLone & McLean 1992). Many researchers contributed or re-specify to the original model. Ten years after the publication of their first model and based on the evaluation, DeLone and McLean anticipated an updated IS success model (DeLone & McLean 2002, 2003).

The restructured model consists of six interrelated dimensions of IS success: information, system and service quality, (intention to) use, user satisfaction, and net benefits. They merged the individual and organizational impact into Net Benefit. Secondly they realized the co-integration of the impact of information quality, systems quality and service quality into both Intention to use and user satisfaction rather than the effect was reflected into use and user satisfaction

independently in their previous model. The model can be interpreted as follows: A system can be evaluated in terms of information, system, and service quality; these characteristics affect the subsequent use or intention to use and user satisfaction. As a result of using the system, certain benefits will be achieved. The net benefits will (positively or negatively) influence user satisfaction and the further use of the information system.

Information Systems Success Model (DeLone & McLean 1992)

Updated Information Systems Success Model (DeLone & McLean 2002, 2003)
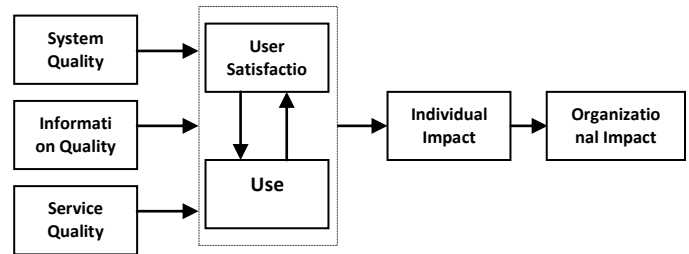
III. METHODOLOGY

In order to test the impact of using E-Learning System in a college environment, a DeLone & McLean (1992, 2002) model has been adopted. TAM model (Davis 1985) could have been used but it restricted upto the using of information system but does not take into account the net benefits derived by the information sytems users. This has been an empirical study for which data collected from the teaching staff of Yanbu Industrial College (YIC), Saudi Arabia. The model suits to this environment as management of the college is pursuing the overall benefits to the YIC after commencing to use E-learning system in the campus for both Teachers and Students community. There are about 300 teaching staff members who use E-Learning System, Moodle. A questionnaire has been designed to collect data filled online with the help of Google

Document option. The questionnaire is divided into two segments; the demographic information of the respondents and ELS using information. The ELS using information is decomposed into five dimensions; Systems Quality, Information Quality, Service Quality, Information Use and ELS Outcomes. Descriptive statistical analysis and correlation applied to see the most impact factor in the measuring the performance of the E-Learning system.

There are five dimensions of this model i.e. Systems quality, information quality, service quality, user's satisfaction and use (delivery instruments) and Systems outcomes (benefits and shortcomings). The model helps to identify the impact over an individual and collectively to an organization. This model has been adopted by many researchers and it suites to my environment to test the success of ELS.

The data collected for this exploratory research paper to test the dimensions of system success as identified by DeLoan & McLean(1992, 2002). We asked questions to the end-users, to what extent has E-Learning Systems (ELS) had helped them. We collected the responses which will discuss in the following paragraphs. We asked users to rate their level of satisfaction with respect to system quality, information quality, service quality, information delivery and its use and ELS outcomes in the form of benefits and shortcomings on a liker scale of (1 – 5), where 5 is most satisfied and 1 is the least satisfied.

First dimension of the model is System Quality. The system quality is further decomposed into six attributes i.e. User-Friendliness, Stability, Security, Quick and Responsiveness. Second dimension is Information Quality. This dimension is composed of six attributes i.e. Organized, Effective, Right Size, Clarity, Usefulness and Up-to-Date (Current). Third dimension of measuring the performance of E-Learning system is Service Quality that has five attributes i.e. Promptness, Responsiveness, Fairness, Knowledgeable and Availability. Fourth dimension of success of information systems measurement is system delivery i.e. how an e-learning system is used to deliver information to the end-users. This dimension is decomposed into two segments; first, ELS delivery instruments and second, user satisfaction to use this system. Final dimension of using ELS is Systems Outcomes. We posed five positive outcomes and five shortcomings to the ELS in our questionnaire.

DeLone & McLean (2002) IS Success Model

A. Reliability and Validity Test

Reliability used by using Cronbach's α values for each components of IS used in this study. As presented in Table 3.1, all the values are above 0.70, which is commonly acceptable level. The reliability of each component is as follows: System Quality=0.802, Information Quality=0.868, Service Quality=0.785 and Systems Delivery=0.916. This suggests that there is high internal consistency among each item in these categories. These values are a bit low as compared to Cronbach's α values used by Peter Seddon (AJIS 2007) in his study using the same model.

Table 3.1: Showing Reliability & Validation Test

IS Components	Cronbach's Alpha		Cronbach's Alpha Based on Standardized Items	No of Items
	This Study	Peter Seddon		
Systems Quality	.802	.935	.808	6
Information Quality	.868	.951	.877	6
Service Quality	.785	.885	.777	5
Systems Delivery	.916	.986	.916	4

IV. RESULTS AND DISCUSSION

The mean value of each dimension suggests that level of satisfaction of respondents is relatively higher and overall satisfaction to use ELS is also higher i.e. 3.9 out of 5.0. The user satisfaction plays a pivotal role to make information systems success or failure. In our case it is the most satisfied value. Table 4.0 shows the respondents' mean value to their level of satisfaction of using ELS.

Table 4.0: Shows the mean value of the information system dimensions

System's Dimensions	Mean Value
Systems Quality	3.7
Information Quality	4.0
Service Quality	3.9
User Satisfaction	4.1
Overall Mean Value	3.9

Overall 3.9 mean values states that most of the ELS users are satisfied with the system's attributes. It is near to 4.0 out of 5.0, which is quite reasonable to say the level of satisfaction is more than higher for using ELS. The most satisfied attributes is Easy-to-use (4.2), then the fast retrieval of information (4.1). Table 4.1.1 represents all the mean value of the attributes of Systems Quality.

It is found that most the users responded to their higher level of satisfaction for easy-to-use, user friendliness and fast information retrieval. Table 4.1.2 shows that 84% of the users are satisfied or relatively most satisfied if the system is easy to use for them. Similarly 76% users feel comfortable if the system is User-Friendly, which ultimately results in their satisfaction for fast retrieval or using information system. The least importance (43%) is given to stability of the system. It means that they are least concerned how frequently the system changes its input and output design, but they feel simple and workable if the above three mentioned are provided i.e. easy to use, friendliness and quick information retrieval.

Another investigation done to see if there is any correlation among these attributes to see the influencing attribute(s). We find that Easy-to-Use (0.617) and User-Friendliness (0.516) positively correlated to Fast retrieval of information. Similarly these two attributes are also positively correlated to System Responsiveness (0.597 and 0.560 respectively). Table 4.1.3 shows the correlation among the six variables and depicts that easy to use and user friendliness of the system are positively correlated to fast retrieval of the information.

Table 4.1.3: Correlation among the categories of Systems Quality (n=30)

Attributes		1	2	3	4	5	6
1	PC2	1	.414(*)	.352	.458(*)	.617(**)	.597(**)
			.023	.057	.011	.000	.000
2	PC2	.414(*)	1	.255	.196	.516(**)	.560(**)
		.023		.173	.298	.004	.001
3	PC2	.352	.255	1	.210	.348	.277
		.057	.173		.265	.060	.139
4	PC2	.458(*)	.196	.210	1	.365(*)	.434(*)
		.011	.298	.265		.048	.017
5	PC2	.617(**)	.516(**)	.348	.365(*)	1	.596(**)
		.000	.004	.060	.048		.001
6	PC2	.597(**)	.560(**)	.277	.434(*)	.596(**)	1
		.000	.001	.139	.017	.001	

1=Easy to Use; 2=User Friendliness; 3=Stability;
4=Security; 5=Fast; 6=Responsiveness
PC2=Pearson Correlation Sig. (2-Tailed)

The systems is said to be user-friendly and easy-to-use then its response time should be fast i.e. user does not wait too much to retrieve information and updates data and the level of satisfaction is higher in this case. However, systems stability and systems security are also positively correlated to other five attributes respectively, but impact is not high. For example security and user-friendliness has 0.196 correlation value which is close to 0 it means these do not have much impact if there is high security is maintained in the system but it must be user-friendly so that user may enjoy working with it. It also reflects that user satisfaction is relatively higher (57%) if the security of the system is maintained.

Users responded that information should be organized to satisfy their needs and reason to use ELS as the mean value 4.2 proves it. Table 4.2.1 represents the mean value of all the attributes of information quality dimension. The respondents are highly satisfied if the provided information is current (4.1) and clear (4.1) to assimilate and understand them. At the same time information are very useful if they are clear and current. Respondents provide sufficient evidence to prove the statement because the mean value is more satisfied or higher i.e. 4.0.

Table 4.2.2 provides respondents' percentages of their level of satisfaction. 90% are satisfied or relatively most satisfied if information are well-organized. 68% are satisfied or most satisfied if information are clear to understand. In this dimension almost every attributes is at higher level of

satisfaction; ranges from 68% to 90%. It means most of the respondents understand the meaning of information quality and hence furnish higher weightage to their success of using ELS.

Table 4.2.3 displays the correlations among these attributes and shows importance to measure the performance of ELS. We extracted that information are highly organized once they are of right size, clear, useful and up-to-date and this enhances the level of satisfaction of the end-users. These attributes are positively correlated to information organization. Another aspect of this finding is the Right-sized information. There is also higher positive correlation between right-sized information and up-to-date. Clarity, usefulness and up-to-date information are also correlated to each other positively. This means they all play an important role in measuring the user satisfaction with respect to information quality dimension of e-learning system. However, Effective presentation of information is less correlated with other attributes.

Table 4.2.3: Correlation among the attributes of Information Quality Dimension (n=30)

Attributes		1	2	3	4	5	6
1	PC2	1	.312	.681(**)	.541(**)	.578(**)	.682(**)
			.093	.000	.002	.001	.000
2	PC2	.312	1	.241	.460(*)	.189	.337
		.093		.200	.010	.316	.069
3	PC2	.681(**)	.241	1	.645(**)	.708(**)	.746(**)
		.000	.200		.000	.000	.000
4	PC2	.541(**)	.460(*)	.645(**)	1	.577(**)	.695(**)
		.002	.010	.000		.001	.000
5	PC2	.578(**)	.189	.708(**)	.577(**)	1	.766(**)
		.001	.316	.000	.001		.000
6	PC2	.682(**)	.337	.746(**)	.695(**)	.766(**)	1
		.000	.069	.000	.000	.000	

1=Organized; 2=Effectively Presented; 3=Right Size; 4=Clarity; 5=Usefulness; 6=Up-to-Date

Table 4.3.1 presents the mean value of each attributes of Service Quality dimension. The highest level of satisfaction (4.1) by the users is for the availability of information in time. This also refers to Timeliness of information as quality of information. Similarly second highest (4.0) response is for the promptness of services of information systems providers. i.e. how efficiently the queries were entertained by the systems administrators and provide feedback to the users.

87% level of satisfaction rated to service quality availability, which is the most or relatively most satisfied. Second, response (84%) is very high for the promptness of

the services provided by the administration of information systems. Rests of the responses are fair enough for systems feedback (responsiveness), fairness and knowledge creation. Table 4.3.2 corresponds to the data summarized from the end-users.

There is positive and significant correlation between Promptness and Responsiveness (0.817) and Promptness and Knowledgeable (0.539). It means if a system is prompt, it will provide immediate feedback to the end-users. Similarly System is prompt once it creates knowledge into the form of information such as on-screen help provided by the system to assist end-user in case they struggle somewhere in the middle of using it. Interestingly there is almost no correlation between timeliness of information and its fairness (0.130). It means users continue to use information systems even if information are biased or not available in time. They do not stop using E-Learning systems.

Table 4.3.3. Correlation among Service Quality attributes (n=30)

Attributes		1	2	3	4	5
1	PC2	1	.817(**)	.347	.539(**)	.330
			.000	.060	.002	.075
2	PC2	.817(**)	1	.421(*)	.542(**)	.255
		.000		.021	.002	.174
3	PC2	.347	.421(*)	1	.245	.130
		.060	.021		.191	.495
4	PC2	.539(**)	.542(**)	.245	1	.482(**)
		.002	.002	.191		.007
5	PC2	.330	.255	.130	.482(**)	1
		.075	.174	.495	.007	

1=Prompt; 2=Responsiveness; 3=Fair; 4=Knowledgeable; 5=Availability

Table 4.4.1 elaborates the systems delivery instruments used for ELS. The most commonly used instrument is using

PowerPoint Slides (90%), second commonly use is to solve practice problems (53%) such as in Accounting, Programming and Mathematics etc. There are three areas (43% each), use of multimedia, assignments and group discussions, used for delivery of ELS.

Second segment of this finding is the user satisfaction for using the delivery instruments. Table 4.4.2 depicts information about the respondents use instruments for recommending to others (4.1), Enjoy the success of E-Learning (4.1), rate the usefulness of ELS tools (4.3) and rate Overall satisfaction of ELS (3.9). Table 4.4.3 represents the level of satisfaction percentage for each o the attributes of user's satisfactions. Most of the respondents are most and relatively most satisfied by using ELS delivery instruments and they are willing to recommend others (76%), enjoy success of ELS (80%) and feel that ELS is very useful (83%) for them. Hence their overall satisfaction is about 73%. There is high positive correlation among these attributes. It implies that one recommends using ELS tools if he/she enjoys the success of ELS and finds it useful. Among these attributes correlation between Overall satisfaction and Usefulness (0.837) is very high in positive direction. Hence the satisfaction will not arrive if it is not useful for the end-users.

Table 4.4.4: Correlation among the attributes of systems delivery instruments satisfaction (n=30)

	Attributes	1	2	3	4
1	PC2	1	.773(**) .000	.766(**) .000	.769(**) .000
2	PC2	.773(**) .000	1	.650(**) .000	.599(**) .000
3	PC2	.766(**) .000	.650(**) .000	1	.837(**) .000
4	PC2	.769(**) .000	.599(**) .000	.837(**) .000	1

1=Recommend to use; 2=Enjoy Success; 3=Usefulness; 4=Overall Satisfaction

A large number of respondents are in favor that using ELS enhance their own learning (63%). Since it is available 24/7 (60%) therefore, it saves time (53%), where the least importance is given to the empowerment of using ELS (20%). In the shortcomings, 30% rated lack of physical contact, 33% to delivering quality and 27% to technology dependencies. However, the high cost of delivery is also considered by 23% of the respondents as shortcoming of using ELS.

Coincidentally, the findings of this study are similar to previous study done by other researchers but only deviation is in the values.

V. CONCLUSION

We conclude that the dimension of assessing the level of users' satisfaction provide enough feedback to know the important attributes why end-users should continue to use ELS. Some of interesting findings represent that system's user-friendliness; promptness and fast retrieval of information are important attributes to increase the level of satisfaction of using ELS. The most important attribute is Usefulness of the ELS. In addition, once the information is well-organized, also play vital role for increasing the level of satisfaction among the end-users. Surprisingly security of the information and information system does not play critical role and similarly stability of the system does not affect the level of satisfaction provided easy-to-use directions. We also conclude that popularity of using ELS is due to its 24/7 availability and time saving but there is great hurdle of enhancing the use of ELS because of lack of physical contact and technology dependency.

Our future direction of research will focus on to identify the reasons behind the success of using ELS delivery tools and what are the limitations that forced to drop the end-users's willingness to use ELS.

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Tables

Table 4.1.1 shows the mean value of the system s quality responses.

System's Attributes	Mean Value
Easy to use for accessing data and information	4.2
User-Friendliness (GUIs and Reports)	3.9
Stability: How frequent you change the layout?	3.0
Security: How do you rate your ELS security Level?	3.3
Fast: How quickly you get information?	4.1
Responsiveness: What is level of response time?	3.6
Overall Mean Value	3.7

Table 4.1.2: Systems Quality response Percentage for each of the categories

System's Attributes	5	4	3	2	1
Easy to use for accessing data and information	47	37	13	0	3
User-Friendliness (GUIs and Reports)	23	53	13	7	13
Stability: How frequent you change the layout?	3	40	27	17	13
Security: How do you rate your ELS security Level?	7	50	20	13	10
Fast: How quickly you get information?	43	33	20	13	0
Responsiveness: What is level of response time?	13	53	10	7	7

Table 4.2.1: Mean value of Information Quality Attributes

Information's Attributes	Mean Value
Well Organized: If the retrieved information is proper?	4.2
Effectively presented: Do you modify the generated output?	3.6
Right Size: If the Information is of required length?	3.8
Clarity: If the Information is easy to assimilate?	4.1
Usefulness: If the information is worth using?	4.0
Up-to-Date: If the information is current?	4,1
Overall Mean Value	4.0

Table 4.2.2: Percentage responses for user's level of satisfaction for Information Quality

Information Quality Attributes	5	4	3	2	1
Well Organized: If the retrieved information is proper?	40	50	3	3	3
Effectively presented: Do you modify the generated output?	13	60	13	3	10
Right Size: If the Information is of required length?	17	57	20	3	3
Clarity: If the Information is easy to assimilate?	33	90	47	27	3
Usefulness: If the information is worth using?	33	43	17	7	0
Up-to-Date: If the information is current?	37	40	17	7	0

Table 4.3.1: User responses for Systems Service Quality

Service Quality Attributes	Mean Value
Prompt: If queries are entertained quickly?	4.0
Responsiveness: If the system provides any feedback?	3.5
Fair: If the information is unbiased?	3.8
Knowledgeable: If it helps in creating knowledge?	3.8
Availability: If information is available all the time?	4.1
Overall Mean Value	3.9

Table 4.3.2. Percentage of satisfaction responses for Service Quality of using ELS

Attributes of Service Quality	5	4	3	2	1
Prompt: If queries are entertained quickly?	27	57	10	7	0
Responsiveness: If the system provides any feedback?	3	60	23	10	3
Fair: If the information is unbiased?	17	50	30	3	0
Knowledgeable: If it helps in creating knowledge?	23	40	30	7	0
Availability: If information is available all the time?	27	60	13	0	0

Table 4.4.1: Frequency and Percentage of using ELS delivery tools by the End-Users

Instruments used for delivery of ELS	Respondents used	Percentage of respondents
PowerPoint Slides	27	90%
Audio / Multimedia	13	43%
Scripts	3	10%
Excel tutorial	6	20%
Discussion Board	6	20%
Assignments	13	43%
Case Studies	11	33%
Group Discussions	13	43%
Practice Problems	16	53%
Smart Board	9	30%
Any Other (Please Specify)	2	6%

Table 4.4.2: Showing attributes of systems delivery tool satisfaction mean value

ELS delivery instruments attributes	Mean Value
Recommend to others to use	4.1
Enjoy the Success of E-Learning	4.1
E-Learning system is very useful	4.3
Rate your overall satisfaction of using E-Learning System	3.9
Overall Mean Value	4.1

Table 4.4.3: Showing user's satisfaction in Percentages

Attributes of User Satisfaction for ELS Delivery Instruments	5	4	3	2	1
Recommend to others to use	43	33	17	4	3
Enjoy the Success of E-Learning	40	40	17	0	3
E-Learning system is very useful	53	30	10	4	3
Rate your overall satisfaction of using E-Learning System	23	50	23	0	4

Table 4.5.1 shows the percentage of the responses by the end-users for systems outcomes.

Positive Aspects		Shortcomings	
Enhanced Learning	63	Lack of physical contact	30
Empowerment	20	Isolation	30
Time Saving	53	Delivery Quality	33
Academic success	37	Dependency over technology	27
24/7 Availability	60	High cost of Delivery	23