Evaluating an Interactive Electronic Lecture System

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Abstract—**Evaluation is an essential part of creating and applying an interactive electronic lecture system (IELS). IELS is designed to enhance lecturing process for undergraduate students at King Abdulaziz University. To evaluate the IELS there are three main issues covered in this paper, namely IELS features, experiment design and research methods. IELS is integrated application that offers rich interactive components for users. The first issue is IELS features such as user accessibility, usability, learnability, interactivity, communication, satisfaction. The second issue is experimented design for evaluation IELS. Third issue describes how the data has been gathered and how the results are analysis.**

Index Terms—**E-learning, evaluating IELS application.**

I. INTRODUCTION

In this paper, the methods employed in the evaluating the Interactive Electronic Lecture System (IELS) are discussed. IELS is a web application that consists of a number of main components, including lectures, video clips, messaging and interactive interfaces. IELS delivers lectures to undergraduate students in a novel format that creates an interactive environment which enables them to interact with the lecture content as well as to communicate with other system users such as their lecturers and colleagues. Interactive tools can facilitate the learning process for teachers and students [1].

II. LITERATURE REVIEW

Several experiments and researches have been conducted regarding the e-lecture and the interactive lecture, such as Savoy & Salvendy (2009), and Demetriadis & Pombortsis (2007). Some previous studies have concentrated on interaction between learner and lecturer, and some have concentrated on interaction between learners, while others have focused on interaction between learners and the content of the lecture. Most of previous studies presented an e-lecture of the same type which was dependent on video streaming or presentation segments. This means that limited interaction is required from the end user (learner) which is represented only by some buttons such as play, pause, forward, backward, and stop as needed.

A. Savoy and Salvendy Study [2]

This study compared a delivered lecture using traditional presentation and e-lecture with the presence of PowerPoint presentation. They argued that the information on PowerPoint presentation slides for lecturing has more perceived importance rather than other information. Also they supposed that more information is retained when PowerPoint is not used than when it is. In addition they discussed the preference of students whether they prefer a traditional lecture or an e-lecture. They delivered their lectures within four weeks to measure the retention of lecture information presented to students. Randomly 61 students participated in this experiment, 19 females and 42 males. 45 students participated, both lectures which are traditional lecture and PowerPoint presentation the rest of the students got the lecture with no class. 61 students participated with submitted questionnaires. All students were delivered the same content and information in both lectures by the same professor. The finding of this study was that the retained information hypothesis it was not supported because was no significant. Regarding the hypothesis of importance information using PowerPoint presentation the finding was not supported as well no significantly difference. According to the hypothesis of preference of students that which type of lecture is preferred the finding was resulted from questionnaires which indicated that PowerPoint presentation was preferred over traditional presentations.

B. Demetriadis and Pombortsis Study [3]

This study conducted for using e-lectures, within the aspect of flexible learning and the efficiency of learning process. The study examined the flexibility of the learning experience utilising three types of e-lecture. First digital lecture which refers to any lecture delivered through digital technology, either online synchronously or asynchronously. Second live digitized lecture which refers to any digital learning resource that captures the experience of lecture-based instruction in the classroom, and third e-lecture which means any digital lecture format captured in the studio. Seventy-two students were participated, 26 male, 9 females for experimental group, while 27 male and 10 females for control group. This study showed that students can learn efficiently using e-lecturing material, and showed their satisfaction in the flexibility of the experience.

III. INTERACTIVE ELECTRONIC LECTURE SYSTEM

In the past, in accordance with behaviourism and cognitivism theories, teachers transferred knowledge to their students, therefore the student's results depended on the teacher's efforts and how well they were able to transfer the knowledge to their students [4]. However, modern theorists differ in that they concentrate on the students themselves and how to create an individual learning experience for each student. The Constructivism emphasises that the student is the center in the class and the teacher is the guide for the

student's significance construction [5]. IELS system was built based on this theory. The IELS system consists of three components lectures, video clips and interactive interface. To build an e-learning environment, it has to be taken in consideration the learner 'needs during the whole e-learning life cycle [6]. Also the development of e-learning system should consider the alignment of individual and organizational learning needs, the integration of learning and communication between individuals [7]. Therefore this system was built according to the user's needs. The IELS system was designed to address issues such as accessibility, usability, interactivity, learnability, communication and satisfaction when delivering lectures to undergraduate students. There are three type of user who used the system.

A. Administrator

The administrator is the person responsible for the application's maintenance and for setting up all basic permissions such as activating, managing users' accounts, setting up the module's name, attributing them to the lecturers and enabling or disabling users' accounts. The administrator is not included when evaluating the system; therefore the researcher will take on the role of administrator when conducting the experiment.

B. Lecturer

Lecturers are one group of participants in the investigation into IELS, and together with the students they will evaluate this system. They have many privileges in IELS: they can register, sign in and edit their personal settings. In addition they can set up their lectures then upload the clips. They can assign students to their lectures and grant them permission to view and interact with the lecture content. Lecturers have the ability to identify what kind of action (popup action, click action) is suitable for students. They have the option to divide the lecture into a series of clips according to the length of the lecture, as well as to set the number of actions applied per clip. Lecturers can communicate with the system users and send a specific message to a particular student or to many; they can also give live feedback via a chat room for their students to enhance the communication environment within the system. Lecturers can view the students' reports and see what level of interactivity with the lecture content has been achieved. These reports enable the lecturer to enhance the learning process via the system and motivate outstanding students or encourage vulnerable students.

C. Student

Students are the main users of IELS; in fact this system has been developed to serve the students and facilitate the learning process for them, and therefore it was built according to the students' requirements and needs. Students play the main role in working and evaluating this system. As the users of the system they can register, sign in, edit their personal settings and sign out of the system.

When students are allocated to a lecture, they can see all their enrolment records which show all lectures and clips which they are permitted to see. When the enrolment record is ready for students they can open each lecture within the module and then see the entire list of clips inside. When students click on the name of the clip it will automatically be ready for interaction. Thus, every action taken during the viewing of clips will be registered in the student's record and it will be shown whether correct or incorrect answers are given to the questions. Students can see their level of interactivity with the contents of each lecture. When a student has seen the clips they will be allowed to enter a chat room with their lecturer and their colleagues in that lecture. If they need to contact the lecturer individually they can do so by sending a message via the inbox messages allocated in their account.

IV. RESEARCH METHODS

A. Study Design

Study design is a crucial stage of research, in particular when the researcher is attempting to draw up systematic procedures and methods to solve a research problem [8]. When a researcher wants to generalise the findings within a population and develop a detailed view of the meaning of a concept for individuals, it is useful to apply a mix method design in order to capture the best of both qualitative and quantitative methods [9].Therefore this experiment depends on mix methods, quantitative and qualitative, to answer the research questions.

This experiment is designed to be carried out using two scenarios. The first scenario is the control group with lectures delivered by the traditional method. The second scenario is the experimental group with lectures delivered by the IELS application. This is shown in Fig. 1.
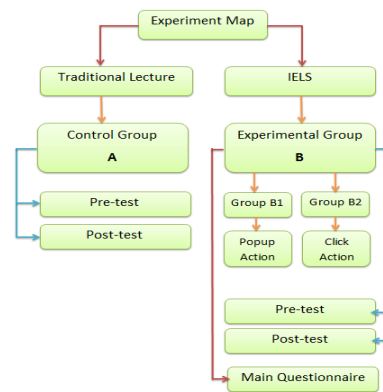
Fig. 1. Experiment map.

B. Research Questions

The research questions to be addressed are as shown in Table I.

TABLE I: RESEARCH QUESTIONS

No	Questions
Q1	Is IELS accessibility easy from the perspective of its users?
Q2	Is IELS usability easy from the perspective of its users?
Q3	Does IELS enhance the interactivity from the perspective of its users?
Q4	Does IELS enhance the learning process from the perspective of its users?
Q5	Does IELS enhance the communication process from the perspective of its users?
Q6	Are the users of IELS satisfied when using this system?

C. Variables

To maximise the confidence in this research it is important to consider all relevant variables to establish whether they are a cause or effect. There is a very close relationship between the independent variables and dependent variables in this research. For instance the independent variable used the IELS system to examine dependent variables such as the students' learning outcomes, satisfaction and their interactivity.

1) Independent variables

The first independent variable is V1 which represent the traditional lecture group (Control Group A), while the second independent variable is V2 which represent the IELS group (Experimental Group B). The V2 variable was divided into two independent variables or condition. Group B was divided into two groups, B1 and B2. B1 worked under condition V2A (Popup Action), while B2 worked under condition V2B (Click Action).

Both groups A and B were given pre-tests and post-tests to check the experiment results before and after the conditions (independent variables) were implemented.

2) Dependent variables

System performance is as a major element of this research. It indicates some of the functions of the IELS that can be used and checked for validity, such as system interfaces, accounts, lecture duration, clip actions, messages and system reports. These features are intended to be used then examined to manipulate the dependents variables such as IELS accessibility, usability, interactivity, learnability, communication and satisfaction. In addition when assessing the dependent variables, it helps to answer some research questions that have been presented in Section B such as (Q1, Q2, Q3, Q4, Q5, and Q6).

D. Experiment Protocol

This experiment was conducted at King Abdulaziz University in Saudi Arabia. This experiment was built and designed to present a new lecturing system therefore there are two main independent variables. The first independent variable is traditional lecturing which is applied to Group A, while for Group B another independent variable was applied. Fig. 2 shows the experimental design.
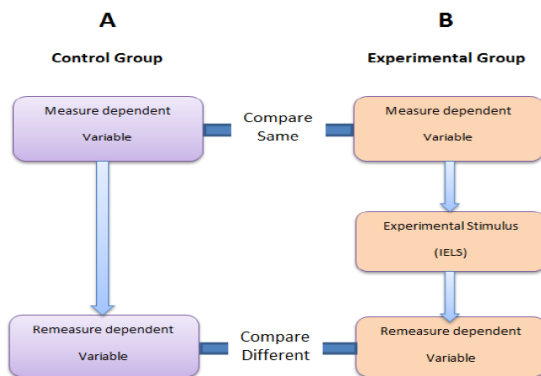

Fig. 2. Experimental design.

V. QUESTIONNAIRE RESULT

From the department of IT at King Abdulaziz University

16 students 8 female and 8 male, have participated in experimental group. In addition four lecturers two female and two male from the same department have participated. Table II and Table III Show the subjects' demographics. Likert scale is a questionnaire technique that presents respondents with series of attitude dimensions [10]. Therefore the questionnaires were designed based on the scale that ranged from 5 = Outstanding 4 = Good 3 = Satisfactory 2 = Poor to 1 = Unsatisfactory. These scales were scored to weight cases as 1=20%, 2=40%, 3=60%, 4=80% and 5=100%. A high score indicates a positive attitude while the low score indicates a negative attitude.

TABLE II: STUDENTS DEMOGRAPHICS

Gender	University Level				Grade Point Average			
	1	2	3	4	1<2	2<3	3<4	4≤5
Male	0	0	7	1	0	1	5	2
Female	0	0	4	4	0	0	4	4
TOTAL	0	0	11	5	0	1	9	6

TABLE III: LECTURERS DEMOGRAPHICS

Gender	Years of Expertise			
	1-5	6-10	11-20	More than 20
Male	0	1	1	0
Female	0	1	1	0
	Computer Skills			
	Satisfied	Good	Very Good	Excellent
Male	0	0	0	2
Female	0	0	0	2

Each of the research questions Q1 (Accessibility), Q2 (Usability), Q3 (Interactivity), Q4 (Learnability), Q5 (Communication), Q6 (Satisfaction) were evaluated and the results are shown in the following subsections.

A. Accessibility [Q1]

Q1 was formulated into five statements to measure the standard of accessibility of the IELS. Table IV shows the statements that evaluate accessibility.

TABLE IV : ACCESSIBILITY STATEMENTS

Item	Statement
A1	It was easy to register with IELS
A2	It was easy to sign in with IELS
A3	It was easy to sign out with IELS
A4	It was easy to run IELS
A5	IELS is easy to run from any device

TABLE V: ACCESSIBILITY BASIC STATISTIC

Item	Student				Lecturer			
	N	M	SD	%	N	M	SD	%
A1	16	3.75	.856	75%	4	3.25	.500	65%
A2	16	3.63	.806	73%	4	4.50	.577	90%
A3	16	3.81	.655	76%	4	3.25	.500	65%
A4	16	3.94	.574	79%	4	3.75	.500	75%
A5	16	3.94	.680	79%	4	3.25	.500	65%
		3.81		76%		3.60		72%

In order to evaluate the overall experience of subjects regard their attitude to accessibility of the IELS, it was achieved by 76% for students for all items and 72% for all items for lecturers. Therefore the result for Accessibility is between satisfactory and good for both students and lecturers

as shown in Table V.

B. Usability [Q2]

Q2 was formulated into seven statements and given to the IELS users to measure the standard of usability. Table VI shows the statements that evaluate usability.

TABLE VI : USABILITY STATEMENTS

Item	Statement
U1	It was easy to use IELS
U2	It was easy to edit personal settings in IELS
U3	It was easy to see modules using IELS
U4	It was easy to see lectures using IELS
U5	It was easy to see clips using IELS
U6	It was easy to see credits using IELS
U7	It was easy to navigate using IELS

The total percent for students was 91% with a mean of 4.53 while the total percent of lecturers was 79% with a mean of 4.11. The usability was between an *Outstanding* and *Good* for students, while it was between *Satisfactory* and Good for lecturers as shown in Table VII.

TABLE VII: USABILITY BASIC STATISTIC

ITEM	STUDENT				LECTURER			
	N	M	SD	%	N	M	SD	%
U1	16	4.56	.512	91.2%	4	4.25	.500	85%
U2	16	4.44	.512	88.8%	4	3.50	.577	70%
U3	16	4.69	.479	93.8%	4	3.75	.957	75%
U4	16	4.69	.479	93.8%	4	4.25	.500	85%
U5	16	4.38	.719	87.6%	4	3.75	.500	75%
U6	16	4.50	.632	90%	4	4.00	.816	80%
U7	16	4.44	.629	88.8%	4	4.00	.816	80%
		4.53		91%		4.11		79%

C. Interactivity [Q3]

Q3 was formulated into three statements and given to the IELS users to measure the standard of interactivity. Table VIII shows the statements that evaluate interactivity.

TABLE VIII : INTERACTIVITY STATEMENTS

Item	Statement
I1	IELS offered me interactivity with lecture contents more than the traditional lecture
I2	IELS actions enhanced my level of interactivity
I3	IELS fosters my ability to use technology in learning

TABLE IX: USABILITY BASIC STATISTIC

Item	Student				Lecturer			
	N	M	SD	%	N	M	SD	%
I1	16	4.25	.775	85%	4	4.25	.957	85%
I2	16	4.25	.775	85%	4	4.75	.500	95%
I3	16	4.25	.683	85%	4	4.25	.957	85%
		4.58		85%		4.42		88%

With regards the evaluating of the interactivity of IELS, that the total percent for students was 85% with a mean of 4.58 while the total percent of lecturers was 85% with a mean of 4.42. The interactivity was between *Good* and *Outstanding* for both students, and lecturers as shown in Table IX.

D. Learnability [Q4]

Q4 was formulated into five statements and given to the IELS users to measure the standard of learnability. Table X shows the statements that evaluate learnability.

TABLE X : LEARNABILITY STATEMENTS

Item	Statement
L1	It was easy to learn from IELS
L2	IELS actions are easy to learn from IELS
L3	IELS offered learning to me for any time I wanted
L4	IELS facilitates the learning process
L5	IELS offered me more learning than the traditional Lecture

The total percent for students of their learnability using the IELS system was 85% with a mean of 4.33 while the total percent of lecturers was 84% with a mean of 4.20. The learnability was between *Good* and *Outstanding* for both students, and lecturers as shown in Table XI.

TABLE XI: LEARNABILITY BASIC STATISTIC

Item	Student				Lecturer			
	N	M	SD	%	N	M	SD	%
L1	16	4.25	.683	85%	4	4.50	.577	90%
L2	16	4.31	.704	86.2%	4	3.75	.500	75%
L3	16	4.44	.727	88.8%	4	4.25	.500	85%
L4	16	4.37	.719	87.4%	4	4.25	.957	85%
L5	16	4.25	.683	85%	4	4.25	.957	85%
		4.33		85%		4.20		84%

E. Communication [Q5]

Q5 was formulated into four statements and given to the IELS users to measure the standard of communication. Table 3.7 shows the statements that evaluate communication.

TABLE XII : COMMUNICATION STATEMENTS

Item	Statement
C1	It was easy to communicate with lecturer /student using IELS
C2	It was easy to get feedback from my lecturer/student using IELS
C3	IELS motivated me/my students to concentrate more on the lecture contents
C4	IELS motivated me/my students to concentrate on the lecture contents

For evaluating of the communication of IELS the total percent for students was 91.6% with a mean of 4.58 while the total percent of lecturers was 92.5% with a mean of 4.63. The communication was between *Good* and *Outstanding* for both students, and lecturers as shown in Table XIII.

TABLE XIII: COMMUNICATION BASIC STATISTIC

Item	Student				Lecturer			
	N	M	SD	%	N	M	SD	%
C1	16	4.63	.619	92.6%	4	4.50	.577	90%
C2	16	4.56	.727	91.2%	4	4.75	.500	95%
C3	16	4.69	.602	93.8%	4	4.75	.500	95%
C4	16	4.44	.629	88.8%	4	4.50	.577	90%
		4.58		91.6%		4.63		92.5%

F. Satisfaction [Q6]

Q6 was formulated into two statements and given to the IELS users to measure the standard of satisfaction. Table XIV shows the statements that evaluate satisfaction.

To determine the level of the IELS satisfaction the total proportion for students was 91.6% with a mean of 4.53 while

the total percent of lecturers was 90% with a mean of 4.50. The satisfaction was between *Good* and *Outstanding* for both students, and lecturers as shown in Table XV.

TABLE XIV : SATISFACTION STATEMENTS

Item	Statement
S1	I enjoy using the IEL System
S2	I am satisfied with IELS

TABLE XV: SATISFACTION BASIC STATISTIC

	Student				Lecturer			
Item	N	M	SD	%	N	M	SD	%
S1	16	4.56	.629	91.2%	4	4.50	.577	90%
S2	16	4.50	.632	90%	4	4.50	.577	90%
		4.53		90.6%		4.50		90%

VI. PRE AND POST TESTS RESULT

In this paper pre-tests and post-tests, another data resource, were carried out to enable assessment of the students' learning outcomes for both group experimental and control. Both groups were given pre-test and post-test to check their learning outcomes before and after implemented experiment. Independent *t*-test was carried out to compare between the control group and the experimental group. For the pre-test the study shows that the mean of Control group was at 5.06 with a SD of 1.569, while it was at men of 5.75 with a SD of 1.528. Table XVI shows that there was no significant difference between the means of both groups because the significant level of *P value* was at 0.219 which is larger than the level significant of 0.05. In contrast Table XVII shows the post-test for both groups, therefore the mean of control group was at 8.19 with a SD of 2.713, while it was at a mean of 13.75 with a SD of 1.183. This indicates that there was a significant difference between the means of both groups, because the significant level of *P value* was at 0.00 which is below the level significant of 0.05.

TABLE XVI: PRE-TEST

Group	N	Mean	SD	Sig. (2-tailed)
Control(A)	16	5.06	1.569	
Experimental(B)	16	5.75	1.528	.219

TABLE XVII: POST-TEST

Group	N	Mean	SD	Sig. (2-tailed)
Control(A)	16	8.19	2.713	
Experimental(B)	16	13.75	1.183	.000

VII. DISCUSSION

The IELS system was created to enhance the lecturing process and some features of the system have been tested such as accessibility, usability, interactivity, learnability, communication and satisfaction. The results are summarised in Table V. Result shows that the highest proportion was for IELS communication. It achieved 92.5% for student and 91.6% for lecturer which is close to *Outstanding* and reflects the amount of freedom of communication between the IELS users that were created and enhanced. The second high proportion was for the IELS satisfaction by 90.6 % for student and 90% for lecturer which also near to *Outstanding* and reflect the satisfactory of the users to the IELS system. The third proportion was for the IELS interactivity which achieved 88% for lecturer and 85% for student, and shows

that the IELS system supports a high level of interactivity between the users and the system contents, even more it offers a rich environment of interactivity. IELS usability was the fourth category that achieved 91% for student and 79% for student, which shows that the IELS enabled its users to use the system smoothly. The fifth category was learnability that achieved 85%, and 84% for lecturer and is near to *Good*, which reflects the enhancement of the learning process using the IELS application. The last category is accessibility by 76% for student and 72% for lecturer and indicates that the users of IELS have easy access to the IELS application.

TABLE XVIII: OVERALL RESULT

No	Category	Statue of subject	Total Percent
Q1	IELS Accessibility	Student	76%
		Lecturer	72%
Q2	IELS Usability	Student	91%
		Lecturer	79%
Q3	IELS Interactivity	Student	85%
		Lecturer	88%
Q4	IELS Learnability	Student	85%
		Lecturer	84%
Q5	IELS Communication	Student	91.6%
		Lecturer	92.5%
Q6	IELS Satisfaction	Student	90.6%
		Lecturer	90%
	Overall Result	Student	86%
		Lecturer	83%

In Table XVIII the overall results shows that the responses were at least *Good*. Therefore The IELS system eases the accessibility and usability of the users to it. Moreover the IELS system does enhance the interactivity, learnability, and communication. Overall the users are satisfied about their application by 86% for student and 83% for lecturer. In addition the pre-test shows that there was no significant difference between the means of control group and the experimental group. On the other hand the post-test shows that the using of IELS system was significantly different between the means of both groups. It indicates that the experimental group mean is higher than the control group mean. This lead to say the using of IELS application was more effective on the students learning outcomes than the traditional lecture.

VIII. CONCLUSIONS

In conclusion, the final results provide a clear evidence that the IELS users perceived benefits and satisfactory from using this system. The research questions and the research methodology have been addressed, with an overview of the experiment and design techniques and the presentation of the data analysis methods. Dependent and independent variables have been addressed and data collection methods explained. Finally, in this paper, research results have been presented.

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